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

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THE PEOPLES AND LANGUAGES OF SIERRA LEONE.

Anthropological Report on Sierra Leone. By Northcote W. Thomas. Part i., *Law and Custom of the Timne and other Tribes.* Pp. 196. Part ii., *Timne-English Dictionary.* Pp. viii + 139. Part iii., *Timne Grammar and Stories.* Pp. xxx + 86.

Specimens of Languages from Sierra Leone. By Northcote W. Thomas. Pp. 62. (London: Harrison and Sons, 1916.)

MR. NORTHCOTE THOMAS, employed for a number of years as Government Ethnologist in Southern Nigeria, was transferred recently to the Sierra Leone colony and protectorate to serve there in a like capacity. The first results of his work have now been published by the Crown Agents for the Colonies, and will not disappoint those whose expectations have been already raised over the remarkable research work conducted by Mr. Thomas amongst the tribes of Southern Nigeria—in which direction, be it observed, he revealed much that was new and interesting regarding the Semi-Bantu languages of the Upper Cross River basin.

Sierra Leone is a British possession of some 30,000 square miles in area, but, like the adjoining regions of Liberia and French and Portuguese Guinea, its interest is not measured by the square mile. All this portion of (originally densely forested) West Africa has been the refuge of oppressed tribes driven out of the interior pasture-lands, and also the goal of negroid, cattle-keeping tribes of the mountainous regions of Senegambia, who have been drawn coastwards by the attraction of the sea and its salt, and the commerce brought by European ships, perhaps from the days of the Carthaginians onwards. One feature amongst many others makes this region of Guinea singularly interesting to those who are exploring African ethnology, and that is the presence there of Semi-Bantu languages. We are already much indebted to Mr. Thomas for the information he has placed at our disposal regarding the Semi-Bantu speech forms of the Upper Cross River. The writer of this review, moreover, has received of late invaluable information regarding the Semi-Bantu languages of Eastern Nigeria, first revealed, like so much else in African linguistics, by Koelle's vocabularies. (Mr. Thomas, it should be remarked, both in the works under review and in those alluded to on Southern Nigeria, has always done full justice to Sigismund Koelle, an Anglican missionary of the middle of the nineteenth century, whose "Polyglotta Africana" has only of late received the full appreciation it deserves from students of African languages.) The Semi-Bantu languages are represented at the present day by small and scattered groups in the Bauchi hills and in the Middle Benue basin (Eastern Nigeria), in the Kaduna region of Central Nigeria, in a small portion of Togoland, in Sierra Leone and in Portuguese Guinea, and near the Upper Gambia, and, so far as we are aware, nowhere else. The affinities between each of these groups is indubitable when a comparative study is made, as also their inherent affinity with Bantu speech both in syntax and word-roots.

Two groups of these Semi-Bantu languages are confined in their area (more or less) to the Sierra Leone colony and protectorate: Bulom, originally the dominant speech of the Sierra Leone coast line, and Temne (Timne). The Temne people and language are distributed over the western part of Sierra Leone, with extensions (speaking different dialects) into French Guinea. At the present day the Bulom language is said to be nearly extinct, having been swamped by the steady progress towards the coast of the Mende tribes (which belong linguistically to the Mandingo group). All that we knew of Bulom prior to Mr. Thomas's conscientious work was derived from the records of Koelle and of Nyländer, an Anglican missionary who compiled an imperfect grammar and vocabulary of Bulom a hundred years ago. Temne, on the other hand, had been illustrated not only by Koelle (who alone has dealt with its exceedingly interesting western dialects), but in a thorough-going fashion by another Anglican missionary with a German name, Schlenker. Mr. Thomas's work, however, in Temne, as in Bulom, is quite original, and is most useful in enabling us to understand the structure and phonology of these two forms of Semi-Bantu speech, and moreover represents them as they are spoken to-day. Mr. Thomas will probably quarrel with me for the frequent announcement that Temne and Bulom are "Semi-Bantu." He does not take up such a decided line himself, any more than he has done about some of the Semi-Bantu languages he was the first to illustrate in the Cross River basin. But I claim the right to be more dogmatic, since I have had of late opportunities of dealing somewhat thoroughly with the Semi-Bantu languages and their affinities with the Bantu, and have come to the conclusion (foreshadowed many years ago by the great philologist, Bleek) that Temne and Bulom, like the languages of Portuguese Guinea, Togoland, and Eastern Nigeria, must be classed as Semi-Bantu.

Vol. i. of Mr. Thomas's work deals with the laws and customs of the Mendi, Gōla, Kisi, Konô, Timne, Lokô, Limba, Yalunka, Koranko, Vai, and Susu peoples. (I quote his spelling, not always mine.) This volume contains excellent photographs of ethnic types. Another volume deals generally with the languages of Sierra Leone (besides Temne and Bulom): the Krim, Kisi, Limba dialects, Susu, Koranko, Yalunka, Konô, Vai, Mende, Lokô, and Fula. This will be particularly valuable for its treatment of the little-known and unclassified Limba (the speech of an interesting cattle-keeping tribe) and Lokô. Lokô, I fancy, has not been written down before.

I might state, in conclusion, that Mr. Thomas's work requires careful study and digestion before one can theorise from it.

H. H. JOHNSTON.

AMERICAN NATURE-STUDY.

(1) *The Life of Inland Waters.* An elementary text-book of freshwater biology for American students. By Prof. James G. Needham and J. T. Lloyd. Pp. 438. (New York: The Comstock Publishing Co., 1916.) Price 3 dollars.

(2) *Wild Flowers of the North American Mountains.* By Julia W. Henshaw. Pp. 383. (London and New York: McBride, Nast and Co., Ltd., 1916.) Price 10s. 6d. net.

(3) *Hitting the Dark Trail, Starshine through Thirty Years of Night.* By Clarence Hawkes. Pp. 191. (London: George G. Harrap and Co., 1916.) Price 3s. 6d. net.

(1) PROF. J. G. NEEDHAM, of Cornell University, and his colleague, Mr. J. T. Lloyd, have prepared an introduction to the study of freshwater organisms—their adaptations, associations, and economic possibilities. The subject is an interesting one, the authors are enthusiasts and experts; the book should certainly give a stimulus to limnology. After dealing with the physical and chemical conditions of the freshwater environment, and its relation to the land-surface, the authors discuss the various types of lakes and ponds, of streams, of marshes, swamps, and bogs, and the difference between high and low water in each case. Then comes a vivid, well-illustrated survey of the freshwater plants and animals. The subject of adaptations is also very successfully handled. Flotation is helped by the outgrowth of slender prolongations and by the production of oils, gases, and jelly. Movement is facilitated by the "stream-line form" familiar in fishes. Animals living near the shore have adaptations for avoiding silt, for burrowing, for making shelters, for withstanding the rush of water. Seasonal vicissitudes are circumvented by adaptations for lying low, such as statoblasts, ephippia, and hibernacula. The secondary adaptation of originally terrestrial types to aquatic life is also discussed. Inter-organismal adaptations find fine illustrations in the bladderwort and in the dependence of the larvæ of freshwater mussels on fish hosts. This leads on to associations or societies, whether in the open-water (limnetic) or by the shores (littoral), the latter being again divided into still-water (lenitic) and rapid-water (lotic) societies. The studies end up with a suggestive chapter on water-culture, which is not too dismally utilitarian. As an elementary introduction to a fascinating study the book is admirable—clear, interesting, educative, and of moderate size. It is abundantly illustrated, and many of the figures have had brains put into their construction.

(2) Mrs. Henshaw has done good service in compiling a convenient flora of the North American mountains by means of which travellers can get to know a little about the characteristic alpine flowers. A terse diagnosis is given of each species, and then follow less formal descriptive notes in which there is occasionally a breeze of enthusiasm rather unusual in "Floras." The arrangement is popular—mainly according to colour—but there is a scientific classification as well. There are sixty-four fine photographs and seventeen beautiful coloured plates.

(3) The author of "Hitting the Dark Trail" was accidentally blinded by bird-shot when a boy of fourteen, and the book tells with delightful frankness and simplicity how he has made a success of his life in the true sense. The "menace of the years," as Henley called it, found him unafraid, and in spite of grim difficulties and discouragements he has remained "master of his fate and captain of his soul." Not only so; he has been able to trade with the visual gains of his early years, when he got a good grounding in woodcraft, and to get for himself and to give to many others a great deal of pleasure out of thirty years of Nature-study without eyes. Mr. Hawkes has written a number of popular "animal biographies"; he has now essayed the more difficult task of writing his own. He succeeds considerably by being perfectly natural. The autobiography reveals a fine quality of pluck, to reward which ought not to tax the resources of American civilisation.

THE KINETIC THEORY REVIVED.

The Dynamical Theory of Gases. By J. H. Jeans. Second edition. Pp. vii + 436. (Cambridge: At the University Press, 1916.) Price 16*s.* net.

MORE than eleven years have elapsed since the first edition of this work was reviewed in NATURE (April 27, 1905). Most of the pioneers of the attempted rigorous mathematical theory have passed away, and the attempt to reconcile Boltzmann's minimum theorem with the properties of an aggregate of perfectly reversible units may be said to have been abandoned. On the other hand, the recently developed quantum hypothesis has, to some extent, had the opposite effect of leading us to believe that something more than the equations of reversible dynamics is needed to account for the phenomena of Nature. Equipartition may be characteristic of molecular systems, but the celestial universe shows no tendency towards Maxwell's law, and would probably refuse to obey it even if started according to this distribution.

The plan which Prof. Jeans now adopts in his book is probably the best one in the circumstances. The kinetic theory cannot be proved mathematically, neither can the data determined from a *calculable* mathematical theory be made to serve as more than approximations to the results of experiments. Thus arises a school of slipshod students of physics, who, when they cannot prove a result mathematically, state that it "has been shown experimentally," and if they cannot get their experiments to verify they state that it "may be proved" (from theory). This danger is largely obviated by the division of the earlier chapters into four sections, entitled "Mathematical Theory of a Gas in a Steady State," "Physical Properties of a Gas in a Steady State," "Mathematical Theory of a Gas not in a Steady State," "Physical Phenomena of a Gas not in a Steady State."

Among the miscellaneous applications it is interesting to note Prof. Jeans's remarks on the rate of escape of gases from planetary atmospheres. It will be remembered that the late Dr. Johnstone Stoney attempted to account for the loss of gases by the motion of the molecules which describe hyperbolic orbits under the attraction of the primary; and by assuming the absence of a particular gas from a particular member of the system he deduced the absence of other gases from other systems. It was, however, subsequently shown that, under the assumptions made by Dr. Stoney, the gases in question would not escape, and Dr. Stoney advanced the opinion that the methods of the kinetic theory on which his own investigations were based were inapplicable to the problem to which he had applied them. According to Prof. Jeans's views, hydrogen does not at present escape, but it did so when the earth was at a far higher temperature than at present. On the other hand, the brief discussion on our existing knowledge regarding the upper and lower regions of the atmosphere will help to reconcile theory with experiment.

The book thus contains as much information as an ordinary physics honours student can profitably study. But, of course, this is nothing like the whole of the kinetic theory, whether studied mathematically or experimentally.

G. H. B.

MENDELISM ON THE FARM.

A Manual of Mendelism. By Prof. James Wilson. Pp. 152. (London: A. and C. Black, Ltd., 1916.) Price 2*s.* 6*d.* net

PROF. WILSON has prepared an exposition of Mendelism which will be of special interest to stock-breeders and serious students of agriculture. It is a model of clearness and directness, and bears the marks of the teacher as well as of the investigator. After explaining Mendel's experiments, his rule and his theory, the author passes to a discussion of various disturbing causes which account for abnormal distributions of characters. Thus there are cases in which the effects of the individual factors cannot be identified separately; cases of the suppression of the effect of one factor by that of another; cases of incomplete or absent dominance; cases where a factor is believed to combine indifferently with more than one other; cases where two or more factors seem to be linked together so that they are handed on from generation to generation as one; and cases in which two different factors produce a similar effect.

These are some of the reasons for results which are not typically Mendelian, and they might have been added to. Thus it has been convincingly shown by Morgan and others that environmental and developmental influences may have a profound effect on the outcome of Mendelian factor-differences. Prof. Wilson goes on to illustrate the improvements which have rewarded careful experimentation, *e.g.* as regards yield of wheat and of milk. That Mendelian formulæ can be used towards an increased production of material wealth has been proved by the results of workers like Nilsson-Ehle and Pearl, and these are but indications of what might be achieved. The average yield of wheat in Britain is about 32 bushels to the acre; it might be raised to 40 or even 50 bushels. "For every day by which the life of a variety of wheat is shortened between seed-time and harvest, the wheat-growing area in Canada reaches fifty or sixty miles farther northwards."

The work done in Denmark shows how the wealth of Britain, so far as it proceeds from dairy cattle, might be very nearly doubled. Those who wish to know how such exceedingly desirable results can be attained will be well advised if they study a book like Prof. Wilson's. It will show them how they may act with circumspection and foresight. The book would have been the better for pictures and its terse style is perhaps a trifle severe, but it is a book for the times, competently and carefully executed, which those whom it especially concerns should run to read.

HIGHWAY ENGINEERING.

Elements of Highway Engineering. By Prof. A. H. Blanchard. Pp. xii + 514. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 12*s.* 6*d.* net.

THE rapid development of mechanically propelled road vehicles during the past twenty years has brought about a complete revolution both in the construction and maintenance of roads, and the question of the development of the public road system has again, after years of neglect, become a problem of national importance. Motor vehicles are no longer mainly used for pleasure purposes; they are now an indispensable adjunct to almost every business, and for the economical working of motor lorries good road surfaces, and roads correctly laid out in regard to grade, are indispensable. Mr. Blanchard's book, which has been written as a text-book for engineering students as well as a reference book for engineers, is a welcome addition to the literature of this branch of engineering practice.

The first three chapters are devoted to an historical review of the subject, to a brief account of the systems of road administration in Europe and the United States, and to the preliminary investigations which must be made before an engineer can design satisfactory and economical highways. The fourth chapter treats of the necessary survey work in laying out urban and country roads, and of the preparation of the plans. The next chapter is devoted to the problems of grading, drainage, and, most important of all, to the question of the foundations upon which the roadway is to be carried.

Earth roads, gravel roads, and broken-stone roads are then dealt with in order; the methods to be adopted in the construction of each class are described, and the question of maintenance is fully discussed. In the chapter on broken-stone roads the author explains in detail the modern methods of testing the suitability of various classes of rocks for road metal; more attention might with advantage be given in this country to the systematic testing of road materials.

The ninth chapter is devoted to a detailed account of the sources, characteristics, and physical and chemical properties of bituminous materials; the highway engineer will find information in this chapter of great value to him when considering the question of the utilisation of bituminous materials in any proposed road reconstruction work. The next three chapters explain fully how these bituminous materials are best employed for dust-preventive purposes on ordinary roads and in the construction of bituminous macadam pavements and bituminous concrete pavements; the mechanical plant required for these operations is described in detail.

In the next five chapters the author treats of asphalt, wood-block, brick, and stone-block city roadways, describing the latest methods of constructing each type of roadway and of the machinery and other appliances required for their economical and speedy construction.

The remainder of the book is devoted to a brief but valuable discussion of the relative advantages and disadvantages of various types of roadway, and to an account of the methods of constructing the side-walks, curbs, gutters, culverts, bridges, and other details of road construction.

The book is well illustrated and thoroughly up-to-date, and should prove a welcome addition to the reference library of every engineer engaged on roadway design, construction, and maintenance.

T. H. B.

OUR BOOKSHELF.

The Military Map: Elements of Modern Topography (French School of War). Pp. vii + 130. (London: Macmillan and Co., Ltd., 1916.) Price 2*s.* 6*d.* net.

IN this book the authors set out to discuss the topographical map which has been produced especially for military purposes, and to treat particularly of the French General Staff map on the scale of 1 : 80,000. An introduction deals with the general principles on which a survey is carried out, while five chapters are devoted to the representation of detail and relief, and to some information relating to the French 1 : 80,000 map.

It cannot be said that the result is satisfactory as an introduction to military topographical maps or as a description of the French map. The authors do not seem to have that practical acquaintance with topographical surveying which would have enabled them to avoid several mistakes which occur, and render the book misleading for a beginner. The statement in the introduction that in triangulation the actual angles of the plane triangle formed by three stations are measured could not have been made by anyone who had used a theodolite, and is quite misleading as describing an operation in which horizontal angles are determined. Map projections are not satisfactorily treated, and at least the respective merits and demerits of those which are instanced might have been given. The retention of French terms is stated in the preface to be intentional, but it would have made the book much easier to read if after once quoting the French term the English equivalent had been employed, and a glossary of the French terms added as an appendix; as it is, many existing English terms do not appear, and some new ones are coined for which there is no need.

The relief of the ground is attributed to certain portions of the soil having sunk while others have been lifted, but no suggestion of the modelling of the surface by erosion appears. In treating of relief, the theoretical principles of contours and hachures are given, but in practice these are not strictly followed, and the reasons for the modifications should be given; the use of colour is not alluded to. Orientation in the field is the subject of the last chapter, but in advocating the use of the watch for this purpose, the error which may be introduced at different times and places should have been carefully explained.

H. G. L.

Commercial Egg-Farming: From Practical Experiences gained over a Period of Years. By S. G. Hanson. Pp. 62. (London: Constable and Co., Ltd.) Price 1s. net.

"I AM not a poultry-farmer because I like hens, but simply because I do not know how to earn an equal income so easily in any other way." So says the author on p. 10. This fact alone should secure for the work the serious consideration of all poultry-keepers. It is a good book containing much information and no padding. We should, however, have liked more detail on several points, and are far from convinced as to the economic side of the large brooder-house.

We note there is no balance-sheet. The cost of rearing pullets, even Leghorns, appears almost too modest at 2*s*. 6*d*. per head; and colony houses at about 2*l*. each (p. 39) also seems scarcely sufficient.

We like the author's capital charge of 1*l*. per bird, and this agrees with our own estimates and experience. No figures are given covering labour, rent, rates, and depreciation, considerable items on large plants.

The book is well worth reading, being full of hints, and the figures on the income side do not appear to be exaggerated; but it must be remembered that there are many drones in a large flock, and it is on the elimination of these that ultimate success depends. Although we are far from convinced as to the desirability of dry-mash feeding, there is much to be said in its favour on the score of economy of labour.

LETTERS TO THE EDITOR.

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

Observations on the Excitation of Helium Spectra.

IN the course of an examination of the properties of the electron discharge in an atmosphere of helium we have made some observations of the conditions affecting the excitation of the lines of the helium spectra which seem to be of considerable interest. The source of electrons was an incandescent tungsten filament, and the discharge passed to a parallel nickel wire about 8 mm. distant. The electrodes were mounted in a quartz tube filled with helium at about 2 mm. pressure. The helium was free from all contaminants except a small amount of mercury vapour, the partial pressure of which was about 0·001 mm. in the observations immediately following.

In a particular experiment the current across the gap increased slowly from zero to 10 microamperes as the potential difference between the anode and the negative end of the filament was raised from 0 to 20 volts. The current then increased more rapidly to 100 microamperes at 23 volts, when the arc spectrum of mercury flashed out and the current jumped to 220 microamperes, the potential necessary to maintain the discharge dropping at the same time to 21 volts. On raising the potential further the current increased rapidly to 690 microamperes at 23·5 volts, when the helium spectrum flashed out. With higher potentials most of the lines in the helium spectrum increased in intensity and the current increased, but at a gradually diminishing rate, to 1450 microamperes at 40 volts.

In other experiments the helium spectrum has been found to be excited by 22·5 volts potential difference. If allowance is made for the initial kinetic energy of the electrons and for the drop of potential down the filament due to the heating current, this quantity is not increased by so much as one volt, and there are indications that it tends to approach a lower limit close to the ionisation potential value for helium found by Franck and Hertz and by Pawlow. In any event, the observations made would seem to destroy the special significance of the value (approximately 30 volts) of the minimum potential difference necessary to excite the line spectra of helium given by Rau. There is no doubt that these spectra can be excited by the impact of electrons having energies much less than the value of the ionisation energy of helium calculated by Bohr. We are unable to reconcile these results with Bohr's theory except on the hypothesis that the impact ionisation of helium is a more complex phenomenon than has been supposed. Possibilities which suggest themselves are that the ionisation is the result of successive impacts or results from impacts on atoms in an abnormal condition caused by the absorption of radiation generated in other atoms in consequence of electron impact. Experiments to test these possibilities are in preparation.

In contrast to the lines of the mercury arc spectrum the different helium lines behave differently *inter se* when the exciting voltage is changed. Thus the blue line 4472 requires about half a volt, and the blue line 4713 about a quarter volt more potential difference for excitation than the yellow line. The green line 4922 of the first subsidiary series of parhelium seems to appear and disappear along with the blue line 4472 of the first subsidiary series of helium. The order of excitation with voltage for the different lines is not simply a question of frequency, but depends partly on the series to which the lines belong. Most of the lines increase steadily in intensity with increasing voltage and current density, but the line 4713 of the second subsidiary series of helium increases rapidly in intensity to a maximum soon after excitation, then becomes very faint as the potential difference is increased to about 40 volts, reappears with higher voltages, and then increases steadily in intensity with rising potential difference. Several of these effects have been noted by Rau at higher voltages.

We have examined the radiation from the helium spectrum in the extreme ultra-violet when excited by 40 to 70 volts potential difference, using a photoelectric method, and have obtained definite indications of the presence of radiations having wave-lengths close to 600 and to 400 Ångstrom units respectively.

O. W. RICHARDSON.
C. B. BAZZONI.

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King's College, London.

The late Prof. James Geikie.

A BIOGRAPHY of the late Prof. James Geikie is now in course of preparation, and the work would be greatly facilitated if those who have letters or communications of general interest from him would kindly forward these to me at the Royal Scottish Geographical Society's Rooms, Synod Hall, Castle Terrace, Edinburgh. They will be carefully preserved and returned after being copied. MARION I. NEWBIGIN.

Edinburgh, September 4.

A TREATISE ON ELECTRICITY.[1]

IN the treatise on electricity referred to below the author aims at the production of "an advanced text covering both the theoretical and practical sides of the subject, so far as this can conveniently be done in a single volume." A somewhat obscure statement in the preface informs us that "though complete in itself, the book is not intended for beginners, who may be supposed to have read one of the excellent elementary treatises available, such as Whetham's 'Theory of Experimental Electricity.'" As a matter of fact, the first half of the book contains a curious combination of advanced mathematics and elementary physics. In the present state of our public-school education, in which it is possible for a boy to complete his school course with practically no knowledge of elementary science, such a combination may be necessary. This part of the treatise might therefore be recommended to a mathematical honours student taking up for the first time the study of electricity.

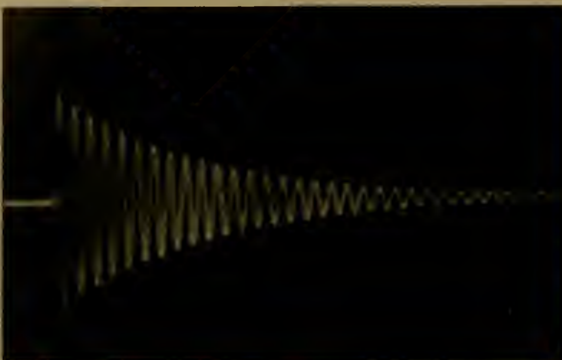

FIG. 1.—Damped Oscillatory Discharge. Photographed by Prof. J. Zenneck. From "A Treatise on Electricity."

In the first chapter, which is a mathematical introduction, the author discusses the transformation of Gauss, the theorems of Green and of Stokes, the equation of wave-motion, and the Bessel functions. In the second chapter he gives an elementary description of the behaviour of magnets and the plotting of lines of force with iron filings. This and the seven chapters following have been kept fairly simple and are intended to contain all the principles necessary for a right appreciation of the subject. The author is to be congratulated on the freshness of his presentation even of familiar topics. Recent forms of apparatus are well described and illustrated, and some novel experiments are introduced. The method of exhibiting lines of electric force by scattering small crystals of oxalic acid on a cardboard sheet is interesting, and the result is well shown in Fig. 38.

We notice that the term "electromotive force" (p. 110) is used as equivalent to "difference of potential." In our opinion this is a mistake; it is better to consider the E.M.F. as that which gives rise to a P.D. Thus in a cell on open circuit the E.M.F. due to the chemical action of the constituents sets up a P.D. between the terminals which, inside the cell, is opposed to the E.M.F. When the terminals are joined by a conductor the P.D. between the terminals falls, but the E.M.F. of the cell (neglecting polarisation) remains the same. In other cases an E.M.F. may arise from thermal effects or electromagnetic induction.

One difficulty which always perplexes a student of electricity is the significance of "magnetic induction," B. It was with a certain amount of pleasurable anticipation that we referred to Mr. Pidduck's treatment of this subject, only to be confronted by the bald statement: "The vector B is called the *magnetic induction*, and the last equation may be written $B = H + 4\pi I$, where addition signifies addition of rectangular components." It is true that the reader is assured that he will appreciate the full importance of the vector B after reading the next chapter, dealing with the induction of currents, but an appreciation of its importance is not the same as a clear realisation of its meaning. It is a remarkable fact that the term "permeability" is not mentioned in the index, nor does it appear to be once referred to in the text.

FIG. 2.—Beats in the Oscillatory Discharge of the Secondary of a Coupled Circuit. From a photograph by Prof. J. Zenneck. From "A Treatise on Electricity."

The latter half of the book, containing chapters which form introductory accounts of special

[1] "A Treatise on Electricity." By F. B. Pidduck. Pp. xiv+646. (Cambridge: At the University Press, 1916.) Price 14s. net.

subjects, is sure to prove of great service to advanced students. A valuable chapter on applied electricity is introduced, in which is a welcome section on the harmonic analysis of curves. The chapter on electric oscillations is one of the best in the volume. Prof. J. Zenneck's photographs of oscillatory discharges, two of which are here reproduced by the courtesy of the publishers, are excellent, as are the descriptions of the laboratory experiments that may be carried out in illustration of various branches of the subject. In a footnote to p. 444 is found a reference to the fact that the ratio of the electromagnetic to the electrostatic unit of charge has the dimensions of a velocity, followed by the startling statement: "The theory of electrical dimensions is otherwise of little interest." In view of the practical advantage to be gained by testing the dimensions of the terms of an equation and the stress laid recently on the principle of similitude or dynamical similarity, such an attitude cannot be justified.

In the chapter on the conduction of electricity through gases the author is scarcely fair to research carried out in this country. The corpuscular view of the kathode rays seems to have been advanced first by Varley in 1871, and the investigations of Sir W. Crookes surely deserve further description. In the account of the measurement of the ratio of the charge to the mass for the kathode particles Mr. Pidduck is less than just to the work of Schuster described in his second Bakerian lecture (1890) and to the experiments of Sir J. J. Thomson shown in a lecture delivered before the Royal Institution (*Electrician*, May 21, 1897). Kaufmann's paper was communicated to the *Annalen* on the same date. Wiechert's earlier experiments, "which did not go beyond the previous work of other observers" ("The Progress of Physics," Schuster, p. 68, 1911), were described in a lecture delivered on January 7, 1897. The experiments of Richardson and Compton in America on the photo-electric effect were carried out almost at the same time as those of Hughes at Cambridge. Millikan has just shown that it is possible to get very accurate values for Planck's constant, h, by the use of this method. A useful summary of fundamental physical quantities is given on p. 513. The name "Boltzmann's constant" is assigned by the author to the constant of molecular energy, α. It is usual to give this name to the entropy constant, k, which has a value $\frac{2}{3}\alpha$.

The concluding chapters deal with radioactivity, as exhibited by radium and its derivatives, and the mathematical theory of electrons. The illustrations include a number of C. T. R. Wilson's remarkable cloud photographs showing the tracks of ionising particles in gases.

H. S. A.

EGYPTIAN ASTRONOMY AND THE ZODIAC.

In a recent number of the *Bulletin de l'Institut Français d'Archéologie Orientale* (cxii.) of Cairo, M. Georges Daressy, one of the foremost among French Egyptologists, treats of the knowledge of the constellations in ancient Egypt. His article is entitled "L'Egypte Céleste," by which words he means the duplication of the geography of the Nile valley into the sky, for the priests mentally projected another Egypt into the northern heavens. By a kind of symbolic celestial geography the daily solar journey was considered as a descent or voyage of the sun upon a river, the duplicate of the Nile, but situate in the firmament.

This conception having been evolved, to render

Double zodiac of the French Archæological Institute at Cairo.

the allegory geographically complete, it became necessary to have a series of "nomes," or counties, alongside the celestial river upon the banks, the district deities of which should correspond with those of similar sites through which the terrestrial Nile wended its way. For this purpose they selected the path of the ecliptic and identified that with the Nile's course. Precisely as each Nilotic "nome" possessed its own deity with his, or her, special totem symbol, so the Egyptian "wise men" provided parallel deity figures for their celestial river upon which the sun voyaged. With this object they adopted the zodiacal signs—the decans, the planets, and various constellations—because they required stellar associations, not only for the forty-two "nomes," but also for more than one temple, or important shrine, and its attendant city in many of the "nomes."

The event which induces M. Daressy to publish the fruits of his erudition upon this subject is the publication by him of a bronze zodiac with a series of two rows of twelve figures, the outer zone being the familiar zodiacal signs, and the inner, twelve animal symbols, attributable, Egyptologists think, to the twelve forms or phases assigned to the sun during his twelve hours' journey. These, in the earthly Egyptian gazetteer, are assigned to twelve of the twenty districts of Lower Egypt. This newly found double zodiac is very valuable for the explanation it affords of the symbols of the constellations upon the Denderah zodiac, because all these figures are intermingled in the large central circular disc, mixed up with deity figures representing the planets and certain prominent high-magnitude stars and the decans.

It should be stated that the zodiacs designed, and hitherto found, in Egypt are not of great antiquity. The arrangement of their symbols and of figurative objects for some constellations has certainly been produced under Greek influence. They appear to emanate from the Egyptian priests uniting their old stellar figure mythologies to the astronomical astrology of the Alexandrian school. Both parties, however, must at the date of the composition of these zodiacs have been acquainted with the Chaldean science of the heavens, derivations from which appear in the Old Testament and early Greek classics and art.

The deity symbols upon the Babylonian boundary stones are almost always astral and frequently zodiacal. Since the large increase in number of these monuments found at Susa, we have a much more complete series of the symbols.

Thus upon the stele of Melishipak we have the figure of an archer with the upper part human and the lower part that of a double-headed horse and two tails; those of a horse and a scorpion; also wings. This representation agrees almost completely with the Sagittarius of the Denderah zodiac, and with this Sagittarius the scorpion is associated in both cases.

This assimilation of Mesopotamian astronomy is identical with the adoption by the Egyptians of several Babylonian legends of the gods into Egyptian mythology. These exploits were foisted upon the deeds of Egyptian deities. For example, the Izdubar (Hercules) legends were in some cases introduced into the conflicts of Horus.

The parallels between terrestrial Egyptian geography and the places of the stars must, however, have been very old in Egypt, though not anterior to the era of Menes. M. Daressy ingeniously explains the principles upon which these were arranged, and henceforth Egyptologists will trace in the primitive texts allusions to them and decide approximately when they were invented. The favourite constellations other than the zodiac were the circumpolar stars, because they never set and so were symbolic of eternity.

In addition to the famous zodiac from Denderah, now in the Louvre, we have, among others, the new one at Cairo, the planisphere and tableaux carved on the hypostyle hall at Denderah, copies of others once at Esneh and Erment, and the coffin of Hern-netch-tep in the British Museum.

JOSEPH OFFORD.

THE PREVENTION OF COLLISION AT SEA.[1]

PROF. JOLY proposes, in the work before us, that sound, which travels at different rates through different fluids, should be utilised for navigational purposes as well as for the prevention of collision. The rate of travel of sound through air—viz. 1090 ft. per sec. at a temperature of 32° F. (zero C.), or 1100 ft. per sec. at a temperature of 52° F. (11·1 C.)—has long been utilised in H.M. naval surveying service for measuring bases in places where it is not possible to land, owing to the coast being covered with mangrove growth. The system in use is to fire a small mortar which has a plug driven in its muzzle and to note the time which elapses between the flash of the discharge and the report of the mortar. For this purpose a chronometer watch which beats five times for every two seconds of time is used, and it will be evident that each beat of the watch represents 440 ft., so that if the observer makes a mistake in counting the beats a corresponding error will be the result in the length of the base.

This method of ascertaining distance has also been used to ascertain the distance off a cliffy coast when sailing along it. In H.M.S. *Actæon*, when sailing along the coast of Russian Tartary, which has very few distinctive marks, a gun was fired at intervals and the beats of the watch counted until the echo was heard. Half the time elapsed gave the distance off.

In the case of sound travelling through water the rate is much more rapid, and that rate depends on temperature as well as on the density. In river water the rate is 4714 ft. per sec. at a temperature of 55° F. (13° C.), and of 5013 ft. per sec. at a temperature of 86° F. (30° C.), whilst in sea-water, at a temperature of 68° F. (20° C.), its rate is 4761 ft. per sec., but where the specific gravity of the water is increased, as in the Mediterranean or Red Sea, the time will be different. In thick weather, therefore, when the flash of a gun cannot be seen, the distance off can be ascertained by noting the number of beats between the receipt of a sound travelling through water and one through the air, provided they are emitted simultaneously. This difference is 4·25 secs. for each nautical mile the observer is distant from the point where the sound is emitted, or 10·63 beats of the watch per mile.

In a vessel fitted to send or receive radiotelegraphic messages, if a signal be sent simultaneously with the sound signals it is equal to seeing the flash of the gun. If the number of

[1] "Synchronous Signalling in Navigation." By Prof. J. Joly. Pp. 64. (London: T. Fisher Unwin Ltd., 1916.) Price 3s. 6d. net.

beats be counted between the receipt of the radiotelegraphic message and the subsequent reports through the water and the air, the distance can be ascertained and checked, observing that an error of the beat means 440 ft. in air, but in water an error of one beat means an error of 1900 ft.

If sound signals could be implicitly relied on they would be a still greater aid to the seaman than they now are, for they are used at present both in air and water to warn vessels—in air by bells, guns, and sirens, and in water by submarine bells—but, unfortunately, they are not absolutely to be relied on, for experiment has shown that areas of silence occur sometimes in the vicinity of the localities where sound signals are emitted through the air, and that signals emitted through water may be deflected or reflected by obstruction. But further experiments are required before a definite opinion can be pronounced on their accuracy, and especially experiments on the rate of travel of sound through ocean water of different densities and temperatures. Experiments seem also to be needed in crowded thoroughfares as to whether sound-signals are or are not masked by more than one vessel emitting them. In addition, experiments are desirable with reference to the conveyance of sound through the water from shore stations: (1) What means should be taken to send the signal? (2) Will waves beating on the shore, especially on a rocky coast, interfere with the signal?

It is a great advantage to seamen that men of science should direct their attention to investigating problems of this nature, and it is to be hoped that Prof. Joly's work may cause the subject to be taken up and some further experiments made on the points which are still uncertain; but the book as it is is well worthy to be studied by all navigators.

It only remains to point out that it is a simple matter to draw a curve which will tell at a glance the distance from a station emitting simultaneous signals. If the beats of the watch be used as ordinates and tenths of miles as abscissæ, three curves can be drawn, one showing the distance off by the time elapsed between the flash of a gun, or the receipt of a radiotelegraphic signal, and the sound conveyed through the air; another, of the distance off by the time elapsed between the flash of a gun, or the receipt of a radiotelegraphic signal, and the sound conveyed through the water; and a third by the time elapsed between the two sounds, one conveyed by air, and the other by the water.

PROF. T. G. BRODIE, F.R.S.

DEEP regret is felt by many men of science at the death of Prof. Brodie, which occurred suddenly (from heart failure) at the early age of fifty on August 20. He was not only pre-eminent in the scientific world, but had endeared himself in a quite exceptional way to his numerous pupils, colleagues, and friends. The world is indeed poorer by his loss, and the tragic suddenness in being cut off in his prime adds an unusual pathos to the event.

Prof. Brodie was born at Northampton, and was the second son of the Rev. A. Brodie, Vicar of Grandborough. He was educated at King's College School and St. John's College, Cambridge. He received his medical education at King's College, London, and after a brilliant academic career there and taking his degree of M.D. at the London University, he became demonstrator of physiology at his alma mater, and devoted his life thenceforth to this branch of science. He then became in turn senior demonstrator of physiology at the London Hospital and lecturer in the same subject at St Thomas's Hospital. While still a student he commenced research work, and his earliest paper on Muscular Elasticity still remains authoritative. So closely was his name connected with original research, and so numerous were his papers on both the chemical and physical side of physiology, that when Prof. Sims Woodhead relinquished his directorship of the laboratories of the Royal Colleges of Surgeons and Physicians, London, for his chair at Cambridge, Brodie was immediately chosen as his successor, and he held the post with distinction and success until the Royal Colleges, as a measure of economy, decided to maintain their laboratories no longer. So fruitful had been the work carried out and inspired by Brodie in this position that in 1904 he received his F.R.S. Then came an interval in which Brodie filled simultaneously three posts—namely, the lectureship on physiology at the London School of Medicine for Women, the professorship of physiology at the Royal Veterinary College, and the professor superintendentship of the Brown Animal Sanatory Institute. This triple part meant overwhelmingly hard work, but it did not stop Brodie's researches, and it was only because each post was so poorly paid that it was necessary. England often treats her scientific sons thus, and it is much to be regretted that a man of such distinction should have been obliged to seek a position and salary worthy of his gifts in a colonial university. It was in 1908 that Brodie accepted the chair of physiology at Toronto, and London's loss was Canada's gain.

Prof. Brodie used to revisit London every long vacation, and during these so-called holidays he was always hard at work at research. It was during this time that his famous work on the kidney was carried out, and his Croonian lecture at the Royal Society dealt with one aspect of his investigations on this subject. Soon after the outbreak of war he became a captain in the Canadian medical service, and in this position undertook valuable research work on questions arising out of the war: such as respiratory effects, and the means of re-educating maimed men to become useful members of society.

As a teacher he was most successful; as a writer he was a little slow, but always sure and lucid; his unpublished manuscripts will be brought to light later; as a personal friend he was loyal, straightforward, and true.

His widow and three fine sons survive to mourn his loss; his funeral at Hampstead on August 23 was a military one, and was largely attended not only by his relations and personal friends, but by representatives, military and medical, of both British and Canadian institutions.

SCIENTIFIC AND INDUSTRIAL RESEARCH.[1]

THE important Report before us embodies the first annual statement of the work of the Advisory Council. Its contents deserve the closest consideration by all who have been interesting themselves in the dominating questions of the organisation of scientific and industrial research. We hope to deal more in detail with the proposals and suggestions in the Report in a later issue. Meanwhile, it will be sufficient to point out that it is divided into sections which are occupied respectively with :—

(i) The statement of the problems at issue and the steps taken by the Advisory Council to inform itself as to the present condition of scientific research in the United Kingdom and the bodies or persons conducting it.

(ii) The standing committees appointed on special subjects and the co-operative action undertaken by trade associations and professional and learned societies.

(iii) The nature of the difficulties surrounding the organisation of scientific and industrial research.

(iv) The sphere of action of the universities and technical colleges and the probable necessity for special research institutions.

(v) The necessity for conjoint action by all portions of the Empire and a general statement of the conditions of successful work.

The general tone of the Report may be described as tentative; the Council evidently desiring to feel its way cautiously and yet desiring to utilise so far as possible at present the existing machinery of research.

Taken as a whole, the Report is a very able statement of the complexity of the questions awaiting solution, and its recommendations should receive the most careful thought from all who are concerned with scientific work, whether pure or applied.

The report occupies fifty-six pages, of which forty are devoted to the report of the Advisory Council, signed by the administrative chairman, Sir William McCormick. In an introductory note Lord Crewe refers to the establishment in July, 1915, of the Committee of the Privy Council for Scientific and Industrial Research, and to grants made on the advice of the Advisory Council. Twenty scientific investigations of industrial importance, particulars of which are given in an appendix, have been aided; and, in addition, grants amounting at the close of the academic year 1916–17 to about 6000*l*. have been made to individual research workers. The amount placed by Parliament at the disposal of the Committee for the establishment of the scheme was 25,000*l*. for the financial year 1915–16, and of this 12,241*l*. was expended, including a grant of 4250*l*. to the Royal Society. For the current financial year the vote by Parliament is 40,000*l*.

A memorandum embodying certain suggestions for promoting co-operation between different parts of the Empire in the organisation of scientific and industrial research is printed as an appendix. Approval is expressed of the principle of Imperial co-operation; and it is suggested that each Overseas Government which is willing to enter into such an arrangement should constitute some body or agency having functions analogous to those of the Advisory Council which acts for the United Kingdom. The Committee of Council is prepared to co-operate with the Secretary of State in establishing and conducting any central organisation which it may be found desirable to set up in London for the purpose of facilitating and carrying on the business of an Imperial Scheme of Research.

The report of the Advisory Council opens with an historical statement in which reference is made to the establishment of the National Physical Laboratory, the Engineering Standards Committee, the Imperial Institute, the Imperial College of Science and Technology, and other national institutions. At the outset the Council decided to give science in its applications to industry precedence over pure science, though under no misapprehension as to the relations between pure and applied science. Conferences were held with a number of professional bodies, and standing committees were appointed on engineering, metallurgy, and mining, while others are contemplated. A register of researches is being prepared, and encouragement is being given to co-operative research to benefit an industry as a whole. The most promising sign of progress is the increased interest in scientific research now manifested by men of business, manufacturers, and trade associations, but much yet remains to be done on a larger scale than has hitherto been attempted. The small scale on which most British industrial firms have been planned is one of the principal impediments in the way of the organisation of research, with a view to the conduct of these long and complicated investigations which are necessary for the solution of the fundamental problems lying at the basis of our staple industries.

It is intended to issue, under the title of "Science and Industry," a new series of pamphlets showing among other matters what is being done in industrial research laboratories in the United States and elsewhere. One of these will include material collected by Mr. A. P. M. Fleming, and another the paper by Dr. C. E. Kenneth Mees, printed in NATURE of July 13 and 20. Some of the conditions to be secured if the object for which the Committee of Council was established is to be attained are summarised as follows :—

If we were asked to state these conditions in the shortest possible terms we should reply: First, a largely increased supply of competent researchers; secondly, a hearty spirit of co-operation among all concerned, men of science, men of business, working men, professional and scientific societies, universities and technical colleges, local authorities and Government departments. And neither condition will be effective without the other.

The first condition of success cannot be secured rapidly at any time, and for the moment is out of the question. It is often said that when the industries call for the research workers, they will be forthcoming. The demand will create a supply. No doubt it will in time, especially if the discoverer or inventor

[1] Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1915–1916. (Cd. 8336). (London: Wyman and Sons, Ltd.) Price 3*d*.

is adequately rewarded. But it is also true that a supply will create a demand, and since the Committee of Council was established in order to encourage a demand for research, we are anxious to see a sufficient supply of trained workers forthcoming to enable a reasonable start to be made on the new road when peace is restored. Before the war the output of the universities was altogether insufficient to meet even a moderate expansion in the demand for research. The annual number of students graduating with first and second class honours in science and technology (including mathematics) in the universities of England and Wales before the war was only about 530, and of these but a small proportion will have received any serious training in research. We have frequently found on inquiry that the number of workers of any scientific standing on a given subject of industrial importance is very limited.

It is in our view certain that the number of trained research workers who will be available at the end of the war will not suffice for the demand that we hope will then exist. We are too apt to forget in this country that with industry as with war a brilliant group of field officers, and even a well-organised general staff, need armies of well-trained men in order to produce satisfactory results. Our people have no reason to fear or envy the scientific pioneers of other races. They have had, and will probably continue to have, their full share of the outstanding minds to which each century gives birth, but as time goes on the sphere of the solitary worker tends to become relatively, if not absolutely, smaller. Effective research, particularly in its industrial applications, calls increasingly for the support and impetus that come from the systematised delving of a corps of sappers working intelligently, but under orders. We have not yet learned how to make the most of mediocre ability—particularly in things of the mind—yet without the scientific rank and file it will be as impossible to staff the industrial research laboratories which are coming, as to fight a European war with seven divisions. There is as much place and need for plodding labour in scientific research as in other kinds of work.

The responsibility for dealing with the grave situation which we anticipate, rests with the education departments of the United Kingdom. We shall be able to do something to encourage a longer period of training by the offer of research studentships and the like; but that will not suffice. It is useless to offer scholarships if competent candidates are not forthcoming, and they cannot be forthcoming in sufficient numbers until a larger number of well-educated students enter the universities. That is the problem which the education departments have to solve, and on the solution of which the success of the present movement in our opinion largely depends.

As regards the second condition of success, progress in co-operative effort is undoubtedly being made in many directions, and we have mentioned some instances of it. But we wish to point out that there are specially strong reasons for more co-operation between the various British firms in each industry and between the industries and the State in the furtherance of research. The particular difficulties encountered in the day-to-day routine of manufacture, the possibility of improving a process, of diminishing cost of working, enlarging output or enhancing the quality of a product, are matters which we may expect the individual firm to attack directly it begins to believe at all in the application of science to its own trade. But this is not enough. We are looking to the growth of a demand for fundamental research, and fundamental research, as we have seen, requires a very large expenditure on brains and equipment. It also requires continuous effort. The firm that starts out upon this quest must either be very powerful or it must find the necessary strength in association with others. If the general level of manufacture can be rapidly raised by co-operative effort in the exchange of information between firms, and in the support of national trade institutes for research, as well as in the improvement of the conditions and efficiency of labour, this country will have gone far towards establishing its industrial prosperity on a firm basis.

There is already a certain number of large firms in this country who, realising the unity of interest between employers and employed, have systematically striven to raise the standard of living among their workers and to give them a direct interest in the firm's success. Some of these efforts have not been philanthropic; and where they have been so in intention, they have been proved by experience not to require any such spur. But the small firm finds it as difficult to provide pensions or clubs as to pay for research laboratories or original workers. We believe that some form of combination for both purposes may be found to be essential if the smaller undertakings of this country are to compete effectively with the great trusts and combines of Germany and America.

The economic problem lies outside our province, but it is an important aspect of the great issue with which we are concerned, and we do not believe that issue can be met effectively unless a co-ordinated advance is made simultaneously on the whole front. We think it possible that the voluntary efforts of manufacturers in friendly union which enabled the problem of munitions to be rapidly solved may lead to a new kind of reciprocity between firms which will avoid the evils both of monopoly and of individualism. We think that as people have learnt to combine against the risks of fire or shipwreck without losing either initiative or freedom, so firms may come to look upon expenditure for research as a necessary kind of insurance. It is certain that the costs to be met will, on any adequate estimate, have to be counted, not by tens of thousands nor even by hundreds of thousands.

Quite apart from this general and fundamental point of view, team-work is needed, because when we come to deal with the great industries which have an output worth many millions sterling a year and employ labour in proportionate amount, the problems to be solved are too manifold, and too complicated, to be dealt with by individual firms, or even, we may add, by a Government department. The coal-winning industry, the textile industries, the steel industry, the great engineering and shipbuilding industries, the rubber industry, need research on a scale which calls for the financial and intellectual assistance of all parties concerned. When co-operation has done all that is possible in the common interest, there will still remain a mass of research work to be done by individual firms in their own interests, which will amply repay the cost and effort.

We have repeatedly spoken in the pages of this report about the initiation of particular researches, and the solution of particular problems. It has been the inevitable concomitant of the line of procedure we have advisedly selected. But if it is supposed that modern industry can be developed or even maintained by a process of detailed investigations, a series of particular inquiries, however careful, the time, trouble, and expense involved will be largely wasted. Such a supposition is based on fallacious conceptions of the manner in which scientific research proceeds, and of the way in which the great scientific industries have been built up. It is impossible for the most acute investigator to be sure that a particular line of research will lead to a positive result; on the other hand it will often suggest a diverging inquiry that, if followed up, may produce results even more valuable than the original question. Such loose ends litter the laboratories of firms which confine themselves to questions of the moment. They lead straight to the basic theory of a subject, to the roots that strike down into pure science. They are infinite in number and interminable, as the man of pure science knows well; but they also often yield results that revolutionise those industries which are empirical in their methods—as what industry is not?—and give that control over nature which it is the object of all science, whether pure or applied, to secure. The discovery of the structure of the indigo molecule led not merely to the synthetic manufacture of this blue dye, but has enabled the chemist to produce a number of new substances of analogous structure and different shades of colour.

Research of this order does not cease when a problem—even if it be as complicated as synthetic indigo—has been solved. It must be continuous in its operation, and its ramifications will spread as knowledge grows. It will inevitably tend to bring industries into intimate relation, which are at present independent of each other, to transform what have hitherto been crafts into scientific industries, and to require cooperation not only between different firms in the same industry, but between groups of industries in a continuously widening series of inter-related trades.

THE BRITISH ASSOCIATION AT NEWCASTLE.

APPARENTLY, the handbook published in connection with the meeting of the British Association, which is being held this week in Newcastle-upon-Tyne, has been well received by the members. Unlike the handbooks for previous Newcastle meetings, the present one describes not only the industries of the district but also includes articles embracing the remarkable and interesting archæology and history of Northumbria. If there is any fault to be found with its contents it is that no more than a passing reference is made in its pages to two widely known scientific societies—viz., the North-East Coast Institution of Engineers and Shipbuilders and the North of England Institute of Mining and Mechanical Engineers, which have their headquarters in Newcastle and have for nearly half a century done exceptionally useful work, whereas a whole article is devoted to the history of the Literary and Philosophical Society, which is little more than a lending library. The anomaly is more remarkable when one remembers that the handbook has been issued for the information of the members of an association founded for the advancement of science. However, the editors are to be congratulated on producing a useful handbook. Those members of the Association who visit the Roman wall near Chollerford and the ancient buildings in Newcastle should find many of the articles of great interest.

Members of the Association who attended the previous meetings in Newcastle and are there this week will have a further opportunity of studying the characteristics of the North-country people. In the present instance the Monday and Tuesday of the meeting were observed as a general holiday—the deferred August Bank Holiday coinciding with the last two days of the holiday granted to the workers in the Tyne munition factories. When the general holiday was announced, the local committee feared that the further depletion in the number of cabs and other conveyances resulting from the holiday would mean that the bulk of the number of visitors would be put to considerable inconvenience on their arrival. By the action of the North-Eastern Railway Company, however, who placed special vehicles for luggage at the disposal of the members, and assisted in other ways, no such inconvenience was experienced.

It is expected, too, that the other preparations for the meeting are being appreciated by the members. On Monday and Tuesday last the reception room presented that animated appearance which is associated with the opening days of a British Association Meeting. The posters and signs in the streets erected for the guidance of visitors incidentally exhibit the coping-stone of the successful work done by the Sectional Arrangements Committee.

For some time previous to the opening days of the meeting a good deal of interest was shown locally in the forecasts of the activities of the sections, and in the announcements with regard to the President's address and the evening discourses. It was not surprising, therefore, on Tuesday evening last to see that in a larger audience than was expected the local residents were well represented.

In addition to the exhibitions forming part of the programme, to which attention has been directed in previous numbers of NATURE, an attractive and useful exhibition of chemicals and apparatus is being held in the College of Medicine. The main object of the exhibition is to demonstrate the progress made by British firms in manufacturing articles formerly produced in Germany only. In the Hancock Museum, also, an exhibition of geological and botanical interest is being held.

INAUGURAL ADDRESS (ABRIDGED) BY SIR ARTHUR EVANS, D.LITT., LL.D., P.S.A., F.R.S., EXTRAORDINARY PROFESSOR OF PREHISTORIC ARCHÆOLOGY, OXFORD, CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC., PRESIDENT.

New Archaeological Lights on the Origins of Civilisation in Europe: its Magdalenian forerunners in the South-West and Ægean Cradle.

THE science of antiquity depends on evidence and rests on principles indistinguishable from those of the sister science of geology. Its methods are stratigraphic. As in that case the successive deposits and their characteristic contents—often of the most fragmentary kind—enable the geologist to reconstruct the fauna and flora, the climate and physical conditions, of the past ages of the world, and to follow out their gradual transitions or dislocations, so it is with the archæologist in dealing with unwritten history.

In recent years—not to speak of the revelations of Late Quaternary culture on which I shall presently have occasion to dwell—in Egypt, in Babylonia, in Ancient Persia, in the Central Asian deserts, or, coming nearer home, in the Ægean lands, the patient exploration of early sites, in many cases of huge stratified mounds, the unearthing of buried buildings, the opening of tombs, and the research of minor relics, has reconstituted the successive stages of whole fabrics of former civilisation, the very existence of which was formerly unsuspected. Even in later periods archæology, as a dispassionate witness, has been continually checking, supplementing, and illustrating written history. It has called back to our upper air, as with a magician's wand, shapes and conditions that seemed to have been irrevocably lost in the night of Time.

The investigations of a brilliant band of prehistoric archæologists, with the aid of representatives of the sister sciences of geology and palæontology, have brought together such a mass of striking materials as to place the evolution of human art and appliances in the last Quaternary period on a far higher level than had even been suspected previously. Following in the footsteps of Lartet, and after him Rivière and Piette, Profs. Cartailhac, Capitan, and Boule, the Abbé Breuil, Dr. Obermeier, and their fellow-investigators have revolutionised our knowledge of a phase of human culture which goes so far back beyond the limits of any continuous story, that it may well be said to belong to an older world.

To the engraved and sculptured works of man in the "Reindeer period" we have now to add not only such new specialities as are exemplified by the moulded clay figures of life-size bisons in the Tuc d'Audoubert Cave, or the similar high reliefs of a procession of six horses cut on the overhanging limestone brow of Cap Blanc, but whole galleries of painted designs on the walls of caverns and rock shelters.

So astonishing was this last discovery, made first by the Spanish investigator, Señor de Sautuola—or rather his little daughter—so long ago as 1878, that it was not until after it had been corroborated by repeated finds on the French side of the Pyrenees—not, indeed, until the beginning of the present century—that the Palæolithic age of these rock-paintings was generally recognised. In their most developed stage, as illustrated by the bulk of the figures in the Cave of Altamira itself, and in those of Marsoulas in the Haute Garonne, and of Font de Gaume in the Dordogne, these primeval frescoes display not only a consummate mastery of natural design, but an extraordinary technical resource. Apart from the charcoal used in certain outlines, the chief colouring matter was red and yellow ochre, mortars and palettes for the preparation of which have come to light. In single animals the tints are varied from black to dark and ruddy brown or brilliant orange, and so, by fine gradations, to paler nuances, obtained by scraping and washing. Outlines and details are brought out by white incised lines, and the artists availed themselves with great skill of the reliefs afforded by convexities of the rock surface. But the greatest marvel of all is that such polychrome masterpieces as the bisons, standing and couchant, or with limbs huddled together, of the Altamira Cave, were executed on the ceilings of inner vaults and galleries where the light of day has never penetrated. Nowhere is there any trace of smoke, and it is clear that great progress in the art of artificial illumination had already been made. We now know that stone lamps, decorated in one case with the engraved head of an ibex, were already in existence.

Such was the level of artistic attainment in South-Western Europe, at a modest estimate some ten thousand years earlier than the most ancient monuments of Egypt or Chaldæa! Nor is this an isolated phenomenon. One by one, characteristics, both spiritual and material, that had been formerly thought to be the special marks of later ages of mankind have been shown to go back to that earlier world.

The evidences of more or less continuous civilised development reaching its apogee about the close of the Magdalenian period have been constantly emerging from recent discoveries. The recurring "tectiform" sign had already clearly pointed to the existence of huts or wigwams; the "scutiform" and other types record appliances yet to be elucidated, and another sign well illustrated on a bone pendant from the Cave of St. Marcel has an unmistakable resemblance to a sledge.[1] But the most astonishing revelation of the cultural level already reached by primeval man has been supplied by the more recently discovered rock-paintings of Spain. The area of discovery has now been extended there from the Province of Santander, where Altamira itself is situated, to the Valley of the Ebro, the Central Sierras, and to the extreme south-eastern region, including the Provinces of Albacete, Murcia, and Almeria, and even to within the borders of Granada.

One after another, features that had been reckoned as the exclusive property of Neolithic or later ages are thus seen to have been shared by Palæolithic man in the final stage of his evolution. For the first time, moreover, we find the productions of his art rich in human subjects. At Cogul the sacral dance is performed by women clad from the waist downwards in well-cut gowns, while in a rock-shelter of Alpera,[2] where we meet with the same skirted ladies, their dress is supplemented by flying sashes. On the rock-painting of the Cueva de la Vieja, near the same place, women are seen with still longer gowns rising to their bosoms. We are already a long way from Eve!

It is this great Alpera fresco which, among all those discovered, has afforded most new elements. Here are depicted whole scenes of the chase, in which bowmen —up to the time of these last discoveries unknown among Palæolithic representations—take a leading part, though they had not as yet the use of quivers. Some are dancing in the attitude of the Australian Corroborees. Several wear plumed head-dresses, and the attitudes at times are extraordinarily animated. What is specially remarkable is that some of the groups of these Spanish rock-paintings show dogs or jackals accompanying the hunters, so that the process of domesticating animals had already begun. Hafted axes are depicted as well as cunningly-shaped throwing sticks. In one case at least we see two opposed bands of archers—marking at any rate a stage in social development in which organised warfare was possible —the beginnings, it is to be feared, of "kultur," as well as of culture!

Nor can there be any question as to the age of these scenes and figures, by themselves so suggestive of a much later phase of human history. They are inseparable from other elements of the same group, the animal and symbolic representations of which are shared by the contemporary school of rock-painting north of the Pyrenees. Some are overlaid by palimpsests, themselves of Palæolithic character. Among the animals actually depicted, moreover, the elk and bison distinctly belong to the Late Quaternary fauna of both regions, and are unknown there to the Neolithic deposits.

In its broader aspects this field of human culture, to which, on the European side, the name of Reindeer age may still on the whole be applied, is now seen to have been very widespread. In Europe itself it permeates a large area—defined by the boundaries of glaciation—from Poland, and even a large Russian tract, to Bohemia, the upper course of the Danube and of the Rhine, to south-western Britain and south-eastern Spain. Beyond the Mediterranean, moreover, it fits on under varying conditions to a parallel form

[1] This interpretation suggested by me after inspecting the object in 1902 has been approved by the Abbé Breuil (*Anthropologie*, xiii., p. 152) and by Prof. Sollas, "Ancient Hunters," 1915, p. 480.

[2] That of Carasoles del Bosque; Breuil, *Anthropologie*, xxvi., 1915, p. 329 *seqq.*

of culture, the remains of which are by no means confined to the Cis-Saharan zone, where incised figures occur of animals like the long-horned buffalo (*Bubalus antiquus*) and others long extinct in that region. This southern branch may eventually be found to have a large extension. The nearest parallels to the finer class of rock-carvings as seen in the Dordogne are, in fact, to be found among the more ancient specimens of similar work in South Africa, while the rock-paintings of Spain find their best analogies among the Bushmen.

That there was a considerable amount of circulation, indeed—if not of primitive commerce—among the peoples of the Reindeer age is shown by the diffusion of shell or fossil ornaments derived from the Atlantic, the Mediterranean, or from inland geological strata. Art itself is less the property of one or another race than has sometimes been imagined—indeed, if we compare those products of the modern carver's art that have most analogy with the horn and bone carvings of the Cave men, and rise at times to great excellence —as we see them, for instance, in Switzerland or Norway—they are often the work of races of very different physical types. The negroid contributions, at least in the southern zone of this Late Quaternary field, must not be under-estimated. The early steatopygous images—such as some of those of the Balzi Rossi caves—may safely be regarded as due to this ethnic type, which is also pictorially represented in some of the Spanish rock-paintings.

The nascent flame of primeval culture was thus already kindled in that older world, and, so far as our present knowledge goes, it was in the south-western part of our continent, on either side of the Pyrenees, that it shone its brightest. After the great strides in human progress already made at that remote epoch, it is hard, indeed, to understand what it was that still delayed the rise of European civilisation in its higher shape. Yet it had to wait for its fulfilment through many millennia. The gathering shadows thickened and the darkness of a long night fell, not on that favoured region alone, but throughout the wide area where Reindeer man had ranged. Still the question rises—as yet imperfectly answered—were there no relay runners to pass on elsewhere the lighted torch?

Something, indeed, has been recently done towards bridging over the "hiatus" that formerly separated the Neolithic from the Palæolithic age—the yawning gulf between two worlds of human existence. The Azilian—a later decadent outgrowth of the preceding culture—which is now seen partially to fill the lacuna, seems to be in some respects an impoverished survival of the Aurignacian.[3] The existence of this phase was first established by the long and patient investigations of Piette in the stratified deposits of the Cave of Mas d'Azil in the Ariège, from which it derives its name, and it has been proved by recent discoveries to have had a wide extension. It affords evidence of a milder and moister climate—well illustrated by the abundance of the little wood snail (*Helix nemoralis*), and the increasing tendency of the reindeer to die out in the southern parts of the area, so that in the fabric of the characteristic harpoons deer-horns are used as substitutes. Artistic designs now fail us, but the polychrome technique of the preceding age still survives in certain schematic and geometric figures, and in curious coloured signs on pebbles. These last first came to light in the Cave of Mas d'Azil, but they have now been found to recur much further afield in a similar association in grottoes from the neighbourhood of Basel to that of Salamanca. So like letters are some of these signs that the lively imagination of Piette saw in them the actual characters of a primeval alphabet!

[3] Breuil, "Congr. Préhist." Geneva, 1912, p. 216.

The little flakes with a worked edge often known as "pygmy flints," which were most of them designed for insertion into bone or horn harpoons, like some Neolithic examples, are very characteristic of this stratum, which is widely diffused in France and elsewhere under the misleading name of "Tardenoisian." At Ofnet, in Bavaria, it is associated with a ceremonial skull burial showing the co-existence at that spot of brachycephalic and dolichocephalic types, both of a new character. In Britain, as we know, this Azilian, or a closely allied phase, is traceable as far north as the Oban Caves.

What, however, is of special interest is the existence of a northern parallel to this cultural phase, first ascertained by the Danish investigator, Dr. Sarauw, in the lake station of Maglemose, near the west coast of Zealand. Here bone harpoons of the Azilian type occur, with bone and horn implements showing geometrical and rude animal engravings of a character divergent from the Magdalenian tradition. The settlement took place when what is now the Baltic was still the great "Ancylus Lake," and the waters of the North Sea had not yet burst into it. It belongs to the period of the Danish pine and birch woods, and is shown to be anterior to the earliest shell mounds of the Kitchen-midden people, when the pine and the birch had given place to the oak. Similar deposits extend to Sweden and Norway, and to the Baltic Provinces as far as the Gulf of Finland. The parallel relationship of this culture is clear, and its remains are often accompanied with the characteristic "pygmy" flints. Breuil, however,[4] while admitting the late Palæolithic character of this northern branch, would bring it into relation with a vast Siberian and Altaic province, distinguished by the widespread existence of rock-carvings of animals. It is interesting to note that a rock-engraving of a reindeer, very well stylised, from the Trondhjem Fjord, which has been referred to the Maglemosian phase, preserves the simple profile rendering—two legs only being visible—of Early Aurignacian tradition.

It is a commonplace of archæology that the culture of the Neolithic peoples throughout a large part of Central, Northern, and Western Europe—like the newly domesticated species possessed by them—is Eurasiatic in type. So, too, in southern Greece and the Ægean world we meet with a form of Neolithic culture which must be essentially regarded as a prolongation of that of Asia Minor.

It is clear that it is on this Neolithic foundation that our later civilisation immediately stands. But in the constant chain of actions and reactions by which the history of mankind is bound together—short of the extinction of all concerned, a hypothesis in this case excluded—it is equally certain that no great human achievement is without its continuous effect. The more we realise the substantial amount of progress of the men of the Late Quaternary age in arts and crafts and ideas, the more difficult it is to avoid the conclusion that somewhere "at the back of behind"—it may be by more than one route and on more than one continent, in Asia as well as Africa—actual links of connection may eventually come to light.

Of the origins of our complex European culture this much at least can be confidently stated: the earliest extraneous sources on which it drew lay respectively in two directions—in the Valley of the Nile on one side and in that of the Euphrates on the other.

Until within recent years it seemed almost a point of honour for classical scholars to regard Hellenic civilisation as a wonder-child, sprung, like Athena her-

[4] "Les subdivisions du paléolithique supérieur et leur signification." *Congrès intern. d'Anthrop. et d'Archéol. préhist.*, XIV^me Sess., Génève, 1912, pp. 165, 238.

self, fully panoplied from the head of Zeus. The indebtedness to Oriental sources was either regarded as comparatively late or confined to such definite borrowings as the alphabet or certain weights and measures. Egypt, on the other hand, at least until Alexandrine times, was looked on as something apart, and it must be said that Egyptologists on their side were only too anxious to preserve their sanctum from profane contact.

A truer perspective has now been opened out. It has been made abundantly clear that the rise of Hellenic civilisation was itself part of a wider economy and can be no longer regarded as an isolated phenomenon. Indirectly, its relation to the greater world and to the ancient centres to the south and east has now been established by its affiliation to the civilisation of prehistoric Crete and by the revelation of the extraordinarily high degree of proficiency that was there attained in almost all departments of human art and industry. That Crete itself—the "Mid-Sea land," a kind of half-way house between three continents—should have been the cradle of our European civilisation was, in fact, a logical consequence of its geographical position. An outlier of mainland Greece, almost opposite the mouths of the Nile, primitive intercourse between Crete and the further shores of the Libyan Sea was still further facilitated by favourable winds and currents. In the eastern direction, on the other hand, island stepping-stones brought it into easy communication with the coast of Asia Minor, with which it was actually connected in late geological times.

But the extraneous influences that were here operative from a remote period encountered on the island itself a primitive indigenous culture that had grown up there from immemorial time. In view of some recent geological calculations, such as those of Baron De Geer, who by counting the number of layers of mud in Lake Ragunda has reduced the ice-free period in Sweden to 7000 years, it will not be superfluous to emphasise the extreme antiquity that seems to be indicated for even the later Neolithic in Crete. The Hill of Knossos, upon which the remains of the brilliant Minoan civilisation have found their most striking revelation, itself resembles in a large part of its composition a great mound or Tell—like those of Mesopotamia or Egypt—formed of layer after layer of human deposits. But the remains of the whole of the later ages represented down to the earliest Minoan period (which itself goes back to a time contemporary with the early dynasties of Egypt—at a moderate estimate to 3400 B.C.) occupy considerably less than a half—19 ft., that is, out of a total of more than 45. Such calculations can have only a relative value, but, even if we assume a more rapid accumulation of débris for the Neolithic strata and deduct a third from our calculation, they would still occupy a space of more than 3400 years, giving a total antiquity of some 9000 years from the present time.[5] No Neolithic section in Europe can compare in extent with that of Knossos, which itself can be divided by the character of its contents into an Early, Middle, and Late phase. But its earliest stratum already shows the culture in an advanced stage, with carefully ground and polished axes and finely burnished pottery. The beginnings of Cretan Neolithic must go back to a still more remote antiquity.

The continuous history of the Neolithic age is carried back at Knossos to an earlier epoch than is represented in the deposits of its geographically related areas on the Greek and Anatolian side. But sufficient materials for comparison exist to show that the Cretan branch belongs to a vast province of primitive culture that extended from southern Greece and the Ægean islands throughout a wide region of Asia Minor and probably still further afield.

An interesting characteristic is the appearance in the Knossian deposits of clay images of squatting female figures of a pronouncedly steatopygous conformation and with hands on the breasts. These in turn fit on to a large family of similar images which recur throughout the above area, though elsewhere they are generally known in their somewhat developed stage, showing a tendency to be translated into stone, and finally—perhaps under extraneous influences both from the north and east—taking a more extended attitude. These clearly stand in a parallel relationship to a whole family of figures with the organs of maternity strongly developed that characterise the Semitic lands, and which seem to have spread from there to Sumeria and to the seats of the Anau culture.

At the same time this steatopygous family, which in other parts of the Mediterranean basin ranges from prehistoric Egypt and Malta to the north of mainland Greece, calls up suggestive reminiscences of the similar images of Aurignacian man. It is especially interesting to note that in Crete, as in the Anatolian region where these primitive images occur, the worship of a mother goddess predominated in later times, generally associated with a divine Child—a worship which later survived in a classical guise and influenced all later religion. Another interesting evidence of the underlying religious community between Crete and Asia Minor is the diffusion in both areas of the cult of the Double Axe. This divine symbol, indeed, or "Labrys," became the special emblem of the palace sanctuary of Knossos itself, which owes to it its traditional name of Labyrinth. I have already directed attention to the fact that the absorptive and disseminating power of the Roman Empire brought the cult of a male form of the divinity of the Double Axe to the Roman Wall and to the actual site on which Newcastle stands.

The fact should never be left out of sight that the gifted indigenous stock which in Crete eventually took to itself on one hand and the other so many elements of exotic culture was still deep-rooted in its own. It had, moreover, the advantages of an insular people in taking what it wanted and no more. Thus it was stimulated by foreign influences but never dominated by them, and there is nothing here of the servility of Phœnician art. Much as it assimilated, it never lost its independent tradition.

It is interesting to note that the first quickening impulse came to Crete from the Egyptian and not, from the Oriental side—the Eastern factor, indeed, is of comparatively late appearance. My own researches have led me to the definite conclusion that cultural influences were already reaching Crete from beyond the Libyan Sea before the beginning of the Egyptian dynasties. These primitive influences are attested, amongst other evidences, by the forms of stone vessels, by the same æsthetic tradition in the selection of materials distinguished by their polychromy, by the appearance of certain symbolic signs, and the subjects of shapes and seals which go back to prototypes in use among the "old race" of the Nile Valley. The impression of a very active agency indeed is so strong that the possibility of some actual immigration into the island of the older Egyptian element, due to the conquests of the first Pharaohs, cannot be excluded.

The continuous influence of dynastic Egypt from its earliest period onwards is attested both by objects of import and their indigenous imitations, and an actual

[5] For a fuller statement I must refer to my forthcoming work "The Nine Minoan Periods" (Macmillan), vol. i.: Neolithic Section.

monument of a Middle Empire Egyptian was found in the palace court at Knossos. More surprising still are the cumulative proofs of the reaction of this early Cretan civilisation on Egypt itself, as seen not only in the introduction there of such beautiful Minoan fabrics as the elegant polychrome vases, but in the actual impress observable on Egyptian art even on its religious side. The Egyptian griffin is fitted with Minoan wings. So, too, on the other side, we see the symbols of Egyptian religion impressed into the service of the Cretan nature goddess, who in certain respects was partly assimilated with Hathor, the Egyptian cow-goddess of the underworld.

My own most recent investigations have more and more brought home to me the all-pervading community between Minoan Crete and the land of the Pharaohs. When we realise the great indebtedness of the succeeding classical culture of Greece to its Minoan predecessor the full significance of this conclusion will be understood. Ancient Egypt itself can no longer be regarded as something apart from general human history. Its influences are seen to lie about the very cradle of our own civilisation.

The high early culture, the equal rival of that of Egypt and Babylonia, which thus began to take its rise in Crete in the fourth millennium before our era, flourished for some two thousand years, eventually dominating the Ægean and a large part of the Mediterranean basin. To the civilisation as a whole I ventured, from the name of the legendary King and lawgiver of Crete, to apply the name of "Minoan," which has received general acceptance; and it has been possible now to divide its course into three ages—Early, Middle, and Late, answering roughly to the successive Egyptian kingdoms, and each in turn with a triple subdivision.

It is difficult indeed in a few words to do adequate justice to this earliest of European civilisations. Its achievements are too manifold. The many-storeyed palaces of the Minoan priest-kings in their great days, by their ingenious planning, their successful combination of the useful with the beautiful and stately, and, last but not least, by their scientific sanitary arrangements, far outdid the similar works, on however vast a scale, of Egyptian or Babylonian builders. What is more, the same skilful and commodious construction recurs in a whole series of private mansions and smaller dwellings throughout the island. Outside "broad Knossos" itself, flourishing towns sprang up far and wide on the country-sides. New and refined crafts were developed, some of them, like that of the inlaid metal-work, unsurpassed in any age or country. Artistic skill, of course, reached its acme in the great palaces themselves, the corridors, landings, and porticoes of which were decked with wall-paintings and high reliefs, showing in the treatment of animal life not only an extraordinary grasp of nature, but a grandiose power of composition such as the world had never seen before. Such were the great bull-grappling reliefs of the Sea Gate at Knossos and the agonistic scenes of the great palace hall.

The modernness of much of the life here revealed to us is astonishing. The elaboration of the domestic arrangements, the staircases storey above storey, the front places given to the ladies at shows, their fashionable flounced robes and jackets, the gloves sometimes seen on their hands or hanging from their folding chairs, their very mannerisms as seen on the frescoes, pointing their conversation with animated gestures—how strangely out of place would it all appear in a classical design! Nowhere, not even at Pompeii, have more living pictures of ancient life been called up for us than in the Minoan palace of Knossos. The touches supplied by its closing scene are singularly dramatic—the little bath-room opening out of the Queen's parlour, with its painted clay bath, the royal draught-board flung down in the court, the vessels for anointing and the oil-jar for their filling ready to hand by the throne of the priest-king, with the benches of his consistory round and the sacral griffins on either side. Religion, indeed, entered in at every turn. The palaces were also temples, the tomb a shrine of the Great Mother. It was perhaps owing to the religious control of art that among all the Minoan representations—now to be numbered by thousands—no single example of indecency has come to light.

A remarkable feature of this Minoan civilisation cannot be passed over. I remember that at the Liverpool meeting of this association in 1896—just before the first results of the new discoveries in Crete were known—a distinguished archæologist took as the subject of an evening lecture, "Man before Writing," and, as a striking example of a high culture attained by "*Analfabeti*," singled out that of Mycenæ—a late offshoot, as we know now, from Minoan Crete. To such a conclusion, based on negative evidence, I confess I could never subscribe—for had not even the people of the Reindeer age attained to a considerable proficiency in expression by means of symbolic signs? To-day we are able to trace the gradual evolution on Cretan soil of a complete system of writing from its earliest pictographic shape, through a conventionalised hieroglyphic to a linear stage of great perfection. In addition to inscribed sealings and other records some two thousand clay tablets have now come to light, mostly inventories or contracts; for though the script itself is still undeciphered, the pictorial figures that often appear on these documents supply a valuable clue to their contents. The numeration also is clear, with figures representing sums up to 10,000. The inscribed sealings, signed, counter-marked, and counter-signed by controlling officials, give a high idea of the elaborate machinery of government and administration under the Minoan rulers.

The minutely organised legal conditions to which this points confirm the later traditions of Minos, the great law-giver of prehistoric Crete, who, like Hammurabi and Moses, was said to have received the law from the God of the Sacred Mountain. The clay tablets themselves were certainly due to Oriental influences, which make themselves perceptible in Crete at the beginning of the Late Minoan age, and may have been partly resultant from the reflex action of Minoan colonisation in Cyprus. From this time onwards Eastern elements are more and more traceable in Cretan culture, and are evidenced by such phenomena as the introduction of chariots—themselves perhaps more remotely of Aryan-Iranian derivation—and by the occasional use of cylinder seals.

Simultaneously with its Eastern expansion, which affected the coast of Phœnicia and Palestine as well as Cyprus, Minoan civilisation now took firm hold of mainland Greece, while traces of its direct influence are found in the West Mediterranean basin—in Sicily, the Balearic Islands, and Spain. At the time of the actual Conquest and during the immediately succeeding period the civilisation that appears at Mycenæ and Tiryns, at Thebes and Orchomenos, and at other centres of mainland Greece, though it seems to have brought with it some already assimilated Anatolian elements, is still in the broadest sense Minoan. It is only at a later stage that a more provincial offshoot came into being to which the name Mycenæan can be properly applied. But it is clear that some vanguard at least of the Aryan Greek immigrants came into contact with this high Minoan culture at a time when it was still in its most flourishing condition. The evidence of Homer itself is conclusive. Arms and armour described in the poems are those of the Minoan prime, the fabled shield of Achilles, like that of Herakles described by Hesiod, with its elaborate scenes and variegated metal-work, reflects the masterpieces of Minoan craftsmen in the full vigour of their art; the very episodes of epic combat receive their best illustration on the signets of the great days of Mycenæ. Even the lyre to which the minstrel sang was a Minoan invention. Or, if we turn to the side of religion, the Greek temple seems to have sprung from a Minoan hall, its earliest pediment schemes are adaptations from the Minoan tympanum—such as we see in the Lions' Gate—the most archaic figures of the Hellenic goddesses, like the Spartan Orthia, have the attributes and attendant animals of the great Minoan Mother.

Some elements of the old culture were taken over on the soil of Hellas. Others which had been crushed out in their old centres survived in the more Eastern shores and islands formerly dominated by Minoan civilisation, and were carried back by Phœnician or Ionian intermediaries to their old homes. In spite of the overthrow which about the twelfth century before our era fell on the old Minoan dominion and the onrush of the new conquerors from the North, much of the old tradition still survived to form the base for the fabric of the later civilisation of Greece. Once more, through the darkness, the lighted torch was carried on, the first glimmering flame of which had been painfully kindled by the old cave-dwellers in that earlier Palæolithic world.

The Roman Empire, which in turn appropriated the heritage that Greece had received from Minoan Crete, placed civilisation on a broader basis by welding together heterogeneous ingredients and promoting a cosmopolitan ideal. If even the primeval culture of the Reindeer age embraced more than one race and absorbed extraneous elements from many sides, how much more is that the case with our own, which grew out of the Greco-Roman! Civilisation in its higher form to-day, though highly complex, forms essentially a unitary mass. It has no longer to be sought out in separate luminous centres, shining like planets through the surrounding night. Still less is it the property of one privileged country or people. Many as are the tongues of mortal men, its votaries, like the Immortals, speak a single language. Throughout the whole vast area illumined by its quickening rays, its workers are interdependent, and pledged to a common cause.

We, indeed, who are met here to-day to promote in a special way the cause of truth and knowledge, have never had a more austere duty set before us. I know that our ranks are thinned. How many of those who would otherwise be engaged in progressive research have been called away for their country's service! How many who could least be spared were called to return no more! Scientific intercourse is broken, and its cosmopolitan character is obscured by the death struggle in which whole continents are locked. The concentration, moreover, of the nation and of its Government on immediate ends has distracted it from the urgent reforms called for by the very evils that are the root cause of many of the greatest difficulties it has had to overcome. It is a lamentable fact that beyond any nation of the West the bulk of our people remains sunk, not in comparative ignorance only—for that is less difficult to overcome—but in intellectual apathy. The dull incuria of the parents is reflected in the children, and the desire for the acquirement of knowledge in our schools and colleges is appreciably less than elsewhere. So, too, with the scientific side of education, it is not so much the actual amount of science taught that is in question—insufficient as that is—as the instillation of the scientific spirit itself—the perception of method, the sacred thirst for investigation.

But can we yet despair of the educational future of a people that has risen to the full height of the great emergency with which they were confronted? Can we doubt that, out of the crucible of fiery trial, a New England is already in the moulding?

We must all bow before the hard necessity of the moment. Of much we cannot judge. Great patience is demanded. But let us, who still have the opportunity of doing so, at least prepare for the even more serious struggle that must ensue against the enemy in our midst, that gnaws our vitals. We have to deal with ignorance, apathy, the non-scientific mental attitude, the absorption of popular interest in sports and amusements.

And what, meanwhile, is the attitude of those in power—of our Government, still more of our permanent officials? A cheap epigram is worn threadbare in order to justify the ingrained distrust of expert, in other words of scientific, advice on the part of our public offices. We hear, indeed, of "Commissions" and "Inquiries," but the inveterate attitude of our rulers towards the higher interests that we are here to promote is too clearly shown by a single episode. It is those higher interests that are the first to be thrown to the wolves. All are agreed that special treasures should be stored in positions of safety, but at a time when it might have been thought desirable to keep open every avenue of popular instruction and of intelligent diversion, the galleries of our National Museum at Bloomsbury were entirely closed for the sake of the paltriest saving—three minutes, it was calculated, of the cost of the war to the British Treasury! That some, indeed, were left open elsewhere was not so much due to the enlightened sympathy of our politicians, as to their alarmed interests in view of the volume of intelligent protest. Our friends and neighbours across the Channel, under incomparably greater stress, have acted in a very different spirit.

It will be a hard struggle for the friends of science and education, and the air is thick with mephitic vapours. Perhaps the worst economy to which we are to-day reduced by our former lack of preparedness is the economy of truth. Heaven knows!—it may be a necessary penalty. But its results are evil. Vital facts that concern our national well-being, others that even affect the cause of a lasting peace, are constantly suppressed by official action. The negative character of the process at work which conceals its operation from the masses makes it the more insidious. We live in a murky atmosphere amidst the suggestion of the false, and there seems to be a real danger that the recognition of truth as itself a tower of strength may suffer an eclipse.

It is at such a time and under these adverse conditions that we, whose object it is to promote the advancement of science, are called upon to act. It is for us to see to it that the lighted torch handed down to us from the ages shall be passed on with a still brighter flame. Let us champion the cause of education, in the best sense of the word, as having regard to its spiritual as well as its scientific side. Let us go forward with our own tasks, unflinchingly seeking for the truth, confident that, in the eternal dispensation, each successive generation of seekers may approach nearer to the goal.

MAGNA EST VERITAS, ET PRÆVALEBIT.

NOTES.

THE Hon. Sir Charles Parsons, K.C.B., F.R.S., has been nominated as president of the British Association, the meeting of which is to be held at Bournemouth in September next.

THE annual autumn meeting of the Institute of Metals will be held on Wednesday, September 20, in the rooms of the Chemical Society, Burlington House, London. Sir George T. Beilby will preside, and a number of important metallurgical papers will be presented and discussed.

THE fourth annual meeting of the Indian Science Congress will be held at Bangalore on January 10–13. H.H. the Maharajah of Mysore has consented to be patron of the meeting, whilst Sir Alfred Bourne, K.C.I.E., F.R.S., will be the president. The following sectional presidents have been appointed:—Mr. J. MacKenna (Pusa), Agriculture and Applied Chemistry; the Rev. D. Mackichan (Bombay), Physics; Dr. Zia Ud-din Ahmad (Aligarh), Mathematics; Dr. J. L. Simonsen (Madras), Chemistry; Mr. K. Ramunni Menon (Madras), Zoology; Mr. C. S. Middlemiss (Calcutta), Geology. All communications relating to the congress should be addressed to Dr. Simonsen, the Presidency College, Madras.

GREAT satisfaction is felt by everyone in the news published in the *Daily Chronicle* on September 5 that Sir Ernest Shackleton had succeeded in rescuing the twenty-two members of his Antarctic expedition marooned on Elephant Island since April 15. Three previous attempts to reach the island were unsuccessful, but with characteristic persistence Sir Ernest continued his efforts to relieve the men, and sailed from Punta Arenas on August 26 in the *Yelcho*, a small Chilian steamer. On August 30, after steering in a fog through numerous stranded bergs, he reached Wild's camp at 1 p.m., and at 2 p.m. the vessel was homeward bound. On September 3 Punta Arenas was reached, and the message "All saved. All well," was dispatched to the *Daily Chronicle*, from which the following summary of Mr. Frank Wild's report is taken:—"On April 25, the day after the departure of the boat, the island was beset by dense pack-ice. The party was confined to a narrow spit of land, 250 yards long and 40 yards wide, surrounded by inaccessible cliffs and ice-laden seas. We were forced to abandon our ice-hole, which was made untenable by the snow. We made a dwelling of our two boats, supported by rocks, and set up as far as practicable from the sea. The weather continued appalling. In May a heavy blizzard swept much valuable gear into the sea. Fortunately, owing to the low temperature, an icefoot formed on the seashore, and this protection was the means of saving us from total destruction. From June onwards the weather was better as regards wind, but we were under a constant pall of fog and snow. At the beginning of August we were able to collect seaweed and limpets, which formed a valuable change in our diet, but the deep water, heavy seas, and ice prevented us from fishing. On August 28 the gale drove the ice-pack from the island, and on August 30, through the lifting fog, we caught sight of the *Yelcho* steering through a maze of stranded bergs. An hour later we were homeward bound." Sir Ernest Shackleton has announced the safe return of the party in a telegram to the King, who has replied:—"Most heartily rejoice that you have rescued your twenty-two comrades all well. Congratulate you on the result of your determined efforts to save them, and that success crowned your third attempt. I greatly admire the conduct of their leader, Frank Wild, which was so instrumental in maintaining their courage and hope. I trust you will soon bring them all safely home.—GEORGE R.I."

MR. R. W. DOYNE, who died at Oxford on August 30, was well known as an ophthalmologist. Born on May 15, 1857, educated at Marlborough and Keble College, Oxford, he became a naval surgeon, but early relinquished this work to specialise in ophthalmic practice. He returned to Oxford, and devoted his boundless energy and enthusiasm to the prosecution of his favourite study in that town and University. There he succeeded in founding the now flourishing Eye Hospital, and thanks to the munificence of the late Mrs. Ogilvie, obtained recognition of ophthalmology in the University, being himself appointed first Margaret Ogilvie reader in ophthalmology. The clinical material at Oxford is not large, but from the point of view of research the paucity of cases is not without its advantages, and was utilised by Doyne to the fullest extent. The inhabitants of the surrounding country districts are wedded to the soil, so that cases can be kept under observation for many years, and hereditary disorders can be traced through several generations. Doyne was thus enabled to study forms of hereditary cataract, etc., under the most favourable conditions, and thereby to contribute many valuable papers to the Transactions of the Ophthalmological Society. He was enthusiastic in ophthalmoscopic work, and ungrudging in spending money on having coloured drawings made of interesting fundus cases. His collection is extremely fine, and formed one of the attractions at the annual gathering of ophthalmologists which has for several years met at Oxford at his invitation, and is known as the Oxford Ophthalmological Congress. Doyne was very keen on sports, and his papers on "The Eye in Sport," dealing with such topics as the influence of visual acuity, binocular vision, and so on, in shooting, fencing, and other sports, are important, not only for the brilliant application of physiological facts to practical conditions, but also for the light they throw on visual phenomena themselves.

NEWS has just reached us of the death, on May 21, of Prof. J. A. Portchinsky, the distinguished Russian entomologist, at sixty-eight years of age. Prof. Portchinsky graduated in 1871 at the Natural History Faculty of the Petrograd University. He was conservator and librarian to the Russian Entomological Society, and between 1874 and 1894 occupied the post of its scientific secretary. In 1894 he was appointed member of the scientific committee of the Ministry of Agriculture, chief of the Entomological Bureau of this committee, and chief editor of its Memoirs, in which capacity he remained until his death. The number of these Memoirs of which he was himself the author amounts to twenty-four, besides a great number of articles and scientific papers published in many journals and periodicals. He travelled extensively over Russia, Caucasia, and Turkestan, and collected a mass of observations and materials on the biology of insects. He was also the reviewer of "Applied Entomology in Russia."

PROF. FERDINAND FISCHER, professor of chemical technology in the University of Göttingen, whose death, at the age of seventy-four, was recently announced, was born at Rodermühle a. Harz in 1842 and graduated at Jena in 1869, after previously studying both in Göttingen and in Berlin. In 1897 he was appointed to the chair at Göttingen, a position he occupied with conspicuous success for close upon twenty years, during which period he made valuable contributions to chemical technology, both by his writings and by his experimental work. His investigations have been concerned chiefly with problems connected with solid and gaseous fuel, with the examination of water supplies, and with the analytical control of the Le Blanc soda and other industrial processes. In association with these inquiries he designed the many forms of apparatus which bear his name, of which that for accurate gas analysis, his modification of the Orsat apparatus, and his calorimeters for gaseous and for liquid fuel are the best known. Although these are, to a considerable extent, superseded to-day, they each mark an important advance in the construction of the apparatus used for these purposes, and successfully fulfilled the special objects for which they were designed. It is, however, principally as an author and as an editor that Fischer rendered his greatest service to the advancement of chemical technology. He revised and edited several editions of R. v. Wagner's standard text-book on chemical technology, which has been translated into many languages, including English, and from 1887 to 1910 he acted as editor, in succession to Wagner, of the invaluable "Jahresberichte der chemischen Technologie." Fischer's well-known treatise, "Die chemische Technologie der Brennstoffe," which was first published in 1880, and has passed through many editions since then, has always stood as an authoritative work on this branch of chemical technology, and his "Taschenbuch für Feuerungstechniker," which has also passed through many editions, has served as a most useful guide to technologists. Other publications have dealt with a variety of fuel problems and allied subjects, with the technology of water supplies, and with the study of chemical technology. Fischer also acted as editor of *Dingler's polytechnisches Journal* and of the *Zeitschrift für angewandte Chemie* for a number of years, and in 1887 he founded and edited the *Zeitschrift für die chemische Industrie.* Apart from these contributions to chemical literature, Fischer took a leading part in the establishment of the German Society for Applied Chemistry, which has since developed into the important Association of German Chemists.

Important developments have taken place recently in connection with the work of the Corrosion Committee of the Institute of Metals, which for the last six years has been investigating the causes of corrosion of marine condenser tubes. In the first place the committee has been recognised by the Privy Council Committee for Scientific and Industrial Research, and has been enlarged so as to include representatives of several Government departments, including the Admiralty, Lloyd's Register, and the Board of Trade, and some of the leading engineering societies. As from October 1 next it will receive a grant of 900*l.* in aid of its work for the forthcoming year. Hitherto the experimental work has been under the charge of Dr. Bengough at the University of Liverpool. In future the experimental condenser plant will be installed and worked at the Southwick Electricity Generating Station of the Brighton Corporation, an arrangement which is due to the initiative and good offices of Mr. J. Christie, their municipal electrical engineer, and will enable the plant to be worked under conditions much more nearly approximating to "practical" than has been possible hitherto. Laboratory research work in connection with the same problem will be carried out by Drs. Bengough and Hudson in the metallurgical laboratories of the Royal School of Mines, South Kensington, which have been gratuitously placed at the disposal of the committee by the authorities.

In 1902 Mr. A. Hrdlička published an account of all the crania of the Tenape or Delaware Indians which at that time were preserved in American museums. Since then fifty-seven skeletons have been discovered in the Upper Delaware River valley, and the same writer publishes in Bulletin No. 62 of the Bureau of American Ethnology an elaborate monograph describing this fresh material. To this he has added a general sketch of Eastern Indian crania in general. The most interesting result of the survey is that, while the Iroquois are regarded as a linguistic stock distinct from the Algonquian, the measurements of skulls of representatives ot the two stocks show no such distinction. It is also evident that the eastern Algonquian and Iroquois Indians, while essentially of one type, approached purity of type much more in the north-eastern Atlantic States and in south-eastern Canada than further south. The Iroquois group was a complex of tribes, some of which are still poorly represented in American collections, and it is possible that more abundant material will exhibit some differences between these tribes owing to their varied earlier associations, and perhaps to other agencies, among which we may suspect that varieties of environment played an important part.

William Wilberforce, who played such an important part in the abolition of slavery, was born in the fine old Elizabethan mansion in High Street, Hull, now known as Wilberforce House, which has been converted into a public museum and memorial of Wilberforce. Mr. T. Sheppard, the energetic curator, has succeeded in collecting a fine series of the numerous medals issued in connection with the abolition of slavery, and he describes them in No. 109 of the useful series of Hull Museum Publications. The first exhibit in the collection was issued in 1807, immediately on the abolition of the slave trade in the British Dominions, this being the precursor of the abolition of slavery itself in England some years later. The series closes with the medal issued by the Hull Corporation in 1906, when the museum was opened. The portrait of Wilberforce, a very pleasing one, was taken from a miniature in the possession of the Rev. J. B. Harford, son of the author of the Life of the statesman.

The July issue of the *National Geographic Magazine* is entirely devoted to a description of Mexico, as usual illustrated by a fine series of photographs. The most interesting contribution is that by Mr. F. H. Probert, "The Treasure Chest of Mercurial Mexico," a description of the mining centre at Guanajuato, where silver was discovered by a peon at La Luz in 1554. Rayas, a few years later, discovered the mine which still bears his name, and in 1557 the Rayas and Mellado workings led to the recognition of the Veta Madre, the mother lode of Guanajuato, which has yielded untold riches. Cecil Rhodes prophesied of Mexico that "from her hidden vaults, her subterranean treasure-houses, will come the gold, silver, copper, and precious stones that will build the empires of to-morrow and make future cities of this world veritable New Jerusalems." The Veta Madre has already produced gold and silver to the value of more than a billion dollars, and, given the possibility of decent government, the prediction of Rhodes is sure to be fulfilled. The worst feature of the situation is the poverty and social degradation of the mining population.

An interesting addition to the exhibits in the Insect Gallery of the Natural History Museum, South Kensington, has been made in the shape of a collection of "trout-flies," presented by Mr. Martin H. Mosely. The collection consists of a series of the natural insects that serve as food for trout and grayling (preserved in formalin placed in shallow glass dishes), and along with them a series of the artificial insects which are made in imitation of the natural ones and used as bait by anglers.

THERE has been placed on exhibition in the Central Hall of the Natural History Museum, South Kensington, a small series of specimens illustrating the natural history of the worm, Bilharzia (Schistosomum), that causes the disease of the bladder and rectum, known as bilharziosis, common in Africa, the West Indies, and Japan. Actual specimens are shown of the worms as they occur in the veins of the intestine, and examples are shown of pond-snails which are known to harbour the alternate generation of the worms. The life-history of the worm is explained by means of drawings of the egg and the sporocyst and cercaria stages, and photographs of bilharzia-infected canals in Egypt, from Lieut.-Col. R. T. Leiper's report of 1915, are exhibited to illustrate how the disease may be communicated to human beings by bathing or standing in the infected water.

IN the *Zoologist* for August Dr. J. M. Dewar records a series of experiments on habit-formation in a queen wasp which had its nest at the end of a long tunnel opening into a disused rabbit burrow. The approach to the nest at the time of its discovery was made, not by the burrow, but through the tunnel. How she would behave when this tunnel was plugged was the task he set himself to discover. His observations lead him to the conclusion that "the learning of the wasp did not transcend the sensori-motor level, and that images or ideas were not elements essential to an explanation of the observed reactions." He attaches, apparently, no importance to the fact that when the wasp first found the entrance plugged she gained access to the nest by the burrow, about 50 cm. below the tunnel, and endeavoured to break away the plug from behind.

MR. R. GREENAWAY, in the *Zoologist* for August, comments at length on the inability of natural selection to explain certain various phases in the evolution of the protozoa. The protective coverings of Difflugia and Arcella among the Thecolobosa, or the addition of flagellæ in the Flagellata, he argues, cannot be explained by natural selection, since this would demand similar armature and locomotory organs in all the species of their respective types which are now living side by side in the same environment. He concludes, therefore, that these differences are to be explained, at least in part, by "some form of the orthogenesis theory."

OWING to the difficulty of obtaining material, the ovarian tissues of the Marsupialia have been very little studied. Thus the memoir which appears in the *Quarterly Journal of Microscopical Science* (No. 244, N.S., July), by Dr. C. H. O'Donoghue, will be extremely welcome. He describes at length the corporea lutea and the interstitial tissue of the ovary, more especially in regard to Phascolarctos, Trichosurus, and Didelphys, thus supplementing his earlier observations on Perameles, Macropus, and Phascolomys. Perhaps the most important item in the present communication concerns the corpus luteum of Phascolarctos, which remains as a hollow cavity throughout the period of pregnancy, and which during the time that the embryo is in the uterus is quite unlike the corpus in any other known marsupial, or, indeed, that of any other mammal. As a result of his investigations, the author is able to show that the corpus luteum of the marsupial and the eutherian are indistinguishable, thus directly contradicting the statements made on this subject by Fraenkel and Cohn, and repeated without criticism by Van der Stricht.

IN Memoirs of the Geological Survey of New South Wales, Ethnological Series, No. 2, Mr. R. Etheridge, curator of the Australian Museum, Sydney, discusses the origin of the warrigal (*Canis dingo*), the name "dingo" being a contemptuous term applied by the aborigines to the white man's cur. He reviews the evidence collected by Sir F. McCoy and Mr. G. Krefft, who found its remains associated with a fauna now extinct. Mr. Etheridge adds to this that he thinks he has identified teeth of a dog somewhat larger than the warrigal among a quantity of jaw bones and loose teeth found in the Wellington Cave. He leaves the question of the origin and date of introduction in doubt, but the evidence here collected does not seem to conflict with the view that it was like the Indian pariah dog, and was brought by emigrants from the Malay region.

THE report on the investigation of rivers undertaken by the Royal and Royal Geographical Societies has been published by the latter society. The investigation, which was begun in 1906, had in view the examination of certain rivers in England and Wales for the purpose of ascertaining the volume of discharge, the suspended and dissolved matter in wet and dry periods and the total for the year, the erosion of the surface of the basin, the rainfall in each basin, and the extent occupied by calcareous and non-calcareous, and by pervious and impervious formations. The rivers selected for examination were the Exe, the Medway, and the Severn. These were selected as river basins representative of different geological conditions. Circumstances prevented the inclusion of the Salisbury Avon as a typical chalk river. The report is the work of various authors, including Dr. Aubrey Strahan, Mr. N. F. Mackenzie, Dr. H. R. Mill, and Dr. J. S. Owens. Attention was directed to the desirability of such investigations by the recent report of the Royal Commission on Canals and Inland Navigation, but the work requires to be carried on systematically throughout the country. The present report serves to indicate the value of such a survey of our water resources, and the lines on which it should be conducted.

IN the *Geographical Review* for July (vol. ii., No. 1) there is a paper by Messrs. W. G. Reed and H. R. Tolley, of the U.S. Department of Agriculture, on "Weather as a Business Risk in Farming." Climatic data expressed in averages afford a basis for determining the general character of a region, but the farmer requires to know the frequency or magnitude of departures from the average. Late spring and early autumn frosts do great harm to crops. The statement of the extreme dates of these frosts is of doubtful value in the determination of the risk of damage, as it is based on single occurrences. The authors have calculated the standard deviation from the average date of the last and first killing frosts, in spring and autumn respectively, and from this the frost risk may be computed. In two maps of the United States the standard deviations of dates of the last and first frosts are given as accurately as available data permit.

INVESTIGATIONS of the meteorology of the upper air were begun in 1913 at Melbourne. Rubber balloons were used, each with a meteorograph attached to a bamboo "spider." The work had not progressed far when the war interfered with its continuation. Mr.

Griffith Taylor has, however, given some account of the initial experiments (Bulletin No. 13, Commonwealth Bureau of Meteorology). He points out that Melbourne is not suited for these experiments, since the prevailing northerly winds cause a large proportion of the balloons to be carried out to sea and lost, while those carried by the easterly upper-air movement to the Victorian mountains are seldom recovered. No conclusive results can be deduced from the meagre data at present available, but after the war experiments are to be conducted under more favourable conditions at the meteorological observatory at Mount Stromlo, in Federal territory.

Dr. W. van Bemmelen has published in English a very interesting account of the "Results of Registering Balloon Ascents at Batavia" (*Batavia Javasche Bockhandel en Drukkerij*, 1916). Batavia lies a few degrees south of the equator, and these observations are valuable on account of the obvious care that has been taken to ensure accuracy and also on account of the equatorial situation. The ascents were 103 in all, spread over the six years 1910–15, and sixty-six available records were obtained. Dr. van Bemmelen gives tables showing the temperature and humidity, and also discusses the annual and daily variations. The most striking result is the low temperature that is found at great heights in these equatorial regions. Eighteen ascents reached the stratosphere, the mean height of which is shown as just under 17 km. At sea-level the mean temperature is 26° C., the freezing point is reached at 4·7 km., at 10 km. the temperature is −34° C., compared with −51° C. in England, but at 17 km. over Batavia the low value of −84° C. is found, against −54° C. over England. On one occasion a temperature of −90·2° C. (183° A. or −130° F.) was reached at 16·7 km. If any doubt remained about the existence of these low temperatures over the equator it has been removed by the publication of these results. The value given at 17 km., viz. −84° C., is based on twenty observations, and the standard deviation is small, so that there is no room for serious error in this value.

The Journal of the Society of Siberian Engineers (Tomsk, January, 1916) devotes an article, illustrated by climatological charts, to the possibility of extending and developing the beet-sugar industry in Siberia. The desirability of establishing this industry in Siberia was pointed out by the Russian Government thirty years ago, and substantial fiscal relief was offered to pioneers, with the result that the first factory was set up in 1889 in the Minusinsk district of the Government of Yenisei. The seat of the beet-sugar industry, the western provinces of Russia, being now in enemy occupation, there is among the refugees from those regions a large amount of highly skilled labour available for employment elsewhere. The present moment is therefore opportune for directing attention to the subject and taking practical steps to foster a growing industry the development of which is of the greatest importance for the future of Siberia.

Messrs. B. Artis and H. L. Maxwell have estimated the amounts of barium present in the leaves of certain tobaccos and trees, and publish the results in the *Chemical News* for August 11. The barium seems to be present in the ash of the leaf, partly as sulphate and partly in a form soluble in hydrochloric acid. The tobaccos examined were grown in Cuba, Pennsylvania, Connecticut, Sumatra, Wisconsin, and Mexico. The amount of barium (calculated as sulphate) found varied from 0·0132 per cent. to 0·0980 per cent. in the leaf, the lowest amount being found in the tobacco from Mexico and the highest in that from Pennsylvania. The stems invariably contained a larger amount. In the leaves of the trees examined the amount of barium sulphate found varied from 0·0071 per cent. (Sumac) to 0·0941 per cent. (wild grape) in immature leaves. In the mature leaves the amount is generally greater than in the immature where comparison is possible.

According to a note by Mr. A. W. Knapp in the *Chemical News* for August 18, the pink colour frequently noticed by analysts to develop on the surface of margarine fat which has been exposed in the laboratory is not due to bacterial growth or to the action of light or oxygen. It is caused by the action of the vapour of mineral acids on a dye (probably dimethylamidoazobenzene) frequently present in margarine. A method of detecting the dye is described.

A new system of signalling which dispenses with semaphores has been in use on a section of the Pennsylvania Railroad for nearly eighteen months, and is described in the *Engineer* for September 1. Daylight lamp signals having a range of visibility of about 2500 ft. in broad daylight had been obtained, using a lamp of not less than 20 watts and a lens 8 in. to 10 in. diameter. In 1914 Dr. Churchill, of the Corning Glass Company, discovered the possibility of securing very long range from a small lamp arranged in the exact focal centre of a small wide-angle lens. Each light unit consists of a box painted dull black on the inside, and containing a 12-volt 6-watt lamp with tungsten horizontal helical filament. The lamp is placed in the focus of a lens 5·5 in. diameter, having a focal length of 2·25 in. In front of the lens is a convex glass cover of the same diameter, and is so constructed as to avoid the difficulty of sun glare, which was at first experienced when a flatter cover-glass was used. A 4-in. spherical mirror is placed over the lamp, and is so arranged as to give the signal indication at extremely close range. A hood 11 in. long is placed over the cover-glass in order to concentrate the lamp rays and to exclude the sun's rays. The article contains clear illustrations of the arrangement.

We are informed that Messrs. Macmillan and Co., Ltd., have become the sole agents for the sale at home and abroad of the publications of Messrs. W. and A. K. Johnston, Ltd., of Edinburgh.

OUR ASTRONOMICAL COLUMN.

Maxima of Mira Ceti, 1915.—From observations made between November 21, 1914, and March 8, 1916, Mr. Felix de Roy has concluded that the dates of maxima of Mira Ceti were January 25, 1915 (mag. 3·8), and December 20, 1915 (mag. 3·0), while the intervening minimum (mag. 8·7) occurred on August 22 (*Mem. della Soc. degli Spett. Ital.*, vol. v., series 2, July). The first maximum of 1915 was the feeblest observed since 1896, and its abnormal character has already been discussed by A. Bemporad (Nature, vol. xcv., p. 405). The brightness at the minimum was also exceptional, having been equalled or exceeded only at six of the forty-three minima which have been sufficiently recorded. The second maximum of 1915 showed a normal amplitude of variation, and a normal interval from minimum to maximum, and a return of the star to normal conditions is suggested. A general discussion of the "perturbations" indicates the probability that the diminution and re-establishment of the brightness at maximum, of the amplitude, and of the interval from maximum to minimum, are progressive, and pass through a minimum when the maximum is abnormal. The disturbances usually extend through three or four periods, but the three elements are not always simultaneously affected, and no periodicity for the abnormal maxima can yet be established.

A FAINT STAR WITH LARGE PROPER MOTION.—The greatest proper motion yet known for any star has been discovered by Prof. Barnard from a comparison of photographs taken with the 10-in. Bruce telescope, with the aid of the Zeiss blink-microscope. The star in question is one of the 11th magnitude, situated in R.A. 17h. 53m. 44s., declination $+4° 27·4'$ (1916·0), and the annual proper motion, in a northerly direction, amounts to about 10″. The star follows B.D. $+4°$ 3560 by 9·5s., and is 0·4′ north. The motion is confirmed by numerous plates taken at Harvard, dating from 1888 (Harvard Bulletin, 613). The greatest proper motion previously known was that of Cordoba zones, 5h. 243, magnitude 8·3, R.A. 5h. 8m., declination $-45°$, amounting to 8·7″ per annum. The well-known star, 1830 Groombridge, of magnitude 6·5, comes next with a proper motion of 7″ per annum.

THE VAN VLECK OBSERVATORY.—The Van Vleck Observatory of Wesleyan University at Middletown, Connecticut, was dedicated on June 16. The observatory is the gift of the late Joseph Van Vleck, in commemoration of the services rendered to the University by his late brother, John Monroe Van Vleck, who had been professor of mathematics and astronomy for many years. The chief instrument is an equatorial refracting telescope of 18½-in. aperture and 26 ft. focal length, but the completion of the objective has been delayed by the war, and a 12-in. lens is temporarily in use. The observatory is designed for purposes of instruction and research, and, in addition to the large telescope, is provided with two small transits and numerous portable instruments. The director is Prof. F. Slocum, who is well known for his successful work at the Yerkes Observatory. It is intended to apply the large telescope chiefly to the photographic determination of stellar parallaxes (*Popular Astronomy*, vol. xxiv., No. 7).

THE SYSTEM OF POLARIS.—Spectroscopic observations have revealed the existence of two close companions to Polaris, one having a period of about four days, and the other of about twelve years. From a discussion of all the available data, L. Courvisier, of the Berlin-Babelsberg Observatory, has concluded that the visible 9th magnitude companion to Polaris is also a member of the system, its period of revolution being at least 20,000 years (*Astronomische Nachrichten*, 4854). The mass of Polaris itself is probably not greater than one-fourth that of the sun, and its density not more than 0·003 of the sun's density. The deduced parallax of Polaris is 0·053″. The maximum separation of the companion having a period of twelve years is given as 0·20″, and this may be reached about the beginning of next year.

THE AMSTERDAM COLONIAL INSTITUTE.

FOR some years past a movement has been in progress in Holland having for its object the foundation of a colonial institute in Amsterdam commensurate with Dutch colonial interests, and adequately representative of the important part which Holland has taken in the prosecution of research in tropical agriculture and forestry. There has existed at Haarlem for many years a small, but important, colonial museum, and the promoters of the new institute have fortunately been able to secure the transfer of the economic collections, publications, and staff of the Haarlem museum to the Amsterdam institute. The latter is at present housed in temporary quarters, but the authorities have in hand a capital sum of about 1,600,000 florins, which is apparently all available for the construction of buildings and the installation of the new institute. The latter will apparently be supported mainly by subsidies from the Government, the province of North Holland, and the city of Amsterdam, and by subscriptions from private individuals and firms. In 1914 the ordinary annual expenditure was 91,600 florins, but for 1915 the estimate is 78,000 florins, certain of the subsidies having been cut down owing to war economies.

As at present organised, the institute comprises three sections: *Economic* (which is practically the Haarlem museum transferred to new quarters), *Anthropological*, and *Tropical Hygiene*. It corresponds, therefore, on a small scale to the Imperial Institute of the United Kingdom as regards technical and economic work on colonial products, and to the British Schools of Tropical Medicine as regards tropical hygiene. There is, of course, nothing in this country as yet corresponding to the anthropological section of the Amsterdam institute. A site for the new buildings has been secured on the Oosterbegraafplaats, where a building to house the administrative offices and the economic and anthropological sections will be erected with a front of about 170 yds. on the Maurits Kade and about 75 yds. on Linnaeus Straat. A special building for the section of tropical hygiene will be erected as part of the buildings of the Hygienic Institute of the University of Amsterdam, with which this section will work in close co-operation.

The institute has already issued a number of publications, perhaps the most interesting being a concise history by Dr. Sirks of research in natural science in the Dutch East Indies (Koloniaal Instituut te Amsterdam, Mededeeling, No. vi. Afdeeling Handelsmuseum, No. 2).

LAND-SLIDES ON THE PANAMA CANAL.[1]

A COMMITTEE of the U.S. National Academy of Sciences spent the last fortnight of the year 1915 on the Canal zone studying the great land-slides of the Culebra Cut. These are three in number, and are all comprised within a mile or a little more of the Canal bank. The moving ground consists almost entirely of the stratified rocks known as the Cucuracha or Culebra beds. The East Culebra slide and the Cucuracha slide lie north and south of the core of basalt and hard tuff which forms the high central mass of Gold Hill, the flanks of which are composed of the aforesaid stratified rocks. On the west side of the Canal there are three summits of massive rock, tuff or basalt, viz. Contractor's Hill, nearly opposite to Gold Hill; Zion Hill, north of Contractor's Hill; and Culebra Hill, north of Zion Hill. The third great slide, the only one on the west bank of the Canal, known as the West Culebra slide, lies between Zion and Culebra Hills.

The committee finds that no great extension of the slides in the soft Cucuracha or Culebra beds is probable, because the rock itself is limited in extent, and because the broken ground already extends in many places beyond the crest of the slope.

It also reports upon the important question of the stability of Gold Hill, Contractor's Hill, Zion Hill, and Culebra Hill, which rise considerably above the level of the sliding ground. The confident expectation that these eminences will "slide" makes the average visitor to the Canal works pessimistic of the future of the undertaking. Viewed casually, or from a dis-

[1] Preliminary Report upon the Possibility of Controlling the Land Slides Adjacent to the Panama Canal. By the Committee of the National Academy of Sciences appointed at the request of the President of the United States. (Proc. Nat. Acad. Sci., vol. ii., No. 5, April 15, 1916.)

tance, no reason is apparent why these hills should not presently share in the movement of the material which lies upon their flanks. The apprehension is all the more natural because great chunks of the massive rock have broken from the parent masses adjacent to the sliding ground. When, however, we examine the materials closely we find a great difference in character between the central, and highest, part of these hills and the lower slopes which slide. The committee reports that the hills consist of intrusive bodies of basalt or of masses of hard Obispo tuff, and that, so far as the exposures show, they do not rest upon the soft beds, but extend far down below Canal bottom. The committee is therefore of opinion that although rock may break off from them, they will not collapse.

In this connection it is important to note the observation in the report that there has been no upheaval of the Canal bottom between Gold Hill on the east, and Contractor's Hill, nearly opposite to it, on the west, side of the Canal, which is the deepest part of the cut. This shows that the hills are not pressing on the bottom.

Thus the findings of the committee, and the evidence in their report, favour the opinion that the establishment of a permanent waterway free from interruption is only a question of time; of time to be reckoned, not in months, indeed, on one hand, but certainly not in centuries on the other. It thinks that "some sliding ground will continue to enter the Canal for several years to come," and it recommends that certain steps be taken to lessen its amount. These recommendations have to do with the control of the rain-water, which in this region of great precipitation adds so much to the weight of porous, stratified rocks, and so greatly diminishes their cohesion. The committee proposes, therefore, that the growth of vegetation should be promoted, that cracks should be filled up as soon as formed, that surface and tile drainage should be undertaken in threatened areas, and that drains should be established on the moving ground of the three great slides. VAUGHAN CORNISH.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is announced in the issue of *Science* for August 18 that Lafayette College is the residuary legatee of the late Mr. A. N. Seip, of Washington, D.C. It is said that the college will ultimately receive not less than 50,000*l*.

THE Elgar Scholarship of the Institution of Naval Architects, of the annual value of 100*l*., and, subject to certain regulations, tenable for three years, has been awarded to Mr. R. J. Shepherd, of his Majesty's Dockyard, Devonport.

IT is stated in a recent issue of *Science* that the vocational-educational Bill, providing for Federal cooperation with the various States in promoting agricultural and industrial education in the United States, makes an annual appropriation beginning at 100,000*l*. and increasing each year by 50,000*l*. until 600,000*l*. is reached, to be apportioned to the States in proportion to their rural population.

THE calendar for 1916–17 of the Edinburgh and East of Scotland College of Agriculture is now available. The college was founded to provide for agricultural education and research in the central and south-eastern counties of Scotland. It receives annual grants from the Government through the Board of Agriculture for Scotland. Its classes are arranged in conjunction with the science faculty of Edinburgh University, and the courses for the diploma of the college and the B.Sc. degree of the University are concurrent. The calendar contains full details of the courses of instruction available in the departments of agriculture, horticulture, and forestry. The aim of the college is to supply such training in agriculture and the sciences underlying it as is nowadays indispensable to all who intend to gain their living from the land as owners, or tenants, or agents. Copies of the calendar may be obtained from the secretary of the college, 13 George Square, Edinburgh.

A CONFERENCE representative of the Classical, English, Geographical, Historical, and Modern Language Associations has drawn up the following resolutions, which have received the approval of the councils of the five associations named:—That in the opinion of the conference: (1) It is essential that any reorganisation of our educational system should make adequate provision for both humanistic and scientific studies. (2) Premature specialisation on any one particular group of studies, whether humanistic or scientific, to the exclusion of all others, is a serious danger, not only to education generally, but to the studies concerned. (3) Humanistic education implies the adequate study of language and literature, geography and history, which in each case should, at the appropriate stages of education, go beyond the pupils' own language and country. (4) The representatives of humanistic studies would welcome from the representatives of the mathematical and natural sciences a statement with regard to those studies similar to that contained in (3). (5) In all reform of education it must never be forgotten that the first object is the training of human beings in mind and character, as citizens of a free country, and that any technical preparation of boys and girls for a particular profession, occupation, or work must be consistent with this principle. (6) Subject to the above principles the associations concerned would welcome a comprehensive revision of national education from the point of view of present needs. It is stated that "the resolutions are published in the hope that in any coming reconstructions of our educational system this attempt to restate the 'humanistic' position will mitigate the dangers incident to a violent breach of tradition and an excessive reaction against the past predominance of certain types of study. But it will be obvious that they are drawn up in no spirit of hostility or indifference to either scientific or technical studies, and their framers are anxious to co-operate in securing for these, as well as for the studies with which they are themselves more particularly interested, their due place in a national system of education." Co-operation and suggestions are invited; any communication may be addressed to the chairman of the Conference of the Five Associations, Prof. T. F. Tout, Oak Drive, Fallowfield, Manchester.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 21.—M. Paul Appell in the chair.—A. **Lacroix**: Some volcanic rocks of the French possessions in the Indian Ocean and the Pacific.—Paul **Appell**: The developments of the square root of a polynomial in continued fractions.—W. H. **Young**: The convergence of Fourier's series.—M. **Petrovitch**: Theorem of the mean relating to the integrals of an important partial differential equation.—G. **Giraud**: Quadratic forms and hyperabelian functions.—A. **Liljeström**: A geometrical theorem useful for the study of the direct inversion of Abelian integrals.—R. **Garnier**: A new method for resolving Riemann's problem.—R. **Birkeland**: Developments of the movement of a fluid parallel to a fixed plane.—V. **Kostitzin**: The periodicity of the solar activity and the influence of the planets.—H. **Bordier**: The action of light on dilute aqueous solutions of iodine and iodide of starch. Dilute solutions of these two substances, stable in the dark, are bleached by the action of light. The hypothesis put forward to explain this fact is based on the supposition that both iodine and iodide of starch do not form true solutions but colloidal solutions.—A. **Blanchetière**: The relations between the chemical constitution of certain derivatives of amino-acids and the mode of attack of these substances by bacteria.—Ch. **Dhéré** and G. **Vegezzi**: The influence exercised by the degree of reduction of the hæmochromogens on their spectra.

NEW SOUTH WALES.

Linnean Society, June 28.—Mr. C. Hedley, vice-president, in the chair.—R. J. **Tillyard**: Studies in Australian Neuroptera. No. iii., The wing-venation of the Chrysopidæ. The paper shows the method adopted in extracting the pupa of Chrysopa from its cocoon, and preparing the wing-sheaths for photomicrography. The result of a study of the pupal wing tracheation demonstrates that the Chrysopidæ are the most highly specialised of all Neuroptera. In the hindwing the point usually taken as the origin of Rs is shown to be a false origin, the true basal portion being fused with M. In both wings the veins usually named the media and cubitus are shown to be highly complex formations developed from consecutive, short portions of the true media, true cubitus, and the more proximal branches of the radial sector. These latter are termed the Banksian sectors, since their part in the above formations is similar to that of the branches forming the Banksian line in Myrmeleontidæ. The two composite veins themselves are named the pseudomedia (L′) and pseudocubitus (Cu′) respectively. No corresponding veins are known anywhere else in the class Insecta. The true media is shown to be branched in both wings, Banks's "divisory veinlet" in the forewing being formed by divergence and distal re-fusion between M_2 and M_1. The paper concludes with a phylogenetic discussion in which the venation of the Apochrysidæ is compared with that of the Chrysopidæ, and the descent of these families from an original Osmylid-like stock, *via* forms like the Jurassic Mesochrysopa, is indicated.—Dr. A. J. **Turner**: A third contribution to a knowledge of the Lepidopterous fauna of Ebor Scrub, N.S.W. Four additional visits to the Scrub, in January, 1916, resulted in 128 captures, representing forty species, twenty-two of which have been previously recorded. Six of the remaining eighteen are known to occur elsewhere, and twelve are now described as new, as well as an interesting geometrid obtained in 1914, but overlooked. The number of recognised species amounts to sixty-nine, of which only twenty-four are known from other localities.—M. **Aurousseau**: Petrological notes. No. ii., The relations between some West Australian gneissic and granitic rocks. The observations recorded are grouped under two heads—"The Geology of the Roelands District," and "The Crystalline Rocks of Albany."

BOOKS RECEIVED.

Masonry Dam Design. By Dr. C. E. Morrison and O. L. Brodie. Second edition. Pp. ix+276. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s.* 6*d.* net.

Principles of Oil and Gas Production. By Prof. R. H. Johnson and S. G. Huntley. Pp. xv+371. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 16*s.* net.

A Method for the Identification of Pure Organic Compounds, etc. By Dr. S. P. Mulliken. Vol. ii. Pp. ix+327. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21*s.* net.

Through South Westland. By A. M. Moreland. Second edition. Pp. xviii+219. (London: Whitcombe and Tombs, Ltd.)

Growth in Length: Embryological Essays. By R. Assheton. Pp. xi+104. (Cambridge: At the University Press.) 2*s.* 6*d.* net.

Agricultural Geology. By R. H. Rastall. Pp. ix+331. (Cambridge: At the University Press.) 10*s.* 6*d.* net.

The Algebraic Theory of Modular Systems. By F. S. Macaulay. Pp. xiv+112. (Cambridge: At the University Press.) 4*s.* 6*d.* net.

Analytical Chemistry. Vol. i., Qualitative Analysis. By Prof. F. P. Treadwell. Translated by W. T. Hall. Pp. xiii+538. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12*s.* 6*d.* net.

Love and Cruelty. By W. H. Cock. Pp. v+148. (London: R. Scott.) 2*s.* net.

Transactions of the Royal Society of Edinburgh. Vol. l., part iii. Session 1914–15. (Edinburgh: R. Grant and Son.) 27*s.*

The Source of Life and Thought. By J. C. Scholey. Pp. vi+26. (London: Kegan Paul and Co., Ltd.) 1*s.* net.

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

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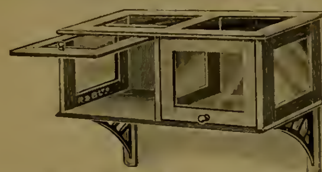

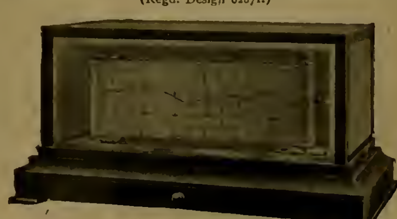

THURSDAY, SEPTEMBER 14, 1916.

A SYSTEM OF PHYSICAL CHEMISTRY.

A System of Physical Chemistry. By Prof. W. C. McC. Lewis. Two vols. Vol. i., pp. xiv+523. Vol. ii., pp. vii+552. (London: Longmans, Green and Co., 1916.) 9*s.* net each vol.

PHYSICAL chemistry in the present-day sense of the term may be said to date from 1887, the year in which Ramsay came to London, Ostwald was appointed to the chair in Leipzig, and the *Zeitschrift für physikalische Chemie* was founded by Ostwald and van't Hoff. Although many pioneers, amongst whom may be mentioned Deville, Debray, Guldberg and Waage, Gibbs, Horstmann, Berthelot, Thomson, Harcourt and Esson, Gladstone, Le Chatelier, and Lemoine had prepared the way for the new development in chemical science, it was the combined influence of van't Hoff, Arrhenius, Ostwald, and Ramsay that gave direction and strength to the new current of thought and research.

It is a remarkable fact that during this period of nearly thirty years the English-speaking peoples of the world have had to depend chiefly on works written in German, or their translations into English, for the accepted standard treatises on the subject. The "Lehrbuch" of Ostwald, the "Theoretische Chemie" of Nernst, and the "Vorlesungen" of van't Hoff were for many years without a serious competitor. A change in this state of affairs was brought about by the appearance of the excellent series of "Text-books of Physical Chemistry" edited by Sir William Ramsay. But as these were mostly in the nature of special treatises on different branches of the subject, the student desirous of obtaining a compact and rounded, and at the same time fairly comprehensive, view of physical chemistry as a whole had still to have recourse to the works previously mentioned. Yet none of these was entirely satisfactory. Ostwald's "Lehrbuch," though unexcelled in its historical treatment of the subject, was too cumbrous, was marred by its author's unfortunate attempt to "energeticise" thermodynamics, and has not been kept up to date. Nernst's otherwise excellent treatise repelled the student by its opening chapters, which presented the subject of thermodynamics in a Helmholtzian form unfamiliar to English students, but so generalised, so condensed, and so careless in reasoning that few students could separate the gold from the dross. Finally, the lectures of van't Hoff, though the work of a master-hand, scarcely covered the required field of study in a sufficiently comprehensive manner.

The present work, which appears as the latest volume of Sir William Ramsay's series of text-books, differs radically from its predecessors inasmuch as it essays to present the reader with a fairly comprehensive "System of Physical Chemistry." In this respect it is worthy of especial consideration and attention. It may be said at once that in its arrangement of matter, lucidity of style, and comprehensive unity of design it is destined to become the standard general treatise on the subject of physical chemistry for English-speaking students.

The frontispiece consists of a table indicating a "philosophical" classification of the subject. This is very interesting, and will be of great service in giving the student a reasoned survey of the field to be traversed. The main division is into systems in equilibrium and systems not in equilibrium. The subdivision of these is based partly on the nature of the subject-matter and partly on the method of treating it. This want of uniformity in the system of classification is, however, no defect, as it corresponds to the natural development of science. The author is to be congratulated on this emphasising of the philosophical aspect of his subject, an aspect which is all too frequently ignored by the authors of scientific treatises. For practical purposes the work is divided into two volumes. Vol. i. deals with the subject from the classical kinetic-molecular point of view. Vol. ii. is divided into two parts, part i. being entitled "Considerations based upon Thermodynamics," and part ii. "Considerations based upon Thermodynamics and Statistical Mechanics."

This method of division has a philosophical and historical as well as a practical didactic basis. As Perrin has pointed out in the beautiful preface to "Les Atomes," there are two methods by means of which the human mind advances in its understanding of the external world. In one case "on généralise des résultats d'expérience, mais les raisonnements ou les énoncés ne font intervenir que des objets qui peuvent être observés ou des expériences qui peuvent être faites." This is essentially the method of the "classical" thermodynamics, on which so much of the science of physical chemistry is based. But there is also another method—"deviner l'existence ou les propriétés d'objets qui sont encore au delà de notre connaissance, *expliquer du visible compliqué par de l'invisible simple*, voilà la forme d'intelligence intuitive à laquelle, grâce à des hommes tels que Dalton ou Boltzmann, nous devons l'Atomistique." It is to this that we owe not only the beginnings of chemical science, but also the latest advances. The trend of modern physical chemistry is largely in the direction of "Atomistique."

The author's presentation of the subject has also an important didactic advantage. Students invariably find chemical thermodynamics difficult, but read with comparative ease an exposition based on a simple kinetic-molecular method of treatment. In vol. i. they will find the latter, enlivened and brought up to date by an account of the work of Einstein, Perrin, and Svedberg on "molecular reality," and a discussion of the electron theory of matter, the structure of the atom, and the transmutation of the elements. Part i. of vol. ii. contains a good account of the thermodynamical treatment of chemical problems, including the application of thermodynamics to electrochemistry, and the "Nernst Theorem." In part ii. the author discusses photo-chemistry, the theory of radiation, and the application of the theory of Quanta to the problems of photochemistry, radiation, and the kinetic theory of matter. These highly important aspects of what one might term the "newer physical chemistry" are dealt with in a very simple and clear fashion, and this part of the book will be exceedingly valuable to students of chemistry.

During the last decade the scope and importance of physical chemistry have become enormously increased. To write within moderate compass a good text-book on the subject has become a task of rapidly increasing difficulty. Nevertheless Prof. Lewis has achieved this task with an admirable success. One might say of him, "Jeunesse savait, jeunesse pouvait."

F. G. DONNAN.

THE FLORA OF ALL AFRICA.

The Flowering Plants of Africa: An Analytical Key to the Genera of African Phanerogams. By F. Thonner. Pp. xvi+647. (London: Dulau and Co., Ltd., 1915.) Price 15*s*. net.

THE work under notice is a translation of the author's "Die Blütenpflanzen Afrikas," which appeared in 1908. The preface is dated Vienna, Austria, 1913, and the work was issued by the Burleigh Press, Bristol, in 1915. Dr. A. B. Rendle revised the translation, which includes "diagnostic characters of the genera, the approximate number of African species described up to the end of the year 1910; their geographical distribution, their uses, and their more important synonyms." So far as tested, it is up to the date named; but six years' additions are very considerable, Kew alone having published at least 300 new species, leaving new genera out of the question. But comprehensive compilations necessitate supplements if they are brought as nearly as possible up to date of publication; and Thonner gives six pages of corrections and additional genera, chiefly from the years 1911 and 1912.

The descriptive part of the work occupies about 550 pages, and the general distribution of the genera enumerated is set forth in a statistical table. It should be understood that only families and genera are described, and the classification is Englerian. The area embraced includes all the African islands, from the Azores to Tristan da Cunha, and Socotra, the Mascarenes, and Madagascar to Kerguelen. And the geographical divisions of the mainland are physical rather than political. Thonner's enumeration and estimates afford a record of 226 families of flowering plants indigenous in the African region, and represented therein by 3551 genera and 39,800 species, or say 40,000. His estimate for the world is 10,055 genera, with a total of 144,500 species, and his figures are certainly not too high. The table also shows the numbers for North, Central, and South Africa, and the Malagasy Islands.

Other features of the book are: a condensed bibliography, a glossary, indexes to the popular and botanical names, and a list of the plates and the abbreviations of authors' names. The plates are excellent, and represent members of 150 families, and the letterpress is clear and idiomatic. Wherever possible the author has chosen as distinctive characters such as are visible to the naked eye in a plant in flower. First comes a key to the families, followed by descriptions of the same, and under each a key to its genera, including a considerable number of introduced plants. The plan and scope of the work have been somewhat fully explained, because that seemed a more useful course than a technical criticism. Its full value can only be determined by actual use; but an elementary knowledge of external morphology and descriptive terminology would be necessary and sufficient to enable the student to understand the treatment of the subject. As a book of reference only it answers many interesting questions.

W. BOTTING HEMSLEY.

CHRISTIANITY IN PARTIBUS.

The Nestorian Monument in China. By Prof. P. Y. Saeki. Pp. x+342. (London: Society for Promoting Christian Knowledge, 1916.) Price 10*s*. 6*d*. net.

THIS volume deals with one of the most interesting romances of literature ever known. The story has often been told before; but it will bear repetition, on the chance of reaching some whose reading may have lain in other directions.

The Christian religion, under the guise of what is now known as the Nestorian heresy, was carried to China early in the seventh century A.D. by a mission dispatched under the auspices of adherents who had been for some time seeking in the Far East the development which was denied to them in the West. Nestorius had been appointed Patriarch of Constantinople in A.D. 428, but in an evil moment for himself he conceived the idea that all difficulties as to Christ's birth would vanish if it were understood that He had distinct human and divine persons. For this he was deposed in 431, and a few years later he disappeared.

Nestorianism survived its founder for many centuries. Reaching China in the year 631, its advance was so rapid that by 635 Nestorian missionaries were allowed to settle at the capital, where for a couple of centuries they enjoyed Imperial protection and even patronage. In 781 the Nestorian Church of the day set up a huge stone tablet, more than 9 ft. in height, more than 3 ft. in breadth, and about a foot thick. On this tablet an inscription was carved, in Chinese and Syriac, explaining and glorifying the Christian religion, and celebrating the praises of the great and good Emperors who had permitted this teaching to take root and flourish. For flourish it unmistakably did, and so it was found in the thirteenth century by Marco Polo. Then, during the fourteenth century, it faded away, leaving no trace of any kind that it had ever existed. There is no mention of Nestorianism in the Chinese dynastic histories; no mention of it in any of the contemporary or later Chinese authors whose writings have covered every department of literature. Nor should we now know anything of the early advent of Christianity in China but for an extraordinary accident. In 1625 it came to the notice of Catholic missionaries that the tablet above described, and of which all knowledge had long been lost, had been unearthed somewhere near the old capital, at which we now know from the tablet that Christianity had flourished as above stated. The tablet was denounced as a Jesuit forgery by Voltaire and others, but for a long time there has not been the slightest doubt of its genuineness, and this point is somewhat laboured by Prof. Saeki, who thinks that it "has been preserved by the Divine Providence to reveal to us the true condition of the spiritual side" of China between A.D. 618 and 907.

Prof. Saeki's work is divided into three parts. The first part gives a general history of Nestorianism, especially in relation to the Far East, and the full story of the tablet, not omitting the attempt of Mr. Frits Holm in 1907 to carry it away to America. This enterprising traveller had to be content with a replica, now in the Metropolitan Museum, New York. Prof. Saeki mentions a second replica, "which stands to-day at the top of Mt. Koyd, the Holy Land of Japan," where, we are told, "it was dedicated, with full Buddhist ceremonial, on Sunday, October 3, 1911."

The second part of the book—the translation of the inscription—is the least satisfactory, though it is just there that improvement would be most welcome. A single example must suffice. In the description of the Messiah we read (p. 164): "Hanging up the bright Sun, He swept away the abodes of darkness." This, of course, is unintelligible. The Chinese text means, "He *was* hung up, a bright sun, in order to prevail against the gates of hell"—a light to "lighten our darkness," alluding to the Crucifixion.

The notes on the text which form the third part are interesting and in many cases valuable.

OUR BOOKSHELF.

Preservatives and Other Chemicals in Foods: Their Use and Abuse. By Prof. Otto Folin. Pp. 60. (Cambridge: Mass. Harvard University Press. London: Oxford University Press, 1914.) Price 2*s*. 6*d*. net.

Prof. Folin's lecture is a judicious and temperately expressed statement of the arguments for and against the use of preservatives in foods, but it adds little or nothing to our knowledge, and will scarcely tend towards forming a sound public opinion. He who seeks for an *ex cathedra* statement whether the addition of "chemicals" should be permitted to food at all, and if so, what alone should be tolerated, will find nothing in the way of definite pronouncement and not much in the way of light or leading. The author apparently halts between two opinions. He is constrained to admit that modern conditions of food supply would seem to require the use of such substances. They have been forced upon the community as a commercial necessity, and the consumer is powerless to resist.

The uncertain attitude of the author, however disappointing it may be to his readers, is at least intelligible. The fact is, no one is in a position to dogmatise on the subject, for as regards certain of the chemical products which are capable of retarding or preventing the decomposition of alimentary substances we have no positive knowledge concerning their action on the economy. Nor is it easy to obtain this knowledge. The usual argument that if they retard or prevent the action of the enzymes or bacteria which are concerned in the decomposition or decay of food they will equally inhibit the action of those agencies in effecting its digestion, begs the question and is unsound. Age, idiosyncrasy, condition of health, and a number of other circumstances affect the matter: what is toxic to one person is harmless to another. This is true of food itself, even in the absence of all preservatives. The aphorism of *caveat emptor* affords little comfort to the consumer, but in the present condition of matters it is all that can be offered him; yet it is at least due to him to know whether the food he buys is "preserved," and if so, what preservative and how much of it has been employed. But this is precisely the kind of information that purveyors of food decline to supply except under pressure of legal pains and penalties.

The Bearings of Modern Psychology on Educational Theory and Practice. By Christabel M. Meredith. Pp. 140. (Constable and Co., Ltd., 1916.) Price 1*s*. 6*d*. net.

The author's aim has been "to give a brief account of some portions of recent psychological work which have had and are likely to have a special influence on education." Part i. of the little book is devoted mainly to genetic psychology, part ii. to certain special observational and experimental studies. Within her limits Mrs. Meredith has done distinctly useful work, choosing her topics with discretion and treating them in a competent and serviceable way. Her sketch of the child's mental development is based largely upon the psychological work of McDougall and Shand, whose ideas she has used skilfully in interpreting the outstanding phenomena of the nursery, the playground, and the class-room, with all of which she shows a sound first-hand familiarity. In a well-written chapter on "Experiment in Education" she brings out, by apt illustrations, the complexity of the problems which the laboratory method has to face, showing why its results must always be used with caution and at the same time that they are indispensable to progress. The final chapter on adolescence contains wisdom for parents as well as for teachers. The omission, in so slight a treatise, of a short list of books for further reading is a defect which should be remedied in a second edition.

LETTERS TO THE EDITOR.

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

The Group Vermidea.

A RECENT number of NATURE (August 24, 1916, p. 525) contains a notice of a work on Nematoda, which are described as "a group of Vermidea which presents great difficulties from a systematic point of view, and has therefore been less investigated than other groups of Vermidea." It may perhaps be asked what is the justification for this use of the term "Vermidea."

In vol. v. (1897) of Delage and Hérouard's well-known "Traité de Zoologie Concrète" it is pointed out (p. 1) that Schulgin and Pruvot had independently suggested the replacement of the denomination "Molluscoïdes" [= Brachiopoda + Polyzoa] by "Vermoïdes," on the ground that the affinities of this group are with the worms rather than with the Mollusca. This idea appeared a happy one to Delage and Hérouard, who proposed to add to the group thus constituted certain small groups which they believed to have a real though distant affinity to the Polyzoa or to the Brachiopoda. The groups thus added are the Gephyrea (Priapulida, Sipunculida, and Echiurida), the Axobranchia (Vermiformiæ [= Phoronidea] and Pterobranchiæ), and the Trochelmia (Rotiferiæ, Gastrotrichiæ, Kinorhynchia, and Chætognathia). These, with the Bryozoaria [= Polyzoa] and the Brachiopodia, constitute the enlarged *embranchement*, which now appears as the "Vermidea." On p. 327 it is stated that the Vermidea "sont liés entre eux par des affinités réelles"; and the Platyhelminthes, the Nematoda, and the Annelida are definitely excluded from this association.

Up to and including vol. xlii., for 1905, the *Zoological Record* included most of the groups of "Worms" under the designation "Vermes." In vol. xliii., the first which was issued as a volume of the International Catalogue of Scientific Literature, "Vermidea" replaces "Vermes," and includes (1) Platyhelminthes, Nemertinea, Mesozoa; (2) Nemathelminthes; (3) Chætognatha, Rotifera, Gastrotricha; (4) Archiannelida, Polychæta, Oligochæta, Gephyrea, Phoronis, and Hirudinea; and to these may be added Pterobranchiata, which appears in the Contents, p. xii., though not in the formal list given at the beginning of the detailed account of the literature of these forms. I am not aware what was the authority for this use of "Vermidea"; but it may be noted that it omits the Polyzoa and the Brachiopoda, the two central groups of Delage and Hérouard's phylum; and that it includes the Platyhelminthes, Nemathelminthes, and Annelida, three groups which were expressly excluded by those authors. The group "Vermidea" of the *Zoological Record* is thus absolutely different from that of the "Traité de Zoologie Concrète." Not only does the propriety of so revolutionary a change seem questionable, but one may well ask in what way was the new departure an improvement on the old group "Vermes," which was admittedly an assemblage of forms which have no demonstrable affinity to one another. It is not possible to say much more for the grouping than that the majority of forms thus associated are invertebrates having a shape suggested by the term "worm," or, in other words, that they are longer than they are broad.

I do not desire to discuss the validity of Delage and Hérouard's phylum, although I am by no means convinced that the groups included in it are allied to one another. But in the sense in which it was defined in 1897 it indicated an attempt to advance the classification of animals. The procedure adopted by the *Zoological Record* appears to me to have nothing to recommend it. There is no doubt some convenience, from the point of view of the recorder, in dividing the animal kingdom into a small number of comprehensive groups. If the forms under consideration were described as "worms" it would be an admission that the name of the group was adopted merely for motives of convenience. The term "Vermes" was no doubt rightly rejected, since most zoologists would agree that it has no more claim to a permanent place in literature than has "Radiata," another assemblage which included animals possessing a type of symmetry which in itself is not now regarded as necessarily indicating affinity to other animals similarly provided. The use of "Vermidea" in the sense of the *Zoological Record* can only be described as pseudo-scientific. It is not only no improvement on "Vermes," but its substitution for that term is misleading, as suggesting that it is a more natural group than the one which it replaced.

SIDNEY F. HARMER.

British Museum (Natural History)
August 27.

The Refractometry of Lenses.

IT may be of value to opticians and others to know of a method by which the refractive indices of irregular or unpolished pieces of glass, lenses, or prisms, can be found fairly accurately—*i.e.* to 1 in the fourth decimal place.

The specimen is immersed in a mixture of carbon disulphide and alcohol contained in a prism cell having refracting sides of optically plane glass; this cell is used on the table of a spectrometer.

By altering the proportions of the two liquids, the refractive index of the mixture can be made equal to that of most specimens. This is easily done by observing the image of the slit refracted through the system. The finest adjustment of proportion takes place automatically through unequal evaporation.

The *important* prevision is that the liquid must be mechanically stirred; this can be done by a small "propellor" blade driven by a motor, which must be quite separate from the spectrometer to obviate vibration.

At the proper moment the angle of minimum deviation is taken, and the refractive index calculated out in the usual way.

The method has given excellent results for refractive index and dispersion on a number of varying specimens. It should prove of use for copying optical systems. The method is at present being developed, and full details will be published shortly.

L. C. MARTIN.

Imperial College of Science and Technology,
South Kensington, London, S.W., August 23.

An Oil Drive for Equatorial Telescopes.

THE drive, or oil, regulator under consideration is the invention of Mr. G. H. Denison, of Hunslet Foundry, Leeds, past president of the Leeds Astronomical Society. The device has been attached to the pedestal which carries the 26-in. reflector, and is fitted on the south side opposite the driving clock.

With the help of the accompanying photograph, the working of the device may be briefly described as follows:—

The binding screw (A) being free (or loose), the driving disc (B) is disengaged from the polar axis. On turning the winding-up wheel (C) the plunger (D) is drawn out of its cylinder (E), sucking oil into the cylinder from the reservoir (F) through a valve. The winding-up has also turned the driving disc (B) and lifted the driving weight (G). When the winding-up is finished, the cylinder (E) is full of oil, which is imprisoned by the automatic closing of the valve from the reservoir (F). The oil is now under pressure, caused by the driving weight (G), and it can only get out of the cylinder (E) back to the reservoir, through a hole, the size of which is controlled by the regulating screw (H). If the binding screw (A) is now screwed fast, the telescope will turn on its polar axis at the rate allowed by the regulating screw (H).

An oil possessing a high flash point is suitable for this purpose, since the change in viscosity under different temperatures is then not much felt. A change in the viscosity causes the oil to pass through the valve at a correspondingly different rate. Hence it is necessary to adjust the valve to the local temperature, which is done by setting the regulating screw according to the positions representing degrees of temperature, which are marked round the top of the oil reservoir. The regulator runs for three hours before re-winding, the oil, of course, being used over and over again.

In a mechanism of this nature it is evident that the question of friction is of the first importance, and great care has been taken, first, to reduce the working friction to a minimum, and, secondly, to make the unavoidable friction as constant as possible. The polar axis is therefore fitted with three sets of ball bearings (two axial and one thrust); the guide pulleys are also fitted with ball bearings, and the plunger is ground truly parallel and very smooth.

The regulator is intended more especially for eclipse and visual work in general. There are slight errors of motion which have yet to be overcome, and they render it difficult to keep a star on the wire; but by an additional contrivance which has yet to be adapted the errors in question might be reduced sufficiently to render the device suitable for stellar photography.

SCRIVEN BOLTON.

The Observatory, Bramley, Yorkshire,
August 23.

On the "Wolf-note" of the Violin and 'Cello.

IN a letter to NATURE (June 29) on the wolf-note of the violin and 'cello which has recently come to our notice, Mr. Raman referred to a paper by one of us (G. W. W.) on the subject. We had anticipated being associated in a joint paper dealing more fully with the results when the war put an end to the work.

At the time when the preliminary results were published the cyclical variation in intensity of the wolf-note was provisionally attributed to the beating of the oscillations of the two tuned resonators, belly and string, "coupled" together by the bridge, and not to transitory beats, as perhaps justly inferred by Mr. Raman from the wording of the paper, it being assumed that the strong reaction of the belly on the string interfered with even bowing. But the later results we obtained could not be reconciled with such a view, and we were seeking an explanation on the lines of that now given by Mr. Raman.

Thus further records of the wolf-note showed very clearly indeed the prominence of the octave at the minima in the belly records. Also simultaneous records of belly and string vibrations led, in the case of one 'cello, to curves practically identical with those given by Mr. Raman, in which the maxima and minima of belly amplitude lag behind those of the string by a quarter of a cycle. With another 'cello of brilliant quality no appreciable lag appeared to exist, though perhaps better photographs would have shown some. Finally, the frequency in variation of intensity seemed to depend on the speed of the bow and not on the form of the bridge, which would affect the degree of coupling.

We take this opportunity of recording two other results obtained by us, which furnish still more evidence for the belief that the wolf-note is a phenomenon accompanying maximum resonance. They are worthy of record, because this interpretation of the effect is not that which is held generally by musicians and instrument-makers.

The first was obtained in some experiments on "the mute." With the two 'cellos with which observations were made, the effect of loading the bridge with the mute was a reduction in pitch of the wolf, by an amount depending on the form of the mute. Thus, with one heavy mute the pitch was lowered from G to D, and with a lighter mute from G to E. By blowing a cornet in front of the belly, it was found that the natural frequency of the belly was correspondingly lowered.

The second was obtained when vibrations of the belly were set up by plucking a string. The transitory beats present in the early stages of a forced oscillation were very clearly shown. The G string was plucked to give a note within a few semitones of the wolf-note. After six or seven beats the belly took up the sinusoidal vibration of the string, which persisted until the sound was no longer audible. Calculations of the natural period of the belly from the frequency of the beats led in each case to a period the same as that of the wolf-note and that given by the cornet.

A. M. TYNDALL.
G. W. WHITE.

University of Bristol, September 1.

BIRDS IN STUDIO AND ON THE HILLSIDE.[1]

(1) THE second volume of Mr. Thorburn's beautiful book includes the rest of the crows, the larks, the picarian birds, the diurnal birds of prey, the owls, cormorants, and some of the herons. Many of these are large birds, and it has not been possible to figure so many of them on one plate. Two species—the golden eagle and the eagle owl—have plates to themselves, and these are most beautiful pictures. Mr. Thorburn is very successful with owls, which must be most difficult birds to paint, and he is famous for his pictures of eagles. The golden eagle is drawn flying along a steep hillside and carrying a mountain hare. The author writes that when an eagle is flying "the curious notched pinion feathers may be clearly seen, separated like the fingers of a hand." This is well shown in the plate. The introduction of certain striking plants which grow in the haunts of various birds is continued with most pleasing effect. Thus the Egyptian nightjar lies on the sand beside that thick, fleshy-leaved plant with large pink, yellow-centred flowers familiar to visitors to North Africa. The common nightjar is figured flying and thus displaying the curious white spots on the underside of the wing. As this volume includes the eagles, hawks, and falcons—favourite studies of the artist—the plates are, if anything, more pleasing than those in the first volume.

The third volume includes the rest of the herons and the allied species, and the swans, geese, ducks, pigeons, game-birds, rails, and the great bustard. The grouping of the different species on the plates is very successful; thus the swans occupy one plate, the four "grey" geese another, and the pigeons a third, thus affording the best opportunity of comparing the small differences in the colouring of allied species. The frontispiece, which shows the striking attitudes assumed by the male great bustards in spring when courting, is a fine picture. The author's acquaintance with the Scotch Highlands and their birds has served him well when treating of the black grouse and the ptarmigan, the latter forming the subject of a fine plate, while the letterpress contains some interesting observations on this bird of the mountain and the mist.

(2) Under the title "Hill Birds of Scotland" we have a charming and most interesting account of twenty-four species of birds, and are rather at a loss to know why some of them should be so designated in particular. The author's personal experiences and field notes are most interesting. But there is also introduced into the text a large amount of matter derived from other sources, and apparently sometimes from hearsay. Some of this cannot be considered as trustworthy. There are statements (for which no authority is given)

FIG. 1.—Nest of the oyster-catcher. From "Hill Birds of Scotland."

[1] (1) "British Birds." Written and Illustrated by A. Thorburn. Vol. ii., pp. vi+72+plates 21-40. Vol. iii., pp. vi+87+plates 41-60. (London: Longmans, Green and Co., 1915.) Price 1*l*. 11*s*. 6*d*. net each volume.
(2) "Hill Birds of Scotland." By Seton Gordon. Pp. xii+300. (London: Edward Arnold, 1915.) Price 12*s*. 6*d*. net.

which are hard to accept and must surely have been founded on hearsay evidence, and perhaps too readily believed. We are told that when the blaeberries have ripened, the woodcocks betake themselves to the hillsides and consume great quantities of the fruit! With regard to the statement that "deer, calves, and lambs" are taken by eagles, we wonder whether this may be a slip for "deer-calves and lambs," which sounds much more likely to be true. The book might have been smaller with advantage had it been confined to the relation of the author's most valuable observations. But a considerable amount of space is occupied with descriptions of the plumage of the birds treated of, and accounts of their distribution within and outside the British islands. Both these subjects seem to us to be beyond the province of the book. The descriptions seem to be unnecessary, and in some cases inadequate, while of the accounts of distribution it must be said that they are open to criticism. For instance, we are told that "there is no bird which has so wide a range as the golden eagle—in fact, it is met with almost throughout the world."

FIG. 2.—Dotterel going to the nest. From "Hill Birds of Scotland."

One of the pleasantest chapters in the book is that on the snow bunting. A curious incident is related showing the undoubted love of coolness which drives this arctic bird to the high Scotch mountains. One very hot day a bird which usually frequented a scree was found on a dwindling snowfield seeking relief from the heat. At times he would seek to cool himself by running over the snow with his head half-buried beneath the surface, and throwing up a furrow as from a diminutive snow-plough.

The oyster-catcher (a name which we read at first with surprise among hill-birds) appears to be only a winter visitor to the eastern seaboard of Scotland—or such parts of it as the author is familiar with—and to retire to the hills to breed. Early in March oyster-catchers leave the river estuaries and make their way in pairs up the rivers—the Don and Spey, for instance. Near the source of the Spey the bird reaches, and is numerous on, a flat 1500 ft. above sea-level. We regret to read that the white-tailed eagle has decreased enormously during the last thirty years, and that there are now only two pairs of them breeding in Britain. The extermination seems to have been effected mainly by sheep farmers and shepherds, their hatred of the bird sometimes prompting them to acts of unnecessary and cold-blooded cruelty.

There are some things in the book which might well be altered in a second edition. The author thinks that in our language there is no distinctive name for the peculiar evening flight of the woodcock, and treats "Rôding" as only a Scandinavian one. But "road" is surely English, and the well-known tracks through covers pursued by woodcocks have long been called 'cock-roads. It is scarcely correct to say that prior to the nineteenth century no case of the woodcock nesting in Britain was recorded. Willughby (1678) mentions that they bred sometimes in England. White (1789) records nests, and Pennant (1776), Walcot (1789), and Lewin (1797) all record woodcocks breeding with us.

There is in the opinion of west-country ornithologists no ground for believing that the dotterel ever bred on the Mendip Hills. And the observation that this bird "is the only representative of the widely distributed and extensive group [of waders] to restrict her clutch always to three hostages to fortune" shows a want of knowledge of these birds. For, not to mention some others, the normal clutch laid by the Kentish plover consists of three eggs only.

There are between thirty and forty illustrations, the most pleasing of which show the wild scenery affected by the birds treated of. Others show the nests or young of birds, and we notice occasionally the want of consideration for the feelings and interests of both sitting and young birds, which is sometimes regrettable, on the part of enthusiastic bird-photographers.

The publishers allow us to reproduce a beautiful picture of the haunts of those oyster-catchers which go far inland and high up to breed—the hills in the background with a fresh coat of snow, and the bulky collection of dead heather stems brought together by this erratic bird when (as it does sometimes) it constructs a nest in the true sense of the term; also a photograph of a dotterel going to her nest.

SCIENTIFIC METHOD IN BREWING PRACTICE.

IN his address to the Institute of Brewing, of which an abstract was published in NATURE of July 6, Dr. Horace Brown has given a very fascinating account of the gradual introduction of scientific method into the brewery, and his reminiscences, which extend over rather more than half a century, enable us to appreciate very thoroughly the progress that has been made in this respect.

So familiar has the idea of the existence of bacteria become to the mind that some effort is required to realise the state of things fifty years ago, when brewing was carried on in total ignorance of the very existence of these ubiquitous organisms. At that comparatively recent date even the facts that yeast was a living organism and that fermentation was correlated with its growth and activity had only just been finally and definitely proved by Pasteur and were by no means universally accepted.

The recognition of these facts has placed in the hands of the brewer the means of instituting a rigorous system of control, which must be regarded as one of the most important applications of scientific method to the art of brewing. It is now recognised that infection by "disease" organisms is the cause of many of the troubles which beset the brewer, and, further, that these infecting organisms may either be bacteria or "wild" yeasts.

As in medicine, so in brewing, prevention is better than cure, and the brewer's first line of defence is the avoidance of infection from external agencies, such as dust, unsterilised casks, bottles, etc. This application of the elementary principles of bacteriology, simple as it may appear, has worked nothing less than a revolution in brewing practice, for we read that in 1865 the breweries in Burton were habitually shut down during the summer months owing to difficulties which we now know were due to infection. Another weapon in the hands of the scientific brewer is the system of "forcing"—incubating a sample of the beer for several days—whereby early information is obtained as to the stability of the beer and the presence or absence of dangerous infection. Even if infection has occurred and the dreaded *Saccharobacillus pastorianus,* which sours the beer by producing lactic acid from sugar, has increased to a dangerous extent, the yeast can be freed from it by subculture in the solution containing 0·1 per cent. of tartaric acid, which was originally proposed by Pasteur for this purpose. This purified yeast can then be used with perfect safety for pitching purposes. The statement made by Hansen that this treatment encouraged the growth of wild yeasts to a dangerous extent has not been realised in British practice.

The hops used in the production of beer provide a natural protection against bacteria, but not against "wild" yeasts, and it is to the undesired intrusion of these widely spread organisms that many faults of flavour and clarification are due. These wild yeasts grow chiefly on fruits, passing the winter and spring, as shown by Hansen, in the soil, and are therefore very abundant in dust during the late summer and autumn. They pass into the wort or beer in precisely the same manner as bacteria, but there find a friendly instead of an antagonistic medium, and they withstand the acid treatment which is fatal to bacteria. In the presence of a healthy culture yeast the wild yeasts only develop very slowly, but in their absence—as, for example, when the beer becomes infected after racking—they may increase rapidly and cause serious trouble. The explanation of this inhibitive action of the culture yeast on the growth of the wild yeast is due to Dr. Horace Brown, who found that the growth of all yeasts is conditioned by the amount of oxygen which is taken up by the cells before fermentation commences. This is shared between the large amount of culture yeast and the small infection, and, since the quantity of yeast present only increases some five-fold during a large-scale fermentation, no great increase in the infecting organism is possible. If, however, infection occurs after racking, when only a small proportion of primary yeast is left, and if, at the same time, air, as is usually the case, obtains access to the beer, all the conditions for a well-developed yeast trouble are at hand. To be forewarned is to be forearmed, and, the conditions which conduce to contamination having been ascertained, the brewer is in a position to avoid these as completely as possible.

A further refinement, chiefly valuable when applied in addition to the most scrupulous "bacteriological" cleanliness throughout the brewery, is the use of air which has been freed from organisms by filtration. The wort, after having been boiled, is cooled and aerated. During these processes, before the addition of the yeast, there is a manifest danger of infection by air organisms, which is largely avoided by the use at this stage of filtered air. As already pointed out, however, the main source of danger in actual practice is the infection of the beer after the primary fermentation has been completed.

One of the chief triumphs claimed for the application of scientific method to brewing is the production and use of pure yeast cultures, by which, it is maintained, greater constancy of result is obtainable. Following the principles laid down by Hansen, such cultures are derived from a single cell which is isolated under the microscope, and serves as the origin of the whole of the yeast employed. This system is largely used abroad, but has not been adopted to any great extent in this country, partly owing, no doubt, to the national inertia, but partly to the different conditions prevailing in the top-yeast breweries. This system undoubtedly keeps the pitching yeast free from contamination, but is, of course, in itself no protection against the subsequent infection by wild yeasts or bacteria, which, as we have seen, is the most frequent cause of trouble. It is, moreover, doubtful, as pointed out by Dr. Brown, whether a single-cell culture can be expected invariably to reproduce all the qualities of a stock yeast, which represent the statistical average of the properties of an immense number of cells, all differing slightly from each other.

From quite a different side the investigations of the past half-century on the action of diastase on starch, both in the barley grain and in the mash-tun—investigations in which Dr. Brown himself has taken a leading part—have also largely contributed to the scientific control of the brewery. The mechanism of the processes of malting and mashing has been to some extent revealed, and it is now possible, when necessary, intelligently to adapt the procedure to the special requirements of any particular case.

Throughout the address Dr. Brown pursues the thesis that modern surgery and preventive medicine are the children of the fermentation industries, the great development of these in recent years being primarily due to the ideas gained by Pasteur from his study of wine and beer. The argument is ably supported by an historical account of Pasteur's researches and of the gradual development of those conceptions which, partly owing to his own work and partly to that of others, led to our present views. The science of bacteriology is, however, not alone in having benefited so largely from researches on fermentation. Many other branches of science have indirectly been furthered by the study of phenomena first observed in the investigation of brewing problems. So widely, indeed, has the inspiration derived from the scientific study of brewing been diffused that the author, with pardonable enthusiasm, sums the situation in the aphorism, "Omnis Scientia ex Cerevisiâ."

THE BRITISH ASSOCIATION AT NEWCASTLE.

THE holiday which was suddenly granted throughout the north-eastern district had a greater adverse effect than was anticipated on the attendance at the Newcastle-on-Tyne meeting of the British Association. Many who in normal times would most certainly have enrolled were far away from Newcastle enjoying a well-earned rest from their labours in connection with the manufacture of the munitions of war.

The actual total attendance was 826, so that the meeting was even a smaller one than was expected. But the only person connected with the Association who has shown any sign of disappointment is the general treasurer. He, naturally, is primarily concerned with financial matters of the Association, and a small meeting means a correspondingly small and inadequate amount available as grants towards the expenses of research committees. The rest, from the President to the members who joined recently, speak in terms of appreciation and satisfaction of both the arrangements made for them by the local committee and the work done by the sections. Locally it is generally admitted that the results obtained justified the Council of the British Association in holding a meeting this year, and the members are of the opinion that, taking into account the circumstances in which the nation stands at present, the meeting was very successful. One fact which is both interesting and significant is that, while the total number of members present was far below that of normal years, the attendance at the meetings of the Sections in Newcastle was quite up to the average. In other words, nearly everyone who attended the Newcastle meeting was a real worker and interested in the chief object for which the British Association was founded, viz., the advancement of science.

One of the outstanding features of the meeting, from the local point of view especially, was the election of the Hon. Sir Charles A. Parsons to the Presidency of the Association for the meeting next year. His name is a household word on the north-east coast, and any honour done him is genuinely appreciated by the residents, more especially the engineers and shipbuilders. Nor can we help mentioning an incident that happened on the last day of the meeting. It was small in itself, but it was kindly and gracious, and it helped to sow the seed from which will spring a still heartier welcome to the British Association than it has previously received in Newcastle, if that were possible. Owing to the scarcity of adult labour a troop of Boy Scouts was employed to act as messengers between the reception room and the Section rooms. These lads did their work admirably; they carried out their instructions to the letter, and earned the praise of the local committee as well as of the general officers. On the closing morning of the meeting those who happened to be in the vicinity of the reception room fairly early were glad to hear Prof. H. H. Turner thank the boys for their services and explain the objects and work of the British Association in a manner that helped them not only to go away feeling that they had rendered good service, but also with an ambition to become members in time to come.

The proceedings of all the sections were well up to the usual standard, both as regards interest and value. Among the subjects of important discussions were the investigation of the chemical and geological characters of different varieties of coal, with a view to their most effective utilisation as fuel, and to the extraction of by-products; science in education and industry; the effects of the war upon credit, currency, and finance; national aspects of fuel economy; the development of fisheries; political frontiers; and afforestation. Some of the main points brought out in these discussions will be described in later issues.

The General Committee adopted a recommendation of the Council that research committees should have power to report through organising committees of Sections to the Council at any time when the Association is not in annual session. Hitherto research committees have had to await the annual meeting before presenting their reports, even when their conclusions call for early action. Under the new rules this will no longer be necessary if the organising committee to which a research committee presents its report considers it desirable to report direct to the Council. Another alteration of the rules of the Association makes it possible for the Council to include upon research committees persons who are not members of the Association, but "whose assistance may be regarded as of special importance to the research undertaken."

The general treasurer has reported to the Council that Mr. M. Deshumbert proposed to leave a legacy of about 5000*l.* to the Association, subject to the condition that his wife and her sister should receive the interest during their lifetime.

The new members of Council elected by the General Committee are Mr. R. A. Gregory, Dr. S. F. Harmer, Dr. E. J. Russell, Dr. A. Strahan, and Prof. W. R. Scott. An invitation to meet in Cardiff in 1918 was unanimously and gratefully accepted by the Committee.

The total grants of money appropriated by the General Committee for purposes of research committees proposed by the various sections amounted to 602*l.* The subjects and grants are as follows:—

Section A.—Seismological observations, 100*l.*; annual tables of constants, 40*l.*; mathematical tables, 20*l.*; gravity at sea, 10*l.*

Section B.—Dynamic isomerism, 15*l.*; Eucalypts, 30*l.*; absorption spectra, etc., of organic compounds, 10*l.*

Section C.—Red Sandstone rocks of Kiltorcan, 4*l.*; Palæozoic rocks, 20*l.*

Section D.—Biology of the Abrolhos Islands, 6*l.*; inheritance in silkworms, 20*l.*

Section F.—Fatigue from an economic point of view, 40*l.*; replacement of men by women in industry, 20*l.*; effects of war on credit, etc., 10*l.*

Section G.—Stress distributions, 40*l.*

Section H.—Artificial islands in the lochs of the Highlands of Scotland, 5*l.*; physical characters of ancient Egyptians, 2*l.* 12*s.* (unexpended balance); Palæolithic site in Jersey, 30*l.*; excavations in Malta, 20*l.*; distribution of Bronze age implements, 1*l.* 14*s.* (unexpended balance).

Section I.—Ductless glands, 15*l.*; psychological war research, 10*l.*

Section K.—Physiology of heredity, 45*l.*; ecology of fungi, 8*l.*

Section L.—School books and eyesight, 5*l.*; work of museums in education and research, 15*l.*; effects of "free-place" system upon education, 15*l.*; science teaching in secondary schools, 10*l.*; mental and physical factors involved in education, 10*l.*

Corresponding Societies' Committee.—For preparation of report, 25*l.*

SECTION B.

CHEMISTRY.

OPENING ADDRESS (ABRIDGED) BY PROF. G. G. HENDERSON, D.Sc., LL.D., F.R.S., PRESIDENT OF THE SECTION.

THE period which has elapsed since the last meeting of the section in Newcastle has witnessed truly remarkable progress in every branch of pure and applied chemistry. For fully fifty years previous to that meeting the attention of the great majority of chemists had been devoted to organic chemistry, but since 1885, or thereabouts, whilst the study of the compounds of carbon has been pursued with unflagging energy and success, it has no longer so largely monopolised the activities of investigators. Interest in the other elements, which had been to some extent neglected on account of the fascinations of carbon, has been revived with the happiest results, for not only has our knowledge of these elements been greatly extended, but their number also has been notably increased by the discovery of two groups of simple substances possessed of new and remarkable properties—the inert gases of the argon family and the radio-active elements. In addition, the bonds between mathematics and physics on one hand and chemistry on the other have been drawn closer, with the effect that the department of our science known as physical chemistry has now assumed a position of first-rate importance. With the additional light provided by the development and application of physico-chemical theory and methods, we are beginning to gain some insight into such intricate problems as the relation between physical properties and chemical constitution, the structure of molecules and even of atoms, and the mechanics of chemical change; our outlook is being widened, and our conceptions rendered more precise. Striking advances have also been made in other directions. The extremely difficult problems which confront the biochemist are being gradually overcome, thanks to the indefatigable labours of a band of highly skilled observers, and the department of biological chemistry has been established on a firm footing through the encouraging results obtained within the period under review. Further, within the last few years many of our ideas have been subjected to a revolutionary change through the study of the radio-active elements.

The more purely scientific side of our science can claim no monopoly in progress, for applied chemistry, in every department, has likewise advanced with giant strides, mainly, of course, through the application of the results of scientific research to industrial purposes. Many of the more striking results in the field of modern chemical industry have been obtained by taking advantage of the powers we now possess to carry out operations economically both at very high and at very low temperatures, and by the employment on the manufacturing scale of electrolytic and catalytic methods of production. Thanks largely to the invention of the dynamo, the technologist is now able to utilise electrical energy both for the production of high temperatures in the different types of electric furnace and for electrolytic processes of the most varied description. Among the operations carried out with the help of the electric furnace may be mentioned the manufacture of graphite, silicon, and phosphorus; of chromium and other metals; of carbides, silicides, and nitrides; and the smelting and refining of iron and steel. Calcium carbide claims a prominent place in the list, in the first place because of the ease with which it yields acetylene, which is not only used as an illuminant, and, in the oxy-acetylene burner, as a means of producing a temperature so high that the cutting and welding of steel is now a comparatively simple matter, but also promises to serve as the starting-point for the industrial synthesis of acetaldehyde and many other valuable organic compounds. Moreover, calcium carbide is readily converted in the electric furnace into calcium cyanamide, which is employed as an efficient fertiliser in place of sodium nitrate or ammonium sulphate, and as a source of ammonia and of alkali cyanides. Among the silicides carborundum is increasingly used as an abrasive and a refractory material, and calcium silicide, which is now a commercial product, forms a constituent of some blasting explosives. The Serpek process for the preparation of alumina and ammonia, by the formation of aluminium nitride from bauxite in the electric furnace, and its subsequent decomposition by caustic soda, should also be mentioned. Further, the electric furnace has made possible the manufacture of silica apparatus of all kinds, both for the laboratory and the works, and of alundum ware, also used for operations at high temperature. Finally, the first step in the manufacture of nitric acid and of nitrites from air, now in operation on a very large scale, is the combustion of nitrogen in the electric arc.

In other industrial operations the high temperature which is necessary is obtained by the help of the oxy-hydrogen or the oxy-acetylene flame, the former being used, amongst other purposes, in a small but, I believe, profitable industry, the manufacture of synthetic rubies, sapphires, and spinels. Also, with a comparatively recent period, advantage has been taken of the characteristic properties of aluminium, now obtainable at a moderate price, in the various operations classed under the heading alumino-thermy, the most important being the reduction of refractory metallic oxides, although, of course, thermite is useful for the production of high temperatures locally.

The modern methods of liquefying gases, which have been developed within the period under review, have rendered possible research work of absorbing interest on the effect of very low temperatures on the properties and chemical activity of many substances, and have been applied, for instance, in separating from one another the members of the argon family, and in obtaining ozone in a state of practical purity. Moreover, industrial applications of these methods are not lacking, amongst which I may mention the separation of nitrogen and oxygen from air, and of hydrogen from water-gas—processes which have helped to make these elements available for economic use on the large scale.

Electrolytic methods are now extensively employed in the manufacture of both inorganic and organic substances, and older processes are being displaced by these modern rivals in steadily increasing number. It is sufficient to refer to the preparation of sodium, magnesium, calcium, and aluminium, by electrolysis of fused compounds of these metals; the refining of iron, copper, silver, and gold; the extraction of gold and nickel from solution; the recovery of tin from waste tin-plate; the preparation of caustic alkalis (and simultaneously of chlorine), of hypochlorites, chlorates, and perchlorates, of hydrosulphites, of permanganates and ferricyanides, of persulphates and percarbonates; the regeneration of chromic acid from chromium salts; the preparation of hydrogen and oxygen. As regards organic compounds, we find chiefly in use electrolytic methods of reduction, which are specially effective in the case of many nitro-compounds, and of oxidation, as, for instance, the conversion of anthracene into anthraquinone. At the same time a number of other compounds, for example, iodoform, are also prepared electrolytically.

Within recent years there have been great advances in the application of catalytic methods to industrial purposes. Some processes of this class have, of course, been in use for a considerable time, for example, the Deacon chlorine process and the contact method for the manufacture of sulphuric acid, whilst the preparation of phthalic anhydride (largely used in the synthesis of indigo and other dyestuffs), by the oxidation of naphthalene with sulphuric acid with the assistance of mercuric sulphate as catalyst, is no novelty. More recent are the contact methods of obtaining ammonia by the direct combination of nitrogen and hydrogen, and of oxidising ammonia to nitric acid—both of which are said to be in operation on a very large scale in Germany. The catalytic action of metals, particularly nickel and copper, is utilised in processes of hydrogenation—for example, the hardening of fats, and of dehydrogenation, as in the preparation of acetaldehyde from alcohol, and such metallic oxides as alumina and thoria can be used for processes of dehydration—*e.g.* the preparation of ethylene or of ether from alcohol. Other catalysts employed in industrial processes are titanous chloride in electrolytic reductions and cerous sulphate in electrolytic oxidations of carbon compounds, gelatine in the preparation of hydrazine from ammonia, sodium in the synthesis of rubber, etc.

Other advances in manufacturing chemistry include the preparation of a number of the rarer elements and their compounds, which were scarcely known thirty years ago, but which now find commercial applications. Included in this category are titanium, vanadium, tungsten, and tantalum, now used in metallurgy or for electric lamp filaments; thoria and ceria in the form of mantles for incandescent lamps; pyrophoric alloys of cerium and other metals; zirconia, which appears to be a most valuable refractory material; and compounds of radium and of mesothorium, for medical use as well as for research. Hydrogen, together with oxygen and nitrogen, are in demand for synthetic purposes, and the first also for lighter-than-air craft. Ozone is considerably used for sterilising water and as an oxidising agent; for example, in the preparation of vanillin from *iso*eugenol, and hydrogen peroxide, now obtainable very pure in concentrated solution, and the peroxides of a number of the metals are also utilised in many different ways. The per-acids—perboric, percarbonic, and persulphuric—or their salts are employed for oxidising and bleaching purposes, and sodium hydrosulphite is much in demand as a reducing agent —*e.g.* in dyeing with indigo. Hydroxylamine and hydrazine are used in considerable quantity, and the manufacture of cyanides by one or other of the modern methods has become quite an important industry, mainly owing to the use of the alkali salts in the cyanide process of gold extraction. Those remarkable compounds, the metallic carbonyls, have been investigated, and nickel carbonyl is employed on the commercial scale in the extraction of the metal. Fine chemicals for analysis and research are now supplied, as a matter of course, in a state of purity rarely attained a quarter of a century ago.

In the organic chemical industry similar continued progress is to be noted. Accessions are constantly being made to the already enormous list of synthetic dyes, not only by the addition of new members to existing groups, but also by the discovery of entirely new classes of tinctorial compounds; natural indigo seems doomed to share the fate of alizarine from madder, and to be ousted by synthetic indigo, of which, moreover, a number of useful derivatives are also made. Synthetic drugs of all kinds—antipyrine and phenacetin, sulphonal and veronal, novacain and β-eucaine, salol and aspirin, piperazine and adrenaline, atoxyl and salvarsan—are produced in large quantities, as also are many synthetic perfumes and flavouring materials, such as ionone, heliotropine, and vanillin. Cellulose in the form of artificial silk is much used as a new textile material, synthetic camphor is on the market, synthetic rubber is said to be produced in considerable quantity; and the manufacture of materials for photographic work and of organic compounds for research purposes is no small part of the industry.

British chemists are entitled to regard with satisfaction the part which they have taken in the development of scientific chemistry during the last three decades, as in the past, but with respect to the progress of industrial chemistry it must be regretfully admitted that, except in isolated cases, we have failed to keep pace with our competitors. A number of different causes have contributed to bring about this state of affairs, and the responsibility for it is assigned by some to the Government, by others to the chemical manufacturers, and by still others to the professors of chemistry. I think, however, it will be generally admitted that the root of the matter is to be found in the general ignorance of and indifference to, the methods and results of scientific work which characterise the people of this country.

The Government has taken a most significant step in advance by appointing an Advisory Council for Scientific and Industrial Research, and providing it with funds; incidentally, in so doing, it has recognised the past failure of the State to afford adequate support to scientific work.

It is safe to prophesy that the money expended by the Advisory Council will sooner or later yield a goodly return, and this justifies the hope that the Government will not rest satisfied with their achievement, but will take further steps in the same direction. This desire for continued action finds strong support in the recommendations made by a Sub-Committee of the Advisory Committee to the Board of Trade on Commercial Intelligence, which was appointed to report with respect to measures for securing the position, after the war, of certain branches of British industry. Of these recommendations I quote the following:—

"*Scientific Industrial Research and Training.* (*a*) Larger funds should be placed at the disposal of the new Committee of the Privy Council, and also of the Board of Education, for the promotion of scientific and industrial training. (*b*) The universities should be encouraged to maintain and extend research work devoted to the main industry or industries located in their respective districts, and manufacturers engaged in these industries should be encouraged to co-operate with the universities in such work, either through their existing trade associations or through associations specially formed for the purpose. Such associations should bring to the knowledge of the universities the difficulties and needs of the industries, and give financial and other assistance in addition to that afforded by the State. In the case of non-localised industries trade associations should be advised to seek, in respect of centres for research, the guidance of the Advisory Committee of the Privy Council. (*c*) An authoritative record of consultant men of science, chemists, and engineers, and of persons engaged in industrial research, should be established and maintained by some suitable Government Department for the use of manufacturers only."

The admirable scheme of the Australian Government is more comprehensive and more generous than that of our Government, but it could be rivalled without much difficulty. We already possess an important asset in the National Physical Laboratory, and there now exists the Advisory Council with its extensive powers and duties. What is lacking in our scheme, so far as chemistry is concerned, could be made good, first, by providing the Advisory Council with much larger funds, and secondly, by the establishment of a National Chemical Laboratory—an institute for research in pure and applied chemistry—or by assisting the development of research departments in our universities and technical colleges (as is now being done in America), or, better still, by moving in both directions. With respect to the second alternative, I do not mean to suggest that research work is neglected in the chemistry departments of any of our higher institutions; what I plead for is the provision of greater facilities for the prosecution of investigation not only in pure but also in applied chemistry. As things are at present, the professors and lecturers are for the most part so much occupied in teaching and in administration as to be unable to devote time uninterruptedly to research work, which demands above all things continuity of effort. The ideal remedy would be the institution of research professorships, but, failing this, the burden of teaching and administrative work should be lightened by appointing larger staffs.

Unless the conditions and methods which have ruled in the past are greatly altered it is scarcely possible to hope that the future prospects of our chemical industry will be bright; it is essential that the representatives of the industry should organise themselves in their own interest and co-operate in fighting the common enemy. More than ever is this the case when, as we are informed, three different groups of German producers of dyes, drugs, and fine chemicals, who own seven large factories, have formed a combination with a capital of more than 11,000,000*l.*, and with other assets of very great value in the shape of scientific, technical, and financial efficiency. Hence it is eminently satisfactory to be able to record the active progress of a movement, originated by the Chemical Society, which has culminated in the formation of an Association of British Chemical Manufacturers.

Needless to say, the progress of this important movement will be assisted by everyone who is interested, either directly or indirectly, in the welfare of our chemical industry, and, moreover, the support of the scientific societies will not be lacking.

In an address given to the Society of Chemical Industry last year, I indicated another way in which chemical manufacturers can help themselves and at the same time promote the interests of chemistry in this country. In the United States of America individual manufacturers, or associations of manufacturers, have shown themselves ready to take up the scheme originated by the late Prof. Duncan for the institution of industrial research scholarships tenable at the universities or technical colleges, and the results obtained after ten years' experience of the working of this practical method of promoting co-operation between science and industry have more than justified the anticipations of its originator. The scheme is worthy of adoption on many grounds, of which the chief are that it provides definite subjects for technical research to young chemists qualified for such work, that it usually leads to positions in factories for chemists who have proved their capacity through the work done while holding scholarships, and that it reacts for good on the profession generally, by bringing about that more intimate intercourse between teachers and manufacturers which is so much to be desired.

It cannot be too often reiterated that no branch of chemical industry can afford to stand still, for there is no finality in manufacturing processes; all are capable of improvement, and for this, as well as for the discovery and the application of new processes, the services of the trained chemist are essential. Hence the training of chemists for industrial work is a matter of supreme importance. We may therefore congratulate ourselves that the opportunities for chemical instruction in this country are immensely greater than they were thirty years ago. The claims of chemistry to a leading position have been recognised by all our universities, even the most ancient, by the provision of teaching staffs, laboratories, and equipment on a fairly adequate if not a lavish scale, and in this respect many of the technical colleges fall not far behind. The evening classes conducted in a large number of technical institutions are scarcely fitted to produce fully trained chemists, if only because lack of the necessary time prevents the student from obtaining that prolonged practice in the laboratory which cannot be dispensed with, unless indeed he is prepared to go through a course of study extending over many years. At the same time these evening classes play a most important part, first, in disseminating a knowledge of chemistry throughout the country, and, secondly, in affording instruction of a high order in special branches of applied chemistry. Finally, in a large and increasing number of schools a more or less satisfactory introduction to the science is given by well-qualified teachers. With our national habit of self-depreciation we are apt to overlook the steady progress which has been made, but at the same time I do not suggest that there is no room for improvement of our system of training chemists. Progress in every department of industrial chemistry is ultimately dependent upon research, and therefore a sufficient supply of chemists with practical knowledge and experience of the methods of research is vital. This being so, it is an unfortunate thing that so many students are allowed to leave the universities in possession of a science degree but without any experience in investigation. The training of the chemist, so far as that training can be given in a teaching institution, must be regarded as incomplete unless it includes some research work, not, of course, because every student has the mental gifts which characterise the born investigator, but rather because of the inestimable value of the experience gained when he has to leave the beaten track and to place more dependence upon his own initiative and resource. Perhaps it is too much to expect that practice in research will be made an indispensable qualification for the ordinary degree; failing this, and indeed in every case, promising students should be encouraged, by the award of research scholarships, to continue their studies for a period of at least two years after taking the B.Sc. degree, and to devote that time to research work which would qualify for a higher degree.

On more than one occasion I have expressed the opinion that every chemist who looks forward to an industrial post should receive in the course of his training a certain amount of instruction in chemical engineering, by means of lectures and also of practical work in laboratories fitted out for the purpose. The practicability of this has been proved in more than one teaching institution, and experience has convinced me that chemists who have had such a course are generally more valuable in a works—whether their ultimate destination is the industrial research laboratory or the control of manufacturing operations—than those who have not had their studies directed beyond the traditional boundaries of pure chemistry. A course in chemical engineering, preferably preceded by a short course in general engineering and drawing, must, however, be introduced as *a supplement to*, and not as *a substitute for*, any part of the necessary work in pure chemistry, and consequently the period of undergraduate study will be lengthened if such a course is included; this is no disadvantage, but quite the contrary. I am glad to say that the University of Glasgow has recently instituted a degree in applied chemistry, for which the curriculum includes chemical engineering in addition to the usual courses in chemistry, and I hope that a place will be found for this subject by other universities.

NOTES.

THE King in Council has appointed Mr. Arthur Henderson, M.P., a member of the Committee of the Privy Council for the organisation and development of scientific and industrial research. The other non-official members of the Committee are Lord Haldane, the Right Hon. A. H. D. Acland, and the Right Hon. J. A. Pease, M.P. Mr. Henderson was the President of the Board of Education when the Government's research scheme was published in July of last year. As such he was a member of the Committee, which includes also, as official members, the Lord President of the Privy Council, the Chancellor of the Exchequer, the Secretary for Scotland, the President of the Board of Trade, and the Chief Secretary for Ireland.

BY permission of the president and council of the Royal Academy an Exhibition of Arts and Crafts is to be held in the galleries of the Royal Academy from October 2 until the end of November next. The exhibition is being arranged by the Arts and Crafts Exhibition Society.

WE are informed that the Secretary of State for India has sanctioned the creation of a post of Director of Fisheries, Bengal, Bihar, and Orissa, and has further sanctioned the permanent appointment of the present Deputy Director of Fisheries (Mr. T. Southwell) to the post. A new Deputy Director will be appointed after the war.

THE death is announced, at sixty-eight years of age, of Sir James Sivewright, K.C.M.G., general manager of the South African Telegraphs, 1877–85, and Commissioner of Crown Lands and Public Works, Cape Colony, 1890–92, when he promoted considerable developments of the railway and telegraphic systems.

OXFORD has lately become poorer by the loss of two of her best-known sons, each in his own way distinguished as well outside the University as within it. During a long residence in Oxford Mr. R. W. Doyne, formerly Margaret Ogilvie reader in ophthalmology, whose career and work were referred to last week (p. 18), had won the respect and affection of colleagues and pupils alike. Dr. Edward Moore, as a young man, had one of the most distinguished academic careers on record. The chief efforts of his mature life were directed towards the welfare and independence of St. Edmund Hall, one of the most interesting of the ancient institutions of Oxford. Consistently conservative in his attitude towards academic questions, there was yet no trace of bigotry or bitterness in his opposition to changes which he thought ill-considered or dangerous. His death at the age of eighty-one removes one whose personal qualities endeared him to an unusually wide circle.

BY the death, on August 28, of Mr. George Coffey, Ireland has lost her foremost student of prehistoric archæology. The Neolithic and Bronze periods are represented in Ireland by a very fine series of monument, weapons, and other remains, and Mr. Coffey made these his special study, applying to them, almost for the first time, the knowledge gained by his French and Scandinavian colleagues from the important series of remains which have been brought to light during recent years in western Europe. He devoted special attention to the history of primitive art in Ireland, and by tracing the development of ornament and applying it to the monuments and other early remains of that country, he did much to establish the sequence of Irish prehistoric history. More recent periods also claimed his attention, and in his "Guide to the Celtic Antiquities of the Christian Period" preserved in the Royal Irish Academy collection in the Dublin National Museum (where for many years he was keeper of the Irish antiquities), he gave a scholarly account of the beautiful work of early historic times in Ireland.

THE death of Dr. C. T. Clough, of H.M. Geological Survey, by an accident on the railway near Bo'ness, has brought to a close a career of remarkable devotion to geological work. On Wednesday, August 23, Dr. Clough was examining rock exposures in the Bo'ness coalfield, and had occasion to cross the railway. He failed to clear an approaching train and was run over. Receiving immediate attention from the railway staff, he was sent by special train to Edinburgh, where an operation was performed. For a time he seemed to recover strength, but early on Sunday, August 27, he died in Edinburgh Infirmary. Dr. Clough was educated at Rugby and St. John's College, Cambridge, and joined the Geological Survey about forty years ago. His first work was done in the north of England; he was afterwards transferred to Scotland, and at the time of his death was senior District Geologist on the Scottish branch of the Geological Survey. Field work in difficult country had an especial attraction for him, and the minuteness and accuracy of his mapping on the six-inch scale were really astonishing. For many years most of his time was spent in the Highlands, in Cowal, the Loch Maree district, western Sutherlandshire, Glenelg, Strathcarron, and Glen Etive. He also surveyed Soay and part of Skye, and for the last ten years he had been in charge of the survey's work in Mull. Since 1901 Dr. Clough spent part of each year in the revision of the maps of the Scottish coalfields, and at first in the Lothian coalfield, later in the Wishaw, Holytown, and Bo'ness coalfields, he produced maps of unrivalled detail and completeness. Of late years he was in charge of the revision of the North Ayrshire field, and himself mapped the Kilmarnock district. A man of singular gentleness, patience, and modesty, Dr. Clough was beloved by all with whom he came in contact. Most of his contributions to geology have been published in survey memoirs. The Geological Society in 1906 awarded him the Murchison medal. In July of the present year the University of St. Andrews conferred on him the honorary degree of LL.D. He was a past-president of the Edinburgh Geological Society.

MANY readers of NATURE will have read with regret of the death, at the age of 62, of Mr. F. W. Frankland on July 23, at New York. Mr. Frankland was the eldest son of the late Sir Edward Frankland, K.C.B., F.R.S.; his brilliant career as a student at University College, London, was cut short by a breakdown in health in consequence of which he was recommended to proceed to New Zealand in 1875. On recovery he turned his great mathematical talents to account by entering the newly created Government Insurance Department of that colony, ultimately becoming Government Insurance Commissioner and Government Actuary and Statist and Registrar of Friendly Societies of New Zealand. He represented New Zealand as statistical delegate at the International Congress of Hygiene and Demography held in London in 1891. At University College, Frankland was one of the late Prof. W. K. Clifford's most distinguished students, and enjoyed a close intellectual intimacy both with him and with Herbert Spencer, and although the academic career for which he was so eminently fitted had been rendered impossible by his ill-health, he continued throughout life zealously to pursue his mathematical and philosophical studies and speculations. Already as a student in 1870 he had, independently of Clifford, arrived at that theory, or doctrine, of existence known as "mind-stuff," a paper on which he communicated to the Wellington (N.Z.) Philosophical Society in 1879; another paper, entitled "On the Metaphysic of Space," was communicated to the now defunct Philosophical Society of London, of which he became a member in 1885. He later evolved a theory of time in which he contended that time, like all else, has existence only in minds, and that the time-process is the dialectical concatenation of a series of "atomic *nows*" in the universe of awareness. In his mathematical speculations he was more especially drawn into the transcendental geometry of Lobatchewsky and Riemann, and in this domain he contributed papers "On the Simplest Continuous Manifoldness of Two Dimensions and of Finite Extent" to the London Mathematical Society (vol. viii., No. 107), and on the "Theory of Discrete Manifolds" to the American Mathematical Society in 1897. Always alive to the possibility of the scientific expansion and improvement in life insurance methods, Frankland originated and introduced in New Zealand the regulation that in the registration of the deaths of males the particulars of the family left should also be recorded, and the data so obtained have been found of great value by actuaries at home and elsewhere. His original views on a great variety of subjects are briefly outlined in "Thoughts on Ultimate Problems," published by David Nutt.

WE notice with regret the report from the Christiania correspondent of the *Morning Post* that Prof. H. Mohn, the well-known meteorologist, died on September 12, at eighty years of age.

THE death is announced, in his seventy-fourth year, of Mr. G. A. Hill, who was a tutor in chemistry at Harvard from 1865 to 1871, and assistant-professor of physics from 1871 to 1876. From 1898 to 1914 he was director of the Nolan laboratory for college preparation in physics and chemistry. He was the author, and joint author, of several text-books in mathematics and physics.

MR. LANSING, the American Secretary of State, has formally announced the signature of a Treaty with Great Britain for the protection of migratory birds. It will apply mainly to the migration of game and insect-eating birds from the United States to Canada. This is the first Treaty of the kind into which the American Government has entered.

NEWS has been received in America of the death of Mr. W. S. Lyon, the leading authority on botany and horticulture in the Philippine Islands, where he had been living since 1902. He had previously served as head of the California State Board of Forestry, and while holding this position had made, at the request of Prof. Asa Gray, a complete and valuable collection of the flora of the Catalina Islands.

MR. R. F. GRIGGS, who has been making an expedition to the Katmai volcano in the interests of the American Geographic Society, has returned to Kodiak, Alaska, and reports that its main crater is one of the largest in the world. It is miles across, and extends down thousands of feet to a blue-green lake, shimmering and sputtering at the bottom. The most wonderful of all sights at the crater was a place where a glacier, blown in two by the great eruption in June, 1912, still formed part of the crater wall, the intense heat being insufficient to melt this palisade of ice. Part of the crater wall is composed of igneous rock of brilliant colour.

SIX members of the Stefansson Arctic Expedition, under the leadership of Dr. Rudolph Anderson, have arrived at Nome, all of them in good physical condition. They reported that Stefansson himself is remaining in the Arctic to continue his exploration of the land he has discovered north of Prince Patrick Land, and that he is not likely to return during the present season. He left Dr. Anderson's party to the south of these lands that they might explore more thoroughly the Canadian continental line. They have mapped the coast-line from the Cape Parry Peninsula for a considerable distance east, and have made topographical and geological surveys of a huge region which lies half-way between northern Alaska and the outlet of Hudson Bay. Sir John Franklin's charts have been corrected, large copper fields have been discovered, and ethnological and other scientific information has been obtained.

ABOUT forty years ago a series of primitive mining implements was discovered in the old copper mines at Alderley Edge, Cheshire, which excited great interest. They were described by Prof. Boyd Dawkins in vol. v. (1876) of the Journal of the Anthropological Institute, who divided them into three classes:—(1) Hammers with a simple groove round the middle for the retention of the withy which formed the handle; (2) tools which, besides this groove, had one of their ends also grooved for the reception of a second withy, and thus were prevented from slipping when a blow was struck; (3) two implements which seemed to be wedges. Prof. Boyd Dawkins was inclined to believe that they were of pre-Roman age. Further examples of the same type were discovered a few years ago by Mr. F. S. Graves, who has contributed three specimens to the Hull Museum. They are made of glacier-borne erratics of igneous rock, carefully trimmed into shape. These interesting survivals of early mining are illustrated and described in No. 108 of the Hull Museum Publications.

Rocky Mountain spotted fever is a typhus-fever-like disease occurring in limited areas in North America. So far no micro-organism has been definitely found associated with it. Wolbach now describes a bacterium having certain peculiar characters, which may be found in large numbers in the lesions characteristic of spotted fever in experimental animals. It is well stained with Giemsa's stain, which is not usual with bacteria, possesses low specific gravity, as it is not thrown down by centrifuging, and cannot be cultivated (*Journ. Med. Research*, xxxiv., 1916, p. 121).

The subject of the filterability of micro-organisms through a porcelain filter is one of considerable interest and importance. The pores of such a filter are so fine that particles passing through them are usually beyond the limit of microscopic vision, and the viruses of several diseases are known to be of this nature. The possibility of easily visible micro-organisms having a sub-microscopic filterable stage has also to be considered. Wolbach shows that certain spiral organisms larger than many bacteria, viz. *Spirochaeta duttoni* of African tick fever, *Sp. elusa*, and *Sp. biflexa*, will pass through the pores of Berkefeld V, N, and W filters (*Amer. Journ. Tropical Diseases and Prevent. Med.*, ii., February, 1915, p. 494). On the other hand, trypanosomes from cultures and from animal tissues are not filterable through bacteria-proof filters (Wolbach, Chapman, and Stevens, *Journ. Med. Research*, xxxiii., 1915, p. 107).

The fourteenth annual report of the Imperial Cancer Research Fund recently issued gives evidence of the effects of war-time conditions on the investigations. In spite of the depleted staff the essential organisation is being maintained, and a number of papers were published by the director and assistants. The studies of Dr. Tsurumi on heterologous tumour immunity constitute an attempt at biochemical analysis of new growths by testing the reactions to blood and tissue extracts of the sera of rabbits immunised against mouse and rat tumours. The hæmolytic and agglutinating properties were found to correspond to the specific protein reactions of mouse and rat tissues. Complement fixation gave indications of common properties in tumours of like histological types. A preliminary account was published of an interesting guinea-pig tumour, a lipo-sarcoma. The relation of the mitochondria to the development of fat in the cells of this growth showed that this process is to be regarded as a differentiation, and not as a fatty degeneration such as is common in the majority of rapidly growing neoplasms. Brief reference is made to unpublished work by the director on the relation of the anti-ferment power of the blood, to the phenomena of the Abderhalden reaction, and to an investigation by Dr. Cramer of the relation of the water content of transplantable carcinomata to rate of growth and other biological characters.

Dr. F. H. Edgeworth publishes in the July issue of the *Quarterly Journal of Microscopical Science* results of his studies on the development and morphology of the pharyngeal, laryngeal, and hypobranchial muscles of mammals. The paper is a continuation of one published in that journal during 1914. The author is to be congratulated on the completion of his task, which must have entailed an enormous amount of labour.

The Transactions of the Royal Scottish Arboricultural Society for July, 1916, contain an article by James W. Munro on the insects attacking the common pine in Scotland. Their life-history, which he has studied for some years, is traced in connection with the mode of felling of the timber, which leaves the felled area covered with branches and stumps. Mr. D. E. Hutchins records as a sign of progress the recent appointment of Mr. Lane Poole, a competent forester trained at Nancy, as chief forest officer in Western Australia. This post had been left vacant for twelve years, though the forests of this State are of great value, consisting mainly of karri and jarrah, two of the finest species of Eucalyptus.

In *British Birds* for August Mr. J. H. Owen continues his notes on the breeding habits of the sparrow-hawk. He describes now the behaviour of the male, which, it would seem, takes no part in the incubation of the eggs, though he feeds the female during both the laying and incubating periods. The food he brings her is never eaten at the nest, but on some tree at a little distance therefrom, to which she flies when called by her mate. Sometimes the transference of food takes place in mid-air, but as a rule it is brought to the tree. As the date of hatching approaches she shows less and less inclination to leave the nest, so that the last days of incubation are passed fasting. The male never feeds the young, so that if the female is killed these must starve. He will bring food and leave it at the nest, but lacks the instinct to break up and distribute it among his offspring. The young, it would seem, are quite unable to feed themselves until they are three weeks old.

An interesting series of papers on muscle physiology appeared in the May number of the *American Journal of Physiology* by Prof. Frederic S. Lee and his colleagues at Columbia University, New York. In the first place, it is shown that the diaphragm takes the leading position among the skeletal muscles, as regards its power of work, and its efficiency is correlated with its richness in glycogen. The effects of temperature and humidity were also examined in cats' muscles. The cats were arranged in three series: (*a*) after exposure for six hours to 21° C. and 52 per cent. humidity; (*b*) 24° C. and 70 per cent. humidity; and (*c*) 33° C. and 90 per cent. humidity. The muscles were excised, stimulated to exhaustion, and the total work measured. The following percentages express the duration of the working period: (*a*) 100, (*b*) 97, and (*c*) 89; and the total work was (*a*) 110, (*b*) 85, (*c*) 76. The total blood per kilogram of body-weight was decreased in the cats exposed to the higher temperatures and humidity, and their blood-sugar was reduced in quantity. We have here an objective illustration of the enfeebling effects of hot, moist climates, which are familiar as subjective experiences.

The *Bul. Imp. Acad. Sci.* (Petrograd, March, 1915) contains an article by A. A. Richter and E. M.

Kollegorsky describing a series of experiments on the mechanism of photosynthesis by means of a luminescent bacterium (*Photobacterium italicum*). Taking as the subject of their experiments two plants of strongly contrasted habits, *Aspidistra elatior* and *Bambusa verticillata*, they give the following summary of the results of their researches:—(1) The working out of a new method of the quantitative study of photosynthesis by the aid of luminescent bacteria. (2) It is established that the luminous intensity indispensable for the decomposition of carbonic acid is the same for plants which vary ecologically. (3) It is shown that the luminous intensity effecting the liberation of oxygen in photosynthesis may be in the case of plants possessing special light-collecting apparatus much lower than for those not so provided.

MUCH valuable meteorological and magnetical work is being done at Hongkong, and the report of the director, Mr. T. F. Claxton, has just reached this country. Continuous photographic records are being maintained showing the variations of barometric pressure and temperature, and there are daily automatic records of the direction and velocity of the wind, the amount of rain, duration of sunshine, and the relative humidity of the air. Eye observations of many of the elements are also made each hour. Attention is directed to the defect of wind velocity which has been noticed for several years past, and this has hitherto been attributed to instrumental rather than climatic causes. The decrease has occurred more or less steadily from 1884 to 1915. A similar defect in the wind velocity has been noticed at the Royal Alfred Observatory, Mauritius. The director of the Mauritius Observatory, in a recent report, remarks: "There is now reason to believe that the low velocities during the years 1901–11 are almost entirely climatic, and due probably to a periodic oscillation in this element." At Hongkong the decrease in the mean velocity of the wind is said to be far greater than the secular variations in any other element, and must, in the opinion of the director, at least in part, be attributed to instrumental causes.

THE Journal of the Franklin Institute for August contains a paper by Prof. Kennelly and Messrs. Achard and Dana, of the Massachusetts Institute of Technology, dealing with the increase of the resistance of standard forms of track and contact rails when the current through them is an alternating instead of a direct one. The currents used were sinusoidal of frequencies from 25 to 60 per second, and varied in root mean square values from 10 to 800 amperes. Both the alternating potentiometer method of comparing voltages down the rail and a manganin strip in series, and the dynamometer method of measuring the current and the active and reactive components of the voltage down the rail, were found satisfactory. The ratio of the resistances with alternating and direct currents increased with the magnitude of the currents to a maximum, at which it remained in most cases, but in a few cases it diminished again. The ratio, when a maximum, had values about 7 for track and 12 for contact rails at a frequency 25, and varied nearly as the square foot of the frequency. The best form of rail is discussed, and it is shown that theory reproduces the observations with a fair degree of accuracy.

WE have received from Mr. Oertling a copy of his recently issued catalogue of balances and weights. This firm claims that all its balances, etc., are, and always have been, manufactured in London. On comparison of the present list with that issued in 1909, we notice that with few exceptions all the balances listed seven years ago appear in the new catalogue; the prices, however, have increased in a proportion varying from 19 to 26 per cent., presumably owing to the general increase in cost of commodities and labour due to the war. Several balances designed especially for the Royal Arsenal, Woolwich, the Aircraft Factory, the Admiralty, and for explosives factories now appear for the first time. One of these is specially adapted for rapidity of weighing. Except in one item the weights are listed precisely as in the 1909 catalogue. The exception is that a cheap set has been introduced for school use. The increase in price of the sets of weights is not so large, varying from 11 to 20 per cent., except in one instance.

WE learn from the *Engineer* of September 1 that the Reclamation Service of the United States has recently finished at Elephant Butte, about twelve miles west of Engle, the dam which forms the keystone of its great water storage project in New Mexico. The work, which has been under construction since 1911, is designed with the object of providing water for irrigational purposes, by means of the storage of the flood waters of the Rio Grande, which are to be distributed at various points downstream, so that a total area of 185,000 acres will be brought under treatment. The district has a general elevation of 3700 ft. above sea-level; the climate is mild, and the temperature fairly equable throughout the year; the annual rainfall is about 10 in. It is thus a suitable location for husbandry, if the soil be adequately watered. The lake, or reservoir, which has been formed by damming the cañon of the Rio Grande at Elephant Butte, has, when full, a storage capacity of 862,200 million gallons, a surface area of 42,000 acres, a maximum length of 45 miles, a maximum depth of 193 ft. (the average is one-third of this), and a shore line of something above 200 miles. The dam contains 610,000 cubic yards of masonry, estimated to weigh about a million tons. It is not quite so imposing a structure as the two earlier dams built by the same service, but it is nevertheless a notable engineering achievement, and the outlay of about 1,000,000*l.* on the scheme will probably be considered but a moderate price to pay for the benefits which are expected to be derived from the undertaking.

MR. A. T. HOPWOOD writes to say that the display of aurora described by Mr. Denning in NATURE of August 3, was visible in Manchester about 11 p.m. (Summer Time) on the night of August 26.

ECONOMIC pamphlets on "The House-Fly as a Danger to Health," "The Louse and its Relation to Disease," and "Fleas as a Menace to Man and Domestic Animals," have already been published by the British Museum (Natural History), South Kensington. Three further pamphlets on, respectively, "Mosquitoes in Relation to Disease," "The Bed-Bug and its Relation to Disease," and "Ticks, etc., Injurious to Man," are in preparation.

OUR ASTRONOMICAL COLUMN.

MEASUREMENT OF CLOSE SOLAR LINES.—As a preliminary to the determination of the wave-lengths of solar lines in international units, and in connection with the search for mutual influence between neighbouring lines, Dr. C. E. St. John and Miss Ware have made a careful study of the difficulties attending the precise measurement of closely adjacent lines (*Astrophysical Journal*, xliv., p. 15). Micrometric measurements were made by at least two observers upon a series of spectrograms representing the first five orders of the 30-ft., and the first order of the 75-ft. spectrograph, and in the case of the closest pairs curves were also obtained with the registering photomicrometer; the separations derived by the latter process appeared to be least affected by accidental or systematic errors. The mean separations determined at Mount Wilson by three methods were systematically smaller than those indicated by Rowland's tables, the difference varying inversely as the separation. For six pairs, mean separation 0·274, the difference was +0·003; for eight pairs, mean separation 0·145, it was +0·008; and for eight other pairs, mean separation 0·075, it was +0·013. These differences are regarded as being probably due to errors in the Rowland values. The filar-micrometer values were found to vary with the width of the slit and the density of the spectrograms; whatever decreased the intensity of the space between the two components, as compared with the continuous spectrum outside, led to over-estimation of the interval. These results have evidently an important bearing upon recent attempts to detect effects due to anomalous dispersion.

The curious personal errors in the measurement of close lines have also been discussed from another point of view by H. H. Plaskett, in a paper entitled "The Psychology of Differential Measurements" (Journal R.A.S. Canada, June, 1916; NATURE, vol. xcvii., p. 451.)

SPECTRA AND ABSOLUTE MAGNITUDES OF STARS.—It has previously been shown by Adams that stars of small proper motion are relatively weaker in the more refrangible parts of the spectrum than stars of large proper motion, and that for stars of classes F to K this difference increases with advancing type. While the first result suggests a scattering of light in space, the second indicates that the absorption in the violet depends, in part at least, on the physical state of the star. This investigation has recently been extended at Mount Wilson by G. S. Monk, who has examined about 1200 plates of stellar spectra (*Astrophysical Journal*, vol. xliv., p. 45). The results are in general agreement with those of Adams, but show the effects to a less extent. All the density measures which could be so used were further discussed in relation to the absolute magnitudes of the stars, as determined by Adams on the basis of intensities of certain special lines. A relationship was thus indicated as existing between absolute magnitude and the relative weakness in the violet part of the spectra of stars having small proper motions, and it is concluded that the greater part of this effect is not due to absorption of light in space. It is thought probable that, with the aid of photographs specially taken for the purpose, the relative intensity of the violet part of the spectrum, together with spectral type, might be successfully employed to provide fairly accurate values of absolute magnitudes. An additional spectroscopic method of determining stellar distances is thus suggested.

OBSERVATIONS OF MINOR PLANETS IN FRANCE.—It is gratifying to find that in spite of difficulties caused by the war, the French observatories have been able to secure a large number of observations of minor planets. A useful summary of these observations, made during the year 1915, is given in the *Journal des Observateurs*, vol. i., No. 10. Although no new discoveries were made by French astronomers, an abundance of precise observations of about 120 known minor planets were obtained. About two-thirds of the observations were made at Algiers, on plates taken with the instrument employed for the photographic chart of the heavens. In addition, numerous ephemerides, in many cases constructed from corrected orbital elements, were issued by the Marseilles Observatory.

THE MARITZBURG MEETING OF THE SOUTH AFRICAN ASSOCIATION.

THE fourteenth annual session of the South African Association for the Advancement of Science was held in Maritzburg, the capital of the Province of Natal, on July 3–8, under the presidency of Dr. Lawrence Crawford, professor of mathematics in the South African College, Capetown. The meetings of the sections took place in what used to be the Natal Houses of Parliament, the buildings of which are now the abode of the Natal Provincial Council. On the afternoon of the opening day of the session the president and members of the association were officially welcomed by the Mayor and Corporation of Maritzburg, and in the evening his worship gave a reception in the Town Hall, after which the president took the chair and delivered his address.

About eighty-five papers were read in the four sections into which the association is usually divided, and summaries of a few of these are given below.

Prof. John Orr, who will preside over the 1917 session of the association, which is to be held at Stellenbosch, Cape Province, was president of Section A at Maritzburg, and his presidential address, which was profusely illustrated by means of lantern slides, was largely a review of the progress of engineering science in South Africa of late years, particularly in connection with mining operations on the Rand.

The presidential address in Section B was given by Prof. J. A. Wilkinson, professor of chemistry in the South African School of Mines and Technology, Johannesburg. He laid stress on the fact that South Africa continues to exist on its rich stock of raw materials—its exports, in addition to the raw products of agriculture, being chiefly metals, crude and unrefined, and uncut diamonds. He devoted his address to urging the need of organising the development of chemical industry and research in the widest sense of those terms. He deplored the existence of the popular impression that the duties of the chemist and the pharmacist are identical, and to this cause he ascribed the fact that South African products were not up to the standard of imported goods. In conclusion, he submitted details of a scheme for organising chemical research in South Africa upon sound lines, and urged that this organisation should be undertaken without delay.

Mr. I. B. Pole Evans, chief of the division of botany in the Union Department of Agriculture, was president of Section C. His presidential address took the form of a sketch of the rise and development of mycology in South Africa. Persoon, the father of the science of mycology, he pointed out, was a South African, having been born at the Cape in 1755, and some of the earliest references to Cape fungi are in his "Synopsis methodica fungorum," published in 1801. During the course of his address Mr. Pole Evans incidentally referred to his own appointment as mycologist to the Transvaal Government in 1905. He could not be expected to know that some years previously the Cape Government, too, had put a sum of money on the Estimates for the salary of a mycologist, but so much sport was made of the item in the Cape Parliament that it was hurriedly withdrawn. "The ignorance of the subject and the vague notions that people have about fungi are," said Mr. Pole Evans, "due chiefly to the fact that most of them are microscopic, and consequently cannot easily be conceived by those unfamiliar with the life of the unseen world."

Section D was presided over by Mr. M. S. Evans, who took as the subject of his address a survey of the past and present relations of the European and Bantu races in Natal and the surrounding districts. He recalled the conditions of native life as they were when he first landed in South Africa about forty years ago. The influence of the white man had been in favour of the Bantu people, for whom it was then an idyllic time. In 1886 came the great discovery which altered the whole social and economic position, not entirely to the native's advantage. Since then two waves of cattle disease—first rinderpest and then East Coast fever—swept across the territories, and an economically free people with considerable assets has been transformed into a community of debtors. Now education has come, and along with it unrest, the old life no longer satisfying, and so capacity has brought about a hunger to take a higher position. The question is now one which calls for scientific treatment, for investigation, for careful generalisation, and for application to the welfare of mankind.

Of the papers read at the various sectional meetings little can be said here. In Section A there were mathematical papers by Sir Thomas Muir and Prof. Roseveare, and papers on industrial development by Prof. Orr and Mr. Kenneth Austin; but those which attracted most popular notice were two short ones on daylight saving and the metric system respectively by Mr. R. T. A. Innes, of the Union Observatory. The principles advocated in both these papers were unanimously affirmed by Sections A and D meeting jointly, and resolutions were passed urging the Union Government to adopt those principles.

In Section B a highly important compilation of analytical figures from various sources was submitted by Prof. M. Rindl, of Grey University College, Bloemfontein, in a paper on the medicinal springs of South Africa. Dr. C. F. Juritz read two papers: one on the wheat soils of the Alexandria district, a tract of country where wheat once flourished, but in which there has been great deterioration during recent years; another on experiments with sugar beet in South Africa, bringing up to date the record of investigations which had already formed the subject of two previous papers by the author. Dr. A. L. du Toit contributed a paper on the occurrence of molybdenum in Natal, where the metal is present in the unusual condition of an impregnation in coarse sandstone of Upper Triassic age. In a paper on Fischer's synthesis of tanning materials the president of the section hinted at the possibility of synthesised depsides proving a formidable rival to the Natal wattle industry.

Section C had a very large number of papers, and only very few of these can be so much as mentioned here. Mr. J. L. Henkel, Conservator of Forests for the Natal Province, contributed three papers on different phases of forestry in Natal, and there were other papers on the subject by Mr. T. R. Sim, who also read a paper on wattle growing, another paper on the entomological aspect of the latter subject being read by Mr. C. B. Hardenberg. Four papers, having as their respective subjects the mealy bug, the Argentine ant, the house fly, and the cultivation of strains of beneficial insects, were submitted by Mr. C. W. Mally. Dr. Ethel Doidge contributed three important papers on bacterial diseases in citrus and pear blossom and on citrus canker. Mr. F. Vaughan Kirby read a paper on game protection in Zululand, while Mr. D. T. Mitchell discussed the association of game in Zululand with tsetse-fly disease. Mr. W. R. Tucker gave an account of the progress of the Natal sugar industry, and Mr. W. H. Scherffius discussed the cotton-growing industry.

Section D, too, was fully supplied with papers, so much so, indeed, that next year will see it divided into two sections, the council having decided to establish a new section, E, specially for native affairs, a subject which has engrossed much attention in Section D during the last three sessions. Two papers in this section by the Rev. Noel Roberts, illustrated with lantern views, on "Rock Paintings in the Northern Transvaal" and on "Bantu Methods of Divination," were both highly appreciated. The Rev. W. A. Norton read an informative paper on Bantu movements in Africa, illustrated by African place-names. Another paper of similar character was read by the Rev. John R. L. Kingon on the place-names of the Tsolo District. One of the most important papers read in Section D was delivered by the Rev. B. P. J. Marchand, and gave an account of the history and operations of the labour colony at Kakamas, on the banks of the Orange River. A valuable paper entitled "The Relation of Production to Consumption," by Mr. P. J. du Toit, Under Secretary for Agriculture, indicated the growth of South African farming industries, and advocated, as channels for constant progress, the increase of the European population, the development of fresh markets, and the educational and social advancement of the natives. Dr. Loram read a paper comparing the mentality of natives and Europeans in view of the theory of arrested development of the former. The Rev. A. T. Bryant gave two papers on the religion of the Zulu, and the concluding paper of the session was read by the Rev. J. R. L. Kingon on native education. Mr. Kingon said that this subject was one of supreme concern to the South African nation. Originally, the deliberate policy of the Imperial Government had been to provide native education as an insurance against Kaffir wars, but to-day the problem is chiefly economic and moral, and on both grounds he urged that the argument against native education is erroneous and unsound.

During the session two evening discourses were delivered, one at Maritzburg by Mr. C. P. Lounsbury, chief entomologist of the Union, on "Scale Insects and their Travels," and the other at Durban by Mr. R. T. A. Innes, Union astronomer, on "Astronomy."

On the first evening of the session, after the presidential address, the president presented to Mr. T. R. Sim, in recognition of his botanical researches, an award of 50*l.* and the South Africa medal for achievement and promise in scientific research, the fund for the annual presentation of which was raised by the British Association during its visit to South Africa in 1905.

C. F. J.

ECONOMIC HISTORY OF THE UNITED STATES.[1]

IN 1904 work was commenced upon an extended study of the economic history of the United States, under the auspices of the Department of Economics and Sociology of the Carnegie Institution of Washington. The subject-matter of this study was divided into twelve departments, and the two volumes before us represent the contribution to learning of the Department of Domestic and Foreign Commerce. They include six parts, dealing respectively with "American Commerce to 1789," "The International Commerce of the United States," "The Coastwise Trade," "The Foreign Trade of the United States since 1789," "American Fisheries," and "Government Aid and Commercial Policy," which are based, in part, upon monographs, some of which have not been published. Vol. ii. contains a classified bibliography which runs to 24 pp., and vol. i. gives 10 pp. to notes and a bibliography concerning American

[1] "History of Domestic and Foreign Commerce of the United States." Vol. i. By E. R. Johnson, T. W. Van Metre, G. G. Huebner, and D. S. Hanchett. Pp. xv+363. Vol. ii. Pp. ix+398. (Washington: Carnegie Institution, 1915.)

Colonial commerce; there are three important railway and three useful fishery maps.

On the whole, the work achieves an object of notable importance—a comprehensive summary of one department of American history. There has been a development in time, but the more important changes have been spatial, so that the underlying unity of the work is geographical rather than historical; spread over an extensive area, the people have always tended towards sectional interests, and the chronological sequence of events necessarily depends upon a continuous adjustment to new topographical conditions. In the earlier periods the exchanges were triangular in character; at first, from the north-eastern coastlands ships carried produce to the West Indies; the goods were, practically, exchanged for sugar, which went to Great Britain, and were there exchanged for British manufactured products to be sent to Boston; later, when the Middle West became populous, farm produce from the Ohio districts went down the Mississippi, was exchanged for cotton, which was sent coastwise to New York, and was there exchanged for manufactured goods, which went west to the Ohio.

The gradual substitution of direct trading based upon increased facilities of ship, canal, and railway, upon increased divergence of fundamental interest as the several areas confined attention to one or other definite form of production, and upon the increased quantity of coin and coin equivalent in the country, is resolved into a commentary upon the steady development of the natural resources of the United States. Tobacco and cotton exports from the plantation States, direct trade with the West Indies (which was always of paramount importance), and direct trade, at a later date, with the Far East, gradually gave the United States the largest mercantile fleet in the world, and despite piracy and privateering, this predominance was maintained until the substitution of iron for timber in the construction of the hulls of ships. The story of the limitation of the fisheries, and of the decline of the whale fishery, helps to explain the smallness of the United States marine, both commercial and naval, at the present day.

The facts for the years 1860, 1880, and 1900 show that the production of maize, wheat, oats, and butter was at least trebled; coal production advanced from 13 to 241 million tons annually, petroleum from a half to 64 million barrels; the numbers of wage-earners engaged in manufacturing increased from $1\frac{1}{4}$ to $5\frac{1}{4}$ millions, and the manufactured products increased from 377 to 2600 million pounds sterling.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE extension of the London (Royal Free Hospital) School of Medicine for Women at Hunter Street, Brunswick Square, W.C., will be opened by H.M. the Queen on Monday, October 2, at 3 p.m.

By the death, on September 1, of Mrs. William Jackson, widow of Mr. William Jackson, of Thorngrove, Aberdeen, a large sum becomes available for the founding of a chair of engineering in the University of Aberdeen.

ARRANGEMENTS have been made by the Cheshire County Council Education Committee with the authorities of McGill University, Montreal, which will permit of engineering students winning technological scholarships in Cheshire to have a portion of their three years' training at McGill University.

IT was announced in our issue of August 31 (vol. xcvii., p. 555) that the Weardale Lead Company is establishing two mining scholarships, each of the value of 60*l.*, in connection respectively with the Royal School of Mines and Armstrong College, Newcastle-upon-Tyne. The former scholarship will be known as the "Richardson," and the latter, a correspondent informs us, as the "Cameron-Swan," and not the "Cameron," as stated in our note.

THE syllabuses of classes which begin at the Sir John Cass Technical Institute, Aldgate, on September 25 has now been issued. The courses of instruction are specially concerned with the technical training of persons engaged in chemical, metallurgical, and electrical industries. In addition, facilities are offered for special investigation and research. We notice that the curriculum in connection with the fermentation industries includes courses in brewing and malting and the microbiology of the fermentation industries. In the metallurgy department advanced courses are provided on gold, silver, and allied metals, on metallography and pyrometry, and other important technical subjects.

AN abridged calendar for the forthcoming session of the London School of Economics and Political Science (University of London) has been issued. One of the objects of the school is to supply liberal courses of education specially adapted to the needs of persons taking up any kind of administration, such as the service of any Government or local authority, or the higher branches of commerce and industry. Courses of study are arranged also for students desiring to graduate at the University of London in the faculty of economics. The school is provided with a research department in which the methods of utilising great libraries and collections of material are explained and hints are given in the prosecution of research. The time-tables of lectures and classes printed in the calendar are comprehensive and exhaustive, and the list of lecturers includes the names of many distinguished authorities.

THE new session of the Battersea Polytechnic begins on September 19. In the day technical college, courses have been arranged in civil, electrical, motor, and chemical engineering, and full preparation for degrees in science at the University of London. The department of hygiene and physiology provides training for women sanitary inspectors and health visitors. Full evening courses will be held in a great variety of subjects in science, technology, and commerce. Special classes for the training of men and women munition workers are held, and the manufacture of munitions for the Admiralty is undertaken. At the request of the War Office, a full-time course in engineering for men of the Royal Flying Corps has been arranged. Red Cross classes for women in the subjects of first aid, home nursing, cookery, and laundry work are also held. In addition, the members of the chemistry department have been engaged on the preparation of chemical substances for the War Office, and the staff of the physics department has assisted in the testing of optical instruments for the Ministry of Munitions.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 28.—M. Paul Appell in the chair.—A. **Lacroix**: The constitution of the volcanic rocks of the archipelago of the Comores. This archipelago is entirely volcanic, and geological researches are carried out with difficulty; basaltic tufa predominates, and the porous rocks have undergone profound alteration. The tropical vegetation is very intense and effectually hides the subsoil. A chart of the geological formation of the Grand Comore is given, together with six complete chemical analyses of typical rocks.—M. **Friedmann**: The vortices in a liquid at variable temperature.—L. **Hartmann**: The determination of the mechanical equivalent of heat by the method of Hirn. It is shown that the hypothesis which forms the basis of the determination of Hirn is not confirmed by experiment.—C. **Camichel**: The amplitude of the odd harmonics in the strokes of a hydraulic ram.—G. A. **Le Roy**: A reagent for free chlorine in drinking water. The amount of free chlorine in drinking water which has been purified by means of hypochlorites is at present controlled by the well-known iodide of starch reaction. The new reagent suggested, which has a higher sensibility than the iodide of starch, is the chlorohydrate of hexamethylparaminotriphenylmethane. The violet colour is formed immediately, and its intensity is proportional to the amount of free chlorine present. Water containing only three hundred millionths of chlorine gives a visible reaction with the new reagent; about three times this quantity is necessary to show the iodide of starch reaction. Details for the preparation and use of the reagent are given.

CAPE TOWN.

Royal Society of South Africa, July 19.—Dr. L. Péringuey, president, in the chair.—E. J. **Goddard**: *Pelodrilus africanus*, a new Haplotaxid from South Africa. The species here described constitutes the first representative of the family Haplotaxidæ recorded from South Africa. Of the two genera included within this family, one—Haplotaxis—is represented by fresh-water species in Europe, North America, and New Zealand, while the remaining genus—Pelodrilus—is represented in New Zealand by a species inhabiting damp earth. The African species is to be included in the latter genus. The specimens were obtained in mud on Sneeuw Kop, near Wellington, Cape Province, at an elevation of 5000 ft. above sea-level. The length varies from 20 to 40 mm.—Paul A. van der **Bijl**: Note on *Polysaccum crassipes*, a common fungus in Eucalyptus plantations around Pretoria. *Polysaccum crassipes* is so common in Eucalyptus plantations around Pretoria that it appeared interesting to determine in what relation it stood to the Eucalypti. The investigation was begun at the Botanical Laboratories, Pretoria, and afterwards concluded at the Natal Herbarium, Durban. The morphology of the fungus is briefly dealt with and followed by suggestions which indicate that the relation between the fungus and host is one of symbiosis.

CALCUTTA.

Asiatic Society of Bengal, August 2.—Dr. N. **Annandale**: Zoological results of a tour in the Far East. I., The Mollusca of Lake Biwa, Japan. Lake Biwa, as might be expected from its geographical position and from what is known of the fauna of Japan generally, seems to be, so far as the Mollusca are concerned, the meeting-place of two lines of migration, one coming from the north, the other from the south.

BOOKS RECEIVED.

Index of Genera and Species referred to, and an Index to the Plates, in the *Ibis* (seventh, eighth, and ninth series), 1895–1912. Pp. 513. (London: British Ornithologists' Union; W. Wesley and Son.) 1*l*. 12*s*. 6*d*.

Cradles or Coffins? By J. Marchant. Pp. 96. (London: C. A. Pearson, Ltd.) 1*s*. net.

First Course in General Science. By Prof. D. Barber and others. Pp. vii+607. (New York: H. Holt and Co.)

Cleator and Cleator Moor, Past and Present. By Rev. Cæsar Caine. Pp. xviii+475. (Kendal: T. Wilson.) 21*s*. net.

Earliest Man. By F. W. H. Migeod. Pp. xii+132. (London: Kegan Paul and Co., Ltd.) 3*s*. 6*d*. net.

The Principles of Electrical Engineering and their Application. By Prof. G. Kapp. Vol. i., Principles. Pp. xii+356. (London: E. Arnold.) 15*s*. net.

The Elements of Non-Euclidean Plane Geometry and Trigonometry. By Prof. H. S. Carslaw. Pp. xii+179. (London: Longmans and Co.) 5*s*. net.

Royal Society of Arts. Cantor Lectures on Optical Glass. By Dr. W. Rosenhain. (London: Royal Society of Arts.) 1*s*.

Raphael Meldola: Reminiscences of his Worth and Work. Edited by J. Marchant. Pp. xv+225. (London: Williams and Norgate.) 5*s*. net.

Tree Wounds and Diseases: their Prevention and Treatment, with a special chapter on Fruit Trees. By A. D. Webster. Pp. xx+209. (London: Williams and Norgate.) 7*s*. 6*d*. net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College. February–June, 1916. By R. M. Milne. Pp. 30. (London: Macmillan and Co., Ltd.) 1*s*. net.

Manual of Russian Commercial Correspondence. By M. Sieff. Pp. xx+232. (London: Kegan Paul and Co., Ltd.) 3*s*. 6*d*. net.

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

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THURSDAY, SEPTEMBER 21, 1916.

CALCULATIONS FOR FLYING MACHINES.

The Design of Aeroplanes. By Arthur W. Judge. Pp. viii+212. (London: Whittaker and Co., 1916.) Price 9*s.* net.

AEROPLANE stability is not the only subject in which progress has been retarded in the early stages of aviation. It is not so very long ago that Prof. Herbert Chatley read a paper on the calculation of the stresses in aeroplanes, and at the conclusion up jumped "Mr. I Don't Agree With You" and said he "didn't think" the results would be of any value. The consequence of this system is that a person who is really an inventive genius has to spend the whole of his time in fighting against the opposition and prejudice of people who "*don't think,*" and he can produce original work only when he can get a post-graduate student or assistant to do the whole working of the necessary details.

As a result of this retardation the literature dealing with the strength of the materials used in aeroplane construction and the stresses in their component parts is quite inadequate for the efficient development of aerial locomotion.

So far as this book deals with details of experimental statistics, it fills a distinct want, and it is sure to receive favourable reviews in our engineering journals. But a great deal of the subject-matter is nothing more or less than boiled-down mathematics, and the process of boiling down has in some instances been conducted in rather an amateurish way; moreover, the book contains statements that are certainly misleading, if not worse, for they cannot be correct if read as they stand.

In the first place a large amount of space is taken up in the appendices with tables for the conversion of units and things of that kind, but no tables are given for use in logarithmic calculations. Now it will be seen that almost all the formulæ quoted in the book, whether empirical or theoretical, involve products and powers rather than sums and differences, and for the efficient use of these formulæ a working knowledge of the use of logarithms is indispensable. The author may tell us that the class of mechanic for whom this book is written does not know how to use logarithms; if that be the case, the sooner he learns the better. He would then be spared an immense amount of time in turning over pages and pages of tables and possibly not finding what he wants at the end. The practice of mixing up tables of mere results of arithmetical operations with tables of experimental data cannot be too strongly deprecated.

The treatment of such matters as moments of inertia is on the whole fairly satisfactory, but it would be better if the author had stated the theorem of parallel axes *in words,* besides giving the formula on p. 113. Experience in teaching elementary students shows that it is very difficult to get them to interpret even the simplest formula in a verbal statement.

The graphic method for constructing a curve the area of which represents the first or second moment of a given plane curve about a given axis is very suitable for teaching purposes, though for actual working an alternative representation could be obtained more easily by the use of a cubical parabola.

In connection with the relative merits and demerits of monoplanes and biplanes, statements are made on p. 31 which are on the face of them at variance with elementary considerations of common sense. We are told that a monoplane possesses a lower head resistance, due to the absence of separate struts, ties, etc., and that it possesses relatively smaller moments of inertia about the axes of symmetry. But it is surely obvious that the use of superposed planes renders it possible to reduce both the framework and the span with the same lifting area. If Mr. Judge's statements are true of actual machines, it must be as the result of circumstances other than the difference between the one-decker and the two-decker type of wings, and this should be explained; otherwise the statements are calculated to mislead.

There must, however, be something much more seriously in error in the statement of the "Bird Flight Data" quoted from Dr. Magnan's conclusions on p. 33. In the seventh line we are told that the total length of a bird in centimetres is equal to the cube root of the total weight in grams; in other words, that the relation between length and weight is the same as in a cube of water. Further, the area of the body is equal to the square of its length. In the next formula but one we are told that the weight of the wings in grams is 197 times the total loaded machine weight in grams. After this follow statements that the chord of the wing at the centre is 2·36 times, the length of the tail 2·6 times, and the real length of the body 5·9 times the cube root of the weight, which has already been stated as equalling the total length of the bird!

While, therefore, the present book is to be welcomed as a step in the right direction, it will be seen that the subject still requires further revision. Had it not been for the discouragement which Prof. Chatley's early efforts received as the result of "discussions" consisting in expressions of premature opinions based upon insufficient data, we do not doubt that by now Mr. Judge would have been handling the subject on more strictly scientific lines. G. H. B.

PALÆOLITHIC MAN.

Men of the Old Stone Age: Their Environment, Life, and Art. By Prof. H. F. Osborn. Second edition. Pp. xxvi+545. (London: G. Bell and Sons, Ltd., 1916.) Price 21*s.* net.

PROGRESS in the study of prehistoric man has been so remarkable during the last few years that the demand for a rapid succession of more or less popular treatises on the subject is not surprising. Most of the original memoirs are in technical language in serials that are not generally accessible, and it is natural that critical summaries by those who have taken part in such research should be widely welcomed. The curiosity of the intelligent public, however, is so eager for satisfaction in many matters which are still beyond the pale of scientific knowledge that there is ever a temptation to make a book successful by pandering to this taste. Probabilities and possibilities which have been judiciously considered in scientific memoirs, and rightly used as tentative hypotheses, run the risk of being quoted as established facts; while unique, isolated discoveries tend to be treated as if they were sufficient for the absolute determination of their mutual relationships and could be used for definite conclusions.

We venture to think that Prof. H. F. Osborn has sadly failed to resist this temptation in his new handsome volume on the "Men of the Old Stone Age," which has reached a second edition in America within six months of its original publication. In every respect it is in strange contrast with such works as Huxley's well-known "Man's Place in Nature," which Prof. Osborn curiously omits both from his historical sketch and from his valuable bibliography of the subject. We are definitely told that modern geology "has firmly established eight subdivisions or stages of Pleistocene time—namely, four Glacial, three inter-Glacial, and one post-Glacial," which can be recognised in America as well as in Europe. We learn with equal certainty that Piltdown man is "four times as ancient as the final type of Neanderthal man," while Heidelberg man is nearly twice as ancient as the Piltdown man, "according to our estimates." The gravels in which Galley Hill man was found "are by no means of the geologic antiquity of 200,000 years assigned to them by Keith," but "lie within the estimates of post-Glacial time—namely, from 20,000 to 40,000 years." In fact, the dates of the successive stages in prehistoric man's progress are so exactly given and so often repeated that they cannot fail to deceive the unwary reader, who must feel especially impressed by their precision when he notes Prof. Osborn's warning that the odd 1900 years of the Christian era must be added to each statement when he desires to reckon time from the present day.

Prof. Osborn has, indeed, attempted with great labour to present a connected story which is distinctly premature, and will give the ordinary reader an exaggerated idea of the value of the conclusions already reached in prehistoric research. With the aid of several industrious compilers, whose services he acknowledges, he has produced a most useful and up-to-date compendium of the facts, with references to the original papers on which his statements are based. Each section is also most profusely and beautifully illustrated, often with original photographs which were made on a tour through France and Spain. We feel, however, that the collected materials have not been used with sufficient scientific discretion and adequate literary skill to produce a satisfying result. We would only add that for those to whom much of the text may prove difficult reading, the illustrations with their legends will still be a source of instruction and delight, while the excellent chapters on later Palæolithic art will be particularly appreciated. A. S. W.

THE NATURAL HISTORY OF HAWAII.

Natural History of Hawaii: Being an Account of the Hawaiian People, the Geology and Geography of the Islands, and the Native and Introduced Plants and Animals of the Group. By Prof. W. A. Bryan. Pp. 596. (Honolulu: The *Hawaiian Gazette* Co., Ltd.; London: G. E. Stechert and Co., 1915.)

THE suspicion that is awakened by the somewhat typical "American" puff that Prof. W. A. Bryan allows himself in the preface to the "Natural History of Hawaii" is dissipated when the book itself is read, and the author is to be congratulated on having produced a book that is at the same time readable, useful, and trustworthy. It gives the reader a very good general idea of the geology, geography, flora, fauna, and ethnology of the group, and it will be of especial value to residents who take an interest in the local natural history. There is a very large number of photographs, some of which are on too small a scale to be of any real use, while the details in others are lost on account of ordinary photographic, instead of orthochromatic (or similar), plates having been used. The voluminous indices are of great practical use.

The section on the people is disappointing in some respects; for example, it is futile in a popular book to say that "North, South, and Middle America, as well as Papua, Malay, China, Japan, and India, have each in turn been declared the cradle" of the Polynesian race, as the uninformed will be led to suppose that any of these alternatives is possible. We know more on this subject than the author admits to be probable. In view of the recent investigations into the problems of Polynesian ethnology, Prof. Bryan might have alluded to Dr. H. Allen's "Study of Hawaiian Skulls" (*Trans. of Wagner Free Inst. of Sci.*, Phil., v., 1898, p. 1), where a dual element in the population is demonstrated, though the conclusions thereon are possibly erroneous.

In dealing with the flora and fauna the author never loses sight of the problems of distribution; thus not only are the characteristics of the seashore, lowlands, and mountains described, but the variation that occurs from island to island and the significance of this are duly noted. In the case of the land snails, for example, great variation may occur, not only in different valleys, but in parts of the same valley, so that the Hawaiian group is a famous field for the student of variations.

Another good feature of the book is the careful manner in which native species are distinguished from introduced species. Those who read the early reports by Dr. Perkins, of the British Association Committee, will remember how rapidly the endemic insects were being replaced by foreigners which had been introduced accidentally; this book deals with a further phase of that sad drama. We all know how successful the Americans of the United States have been in dealing with the problems of economic entomology, and in Hawaii this experience has proved most beneficial, for not only have the enemies of pests been acclimatised, but in the importation of insects to combat the spread of the injurious Lantana we have, we are told, "the first example in the world of the introduction of insects to prevent the spread of a plant." If one more grumble may be permitted, we would like to express surprise that any scientific man should adopt the popular but erroneous spelling for coconut; but to avoid an unpleasant concluding sentence it may be pointed out that all through the book there are occasional references to the ethnological aspect of certain plants and animals which are of interest to the ethnologist.

COLLOID-CHEMISTRY.

A Handbook of Colloid-Chemistry. The Recognition of Colloids, and their General Physico-chemical Properties. By Dr. Wolfgang Ostwald. Translated by Prof. M. H. Fischer. Pp. xii+278. (London: J. and A. Churchill.) Price 12*s*. 6*d*. net.

It is stated in the preface that this book has passed through three large editions in Germany. We are inclined to think that such success was due more to the fact that it was first in the field as a general treatise upon a subject which was attracting widespread interest than to intrinsic merit. The ideas especially of the general theoretical portion are superficial, and the writing loose, words being mistaken for ideas. It is stated more than once, for instance, that the colloid state is independent of chemical composition. Taken literally, the statement is merely foolish. How foolish two examples will suffice to show. Azomethane, one of the most remarkable of colloid substances, loses its colloidal properties if a single hydrogen atom of its complex molecule is replaced by a halogen. Gold, silver, and platinum readily form colloidal solutions in solvents which contain a replaceable hydrogen atom, while the base metals form such solutions in hydroxyl-containing solvents. The author, however, does not really mean what he says. His many pages on the subject show that the thesis he is actually defending is the quite harmless one that for every substance some other substance can probably be found with which it will form a colloidal mixture.

The colloidal state is, to use Bredig's happy phrase, a microheterogeneous state of matter. It is the great merit of Picton and Linder that they made this clear. Dr. Ostwald characterises the different parts as "phases," and speaks of colloids as multiphasic systems. This is an unfortunate use of the word "phase," which Gibbs defined as a portion of matter "uniform throughout, not only in chemical composition, but also in its physical state." Probably the last thing we can claim for portions of matter of microscopic, and especially ultramicroscopic, dimensions is that they are physically homogeneous throughout. The misuse of the word "component" on p. 36, where it is confused with "phase," is probably an error of translation.

The least satisfactory part of the book is the section on surface energy. Here the author, by a series of unsound analogies, introduces unnecessary confusion in a region which Gibbs, Rayleigh, and van der Waals had reduced to order. The part dealing with special properties of colloidal solutions, such as molecular weight, viscosity, osmotic pressure, etc., gives, on the whole, a clear account of the work which has been done.

OUR BOOKSHELF.

The Practical Principles of Plain Photo-micrography. By George West. Pp. xii+145 +plates viii. (Dundee: University College, George West, 1916.) Price 4*s*. 6*d*. net.

In this book plain and practical directions are given for the preparation of photo-micrographs with the use of powers up to a ¼-inch objective. The author very rightly insists that the beginner should commence with low powers, and as he gains experience proceed step by step to the use of the higher powers. A feature of the book is its "common sense": the tyro is not bewildered by a mass of details and scores of chemicals and solutions, but just a few are chosen and fully described which the author has used and found suitable, and throughout directions are given for the adaptation of simple apparatus to the end in view.

After a few pages of general introduction the subjects of microscope and powers, illuminants, colour screens and camera are dealt with; then follow sections on photo-micrography with a landscape camera, without a camera, and with a vertical camera. Next the details of the making of a photo-micrograph from beginning to end are given in dialogue form in the Sandford and Merton style, a method of instruction which personally we do not care for, but which enables the author to give many "tips."

The book is illustrated with two plates showing arrangement of apparatus and six other plates, each with two figures, reproductions of photo-micrographs of various objects. These are described in the text, and a very full table is given of all the details respecting them—nature of the object and its staining, lens, illuminant, screen, plate, exposure, developer, etc. These should be very useful, giving the beginner just the information he wants. Finally, lists of necessaries, photographic formulæ, books on photo-micrography (which might have been priced with advantage), and an index complete the book.

The book is well printed and the reproduction of the plates excellent, the price is exceedingly moderate, and we can recommend the work as an excellent one for the beginner.

Tunbridge Wells and Neighbourhood. Edited by H. R. Knipe. Pp. 207. (Tunbridge Wells: Pelton, 1916.)

THIS volume is a welcome addition to the series of local surveys which owe their origin to the annual congress of the South-Eastern Union of Scientific Societies. The series was begun by the "Survey and Record of Woolwich and West Kent," which was published in commemoration of the twelfth congress of the Union, held at Woolwich in 1907; and later surveys have been issued in connection with the congresses held at St. Albans, Hampstead, and Bournemouth. The present volume makes a notable addition to the series, despite the fact that, owing to the war, it has been brought out under special difficulties.

The South-Eastern Union of Scientific Societies is heartily to be congratulated on these surveys. They are all of them confessedly provisional; but if they are made the basis of patient and continued work, and if they open out beyond the biological and archæological fields to the civic and sociological fields as well, they will mark a great step forward in the much-needed development of regional survey. Two lines of development readily suggest themselves: that each year all the affiliated societies in the area in which the annual congress of the Union is to meet should map out in good time the contributions already available for a local survey and the ground which still requires to be surveyed; and that, after the annual congress has met, further work should be organised and the results printed at intervals uniformly with the congress volume, and so be readily incorporated.

There is always an abundant demand for guide-books of the popular and familiar kinds, but we see no reason why many towns and districts should not gradually provide themselves and their visitors with regional surveys, progressively developing in scope, exhaustiveness, and accuracy, and forming guide-books of a higher and a more intelligent order. Mr. Knipe and his collaborators are to be heartily congratulated on having provided the first draft of such a guide-book for Tunbridge Wells and neighbourhood. C. H. G.

Through South Westland. A Journey to the Haast and Mount Aspiring, New Zealand. By A. Maud Moreland. Second Edition. Pp. xviii + 222. (London and Melbourne, Christchurch, Wellington and Dunedin: Whitcombe and Tombs, Ltd., n.d.) Price 6s. net.

THIS entertaining description of a five weeks' riding tour in South Island, New Zealand, gives an excellent impression of the character of the country traversed and much information as to the kindly disposition of the inhabitants. Both the text and the beautiful photographs with which the volume is provided will interest students of the geography and natural history of New Zealand.

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.]*

Life Assurance Tables.

YOUR article in NATURE for July 6, pp. 383–4, quotes me correctly "that life assurance business has been based upon mortality tables which represented the expectation of life under the relatively unhealthy conditions which existed a half-century ago"; and then, a few sentences later, the article makes the above quotation credit me with saying that the mortality tables were *published* "a half-century ago"—which I did not say.

Your article explains that the mortality table published in 1901, now in use by the assurance companies (of Great Britain?), is based upon mortalities observed by sixty assurance companies under the relatively unhealthy conditions which existed during the thirty years 1863 to 1893—that is, from more than "a half-century ago" (fifty-three years) to twenty-three years ago, *an average of thirty-eight years ago.* It is within the last thirty-eight years that the great advances in preventive and curative medicine (excepting vaccination) have been made.

The American Experience Table was compiled by Homans in the year 1868, and was based chiefly upon the mortality data of the Mutual Life Insurance Company of New York. These data therefore represent the relatively unhealthy conditions which existed in a period of time averaging considerably more than "a half-century ago." As the writers of the article on life insurance in the last edition of the "Encyclopædia Britannica" (p. 666, second column) say, the American Experience Table "is now in wider use than any other for computing the premiums of American companies." It therefore seems that my sentence, quoted in the first paragraph, thoroughly respected the value of understatement. W. W. CAMPBELL.

Lick Observatory, August 7.

Pre-Columbian Use of the Money-Cowrie in America.

IN NATURE of August 10 (p. 488) there was a notice of an article by Mr. C. B. Moore (published in the Journal of the Academy of Natural Science of Philadelphia, 2nd Ser., part ii., vol. xvi.) on the explorations of aboriginal sites in the Tennessee River valley, which raises the interesting question of the provenance of certain cowries found there. These are pronounced by Dr. H. A. Pilsbry, the well-known American conchologist, to be examples of the money-cowrie, *Cypraea moneta*, of Eastern Seas, and they have never been recorded before from an aboriginal mound in the United States. Nor has the species ever been recorded living on any of the shores of the Americas. To account for their presence in the Tennessee mound, Dr. W. H. Dall, another of America's leading conchologists, has suggested that the cowries "may have come off one of Columbus's own ships"!

In the Peabody Museum, Cambridge, Mass., is the dress of a Cree woman, collected by the Lewis and Clark Expedition, 1804–5, on which are four dozen cowries of the dwarf variety *atava* of *C. moneta* (see *American Anthropologist*, 1905, for picture).

Willoughby believes these cowries were sold to the Indians by the Hudson Bay Company in the late eighteenth or early nineteenth century.

Montgomery (Transactions of the Canadian Institute, 1910, ix. (1), No. 20, p. 7, pl. 4, f. 6) records and figures a cowrie found in the Serpent Mound, Ontario. It is a regular *C. moneta*, and it is suggested that "this is probably one from the Hudson Bay Company's stock."

But these suggestions entirely ignore the uses made of the cowrie in America. If Columbus and the Hudson Bay Company really introduced *C. moneta*, as these speculations demand, are we to assume that they also instructed the Indians in certain remarkable ceremonials practised with this shell in Africa, India, and China? Is there any reason for believing that Columbus was even aware of such uses, and if he were, that he should have had the foresight to take *C. moneta* with him, and have devoted the limited time he spent in America in teaching the natives some of the lesser-known elements of Indian and Chinese beliefs?

The money-cowrie is, and has been for centuries, a sacred object among the Ojibwa and Menomini Indians, and is made use of in initiation ceremonies of the Grand Medicine Society (see Hoffman, Bureau of Ethnology, 7th Annual Report, 1885–86 (1891), and 14th Annual Report, 1892–93 (1896); also Nature, January 27, 1916, for abstract of paper by the writer).

The tradition among the Indians is that the original sacred shell came through a particular hero-god, who acted as intermediary between the Great Unknown and the Indians, and founded their Medicine Society.

The initiation ceremonies consist of much dancing and the shooting forward by the medicine men of their medicine bags containing the sacred cowries. Mystic powers are attributed to the shells, and it is firmly believed that if they be swallowed by the medicine man, all he is obliged to do to transfer his power to the medicine bag is to breathe on it, the mysterious power and influence being then transmitted by merely thrusting the bag towards the desired object or person. At initiation ceremonies the magic influence is shot at the candidate's breast, and the cowrie—the symbol of life—is supposed to enter his heart; he becomes unconscious and falls forward on his face. The chief medicine man then raises the candidate's head slightly from the ground, and a sacred cowrie drops from the candidate's mouth.

The same shells are used apparently at baptismal ceremonies of the Ojibwa (see Greenwood, "Curiosities of Savage Life"). There is the same dancing and shooting forward of the medicine bags, and after much facial contortion each medicine man spits out two shells.

The essential part of these ceremonies is the supposed death and survival of the candidate, and it is remarkable how closely the prevailing idea of the cowries being connected in some strange manner with resurrection and resuscitation agrees with the ancient Chinese belief as evidenced in the ceremonial use of money-cowries in obsequies of the dead. In pre-Christian and later times cowries were used in China, in association with rice, for stuffing the mouth of the dead. Wild rice, it might be added, also enters into the ritual of Ojibwa and Menomini ceremonies.

Manchester Museum. J. Wilfrid Jackson.

Notice of Possible Suspension of the Rules of Nomenclature in the Cases of Holothuria, 1758, vs. Physalia, 1801, and Bohadschia, 1833, vs. Holothuria, 1791.

In accordance with the requirements prescribed by the International Congress of Zoology, notice to the zoological profession is hereby given that on or about October 1, 1917, the undersigned proposes to recommend to the International Commission on Zoological Nomenclature that the rules be suspended in the following cases:—

Holothuria, Linn., 1758 (type *physalis*), vs. *Physalia*, Lamarck, 1801 (type *pelagica*). The effect of suspension will be to retain *Physalia* as generic name for the Portuguese man-of-war.

Bohadschia, Jaeger, 1833, vs. *Holothuria*, Bruguière, 1791. The effect of suspension will be to retain *Holothuria* for the sea cucumbers.

The motion for suspension includes the following points:—

(1) Suspend the rules in the case of the generic names in question.

(2) Permanently reject *Holothuria*, 1758, type *physalis*.

(3) Validate *Physalia*, 1801, type *pelagica* (syn. *physalis*, 1758).

(4) Accept *Holothuria* as dating from Bruguière, 1791, despite the existence of *Holothuria*, 1758 (if rejected).

(5) Said suspension is not to be construed as invalidating any specific name.

The grounds for suspension will be:—(*a*) A strict application of the rules in these cases will result in greater confusion than uniformity, because (*b*) the cases involve a transfer of generic names, almost universally accepted in the sense given above since 1791 (for *Holothuria*) and since 1801 (for *Physalia*), to genera in other groups in connection with which they have been used by only a very few authors during more than 100 years.

The undersigned cordially invites zoologists to communicate, not later than September 1, 1917, to him or to any other member of the Commission, either their approval or disapproval of the proposed action.

C. W. Stiles,
Secretary to Commission.

Office of Secretary to International Commission on Zoological Nomenclature, Smithsonian Institution, Washington, D.C.

SCIENTIFIC AND INDUSTRIAL RESEARCH.

The first report of the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research was published in full abstract in the issue of Nature for September 7, and has probably already been read by all who are interested in this important matter. It will therefore be unnecessary to refer in detail to the contents of the report, but it is essential to consider it in its broad aspects and thoughtfully to estimate its bearing as a contribution to the subject of much discussion and contention in the past two years.

One feature of the report is the degree to which it repeats much that has been said and written by British scientific men, engineers, and practical manufacturers in the public discussions which have taken place on this subject during the past twenty-five months or more, but without carrying the matter forward by the prescription of practicable remedies for recognised defects. The arguments for and against various actions are weighed with an air of detachment which gives to it rather the character of an interesting essay than the authoritative decisions of a committee possessing executive power. The public has, without doubt, looked forward to this first report of a committee of eminent scientific men for a masterly, comprehensive, and effectual treatment of the whole subject which would at least outline the strategy of the campaign. The report gives us, however, a more or less tentative discussion of the problem, and sums it up with the rather vague statement that its solution depends upon the largely increased supply of competent researchers, and, secondly, upon a hearty spirit of co-operation among all concerned.

As regards actual achievement, the Council has found that the conditions imposed by the war made it difficult to deal with the problem of assisting pure scientific research effectually, and therefore decided to give science in its applications to industry precedence. Here again, however, obstacles were encountered, and the Council has therefore limited its action to affording financial assistance to about twenty researches which were suggested or begun by engineering or professional societies. It has also expended about 6000*l.* in securing the assistance in certain researches of about forty persons not taken up with other war-work.

In addition to this, there have been established certain Standing Committees on mining, metallurgy, and engineering. A section of the report is occupied with the discussion of the attitude of industry to scientific research, but we think most experienced manufacturers would say that the analysis of the subject does not go deeply enough into the difficulties on the commercial side. The causes which have been at work in retarding or preventing the manufacturer from availing himself more completely of scientific research are very complex, and not by any means due to sheer lethargy or want of foresight. The problem of fostering and encouraging scientific industry is, in fact, a very much less simple one than that of promoting scientific research, although the two act and react on each other in several ways. There would be no difficulty, apart from the present abnormal war-time conditions, in finding men of ability to take up scientific research as a life-work provided only the inducements to it are made sufficiently great, any more than exists in the case of other professions. So long, however, as the pursuit of original scientific investigations remains a blind-alley occupation, or is only capable of being followed in the leisure moments of other work, such as teaching, or by men of independent means, so long will it fail to attract a large number of young men of ambition and ability to its pursuit.

What is required is the formulation of a scheme by which men who have decided or proved talents for pure scientific research can be enabled to devote themselves to it as a life-work with just as much opportunity for reasonable or exceptional emoluments as in other professions. It is said that if scientific abilities were properly utilised in industry such positions would be forthcoming, but having regard to present conditions we are in a vicious circle. If pure scientific research is of national importance, then it behoves the nation to make its pursuit possible as a profession apart from any connection with industry. It is, therefore, much to be regretted that the Council has not been able to formulate even in outline some more definite proposals with this end in view. The establishment of scholarships or temporary engagements at 150*l.* a year or so does not meet the case. There must be the prospect of such permanent and well-paid work as shall induce men of high abilities to take up research work as the business of their lives.

With regard to the relations of industry and science, the report does not furnish recommendations of any very definite character. It is realised by the Council that manufacturers and men of business have not any reluctance to avail themselves of scientific assistance or advice provided they can be shown that expenditure on it is an investment and not a mere speculation. Hesitation to embark on it is not always to be regarded as an indication of disbelief in its utility, but is determined very much by the scale of the business. A small concern, or one of moderate capitalisation, simply cannot afford to wait long for a return on an investment of capital. It must be certain of it within a limited time if it is to continue to exist at all. Moreover, of late years manufacturers have lived in an atmosphere darkened by the clouds of incessant contests with labour, and with the uncertainties arising from legislation directed rather by the interests of parties and politicians than by any serious attempts to support the staple industries of the country. Hence they have been compelled to take short views, and not launch out into enterprises which might bring them no appreciable return. Until these deep-seated difficulties are cleared away, it is therefore futile to reproach the individual manufacturer or manager with his backwardness in availing himself of scientific research.

The report supplies, however, a large amount of interesting information which shows that, under the pressure of circumstances, many trade associations, originally formed merely to fix prices, regulate production, or battle with labour, are now turning their attention to co-operative scientific inquiry as a means of relieving themselves of difficulties created by foreign monopolies of manufacture. In this effort it is probable also that the Advisory Council and its Standing Committees will perform the very useful function of being a clearing-house for ideas, suggestions, and inquiries, and act as guide, philosopher, and friend to these associations who are thus endeavouring to work out their own salvation. There is only one way in which the British manufacturer can meet the threatened post-war competition, and that is by standing shoulder to shoulder with his fellows against the common foe. Isolated they will be destroyed in detail, but as a phalanx they will prevail. The Advisory Council will, no doubt, fulfil a very important function in being a centre to which confidential information and inquiries may be directed in the first efforts to establish and conduct that conjoint scientific work which such co-operation of kindred trades will require.

Turning, then, to that section of the report which deals with the sphere of the universities and technical colleges in relation to scientific research, we find the same absence of positive constructive suggestions for reform as in other portions of the report. The defects or deficiencies of our present conditions are pointed out, but the remedies for them only indicated in the most nebulous manner. It is stated with great truth that "the universities can and must be the main sources of research in pure science, the discoveries in which lie at the root of all practical and technical applications." But no definite recommendations are made as to how this output is to be increased.

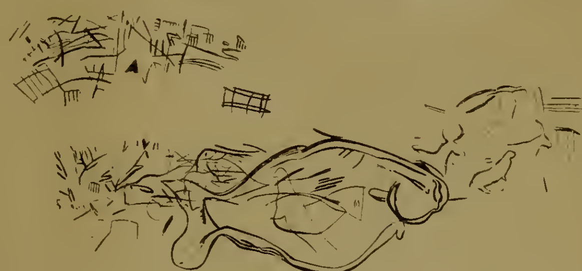
It should be clearly recognised that effective research work of a high class demands a continuity of effort and time which it is in many cases almost impossible to obtain for university teachers. A man who has to drop his observations or experiments at a critical moment to go off and give a lecture or attend a committee or superintend a laboratory class is not placed under conditions in which the best work can be done. On the other hand, there are many men who are admirable and capable as teachers and as college administrators who have not the gifts of originality which make them shine as investigators. The only way out of this difficulty is to separate the functions more clearly. Every university should have research professorships and chairs, the occupants of which should have as their principal work to enlarge the bounds of knowledge in their particular subject.

The report does not furnish us with any definite proposals for the establishment of such research scholarships, fellowships, or professorships, but confines itself to the enunciation of broad and general aspirations in this respect. The universities will have suffered greatly by the close of the war in the loss of many of their most promising and talented students and teachers whose valuable lives have been given in the service of their country. We have to make provision for the careful cultivation of originality and research power in those who remain or return, and it would therefore have been much to the point if we could have found in this report a carefully-considered programme with this object in view. We think that many who study the report will feel disappointed that it does not contain more definite pronouncements of constructive policy in place of generalities. Much of it has the tone of an able article written for a leading monthly magazine rather than the enunciation of the matured conclusions and decisions on the part of a Government-appointed Committee recording the results of more than a year's consideration of this vital subject. Time presses, and our national position now demands vigorous and well-determined action rather than leisurely and academic discussion of our needs.

J. A. F.

THE ART OF THE CAVE.[1]

IN "La Pileta" a further considerable contribution is made to our knowledge of the Jurassic caves of South-west Europe by Abbé Breuil, in collaboration with Dr. Obermaier and Col. Willoughby Verner. The cave, which takes its name from the hill in which it is found, is, with its various corridors, recesses, and "galeries," more than usually complicated, and in fact at certain periods it provides accommodation for a stream and a lake. Wherever the cave opens out to form a chamber, wall paintings are to be seen, and it is these paintings which constitute the chief interest of the cave. The paintings comprise examples of four separate pictorial phases. The earliest are yellow in colour, and consist largely of serpentine forms with an occasional realistic figure of a goat, ox, or horse. The second series in chronological order is red in colour, and here, in addition to animal forms, are to be found various signs or symbols—recurrent dots, lines, spirals, ovoid figures, "claviformes" and "tectiformes." These are followed by a series drawn with charcoal, in which forms of animals naturalistically treated largely predominate, among them, be it noted, in considerable numbers the figures of fish—a new feature in parietal art, as the authors point out. With these are interspersed serpentine forms and schematic figures of animals. It is among these last figures that the authors believe they can recognise figures intended for human beings, and that an attempt has even been made to indicate the sex. The fourth and last series is purely schematic, and comprises geometrical figures with little or no zoomorphic or anthropomorphic suggestion. The vast majority of the figures are pectiniform, the number of teeth and the orientation of the backs of the combs exhibit-



Panneau No. 49, dit du grand Poisson. From "La Pileta."

[1] "La Pileta à Benaojan (Malaga) (Espagne)." Par l'Abbé H. Breuil, Dr. H. Obermaier, et Col. Willoughby Verner. Pp. 65+plates i–xxi. (Monaco: A. Chêne, 1915.)

ing a wide variation. In several cases the combs are combined to form composite figures. In the opinion of the authors the four phases represented extended over a long period, from Aurignacian to Neolithic times. The pictures are, although inferior in execution, closely related to those of Altamira, Niaux, and Font de Gaume, while the signs and symbols follow closely the rock engravings of Portuguese South-east Africa.

The most outstanding feature is the appearance of fish among the animal forms. The fish represented are of the Plaice or Brill family, and form the only instance so far known of fish painted on the walls of a cave, although engravings of fish have been reported from Pindal, Niaux, and "La Gorge d'Enfer." The book is admirably illustrated, and maintains in every way the high level which we have come to associate with the publications of the Institut de Paléontologie Humaine de Monaco. WILLIAM WRIGHT.

BACTERIOLOGICAL RESEARCH IN BOMBAY.

THE report of the Bombay Bacteriological Laboratory for the year 1914, by Major W. Glen Liston, reached this country recently. The report is divided into two parts: (1) that dealing with plague work, and (2) that dealing with general preventive medicine. Statistics are furnished which tend to show that the uninoculated are attacked three times more frequently than the inoculated (against plague). One drawback to the use of plague vaccines is the severe reaction which follows, deterring others from undergoing the operation. It is now suggested, as results of experiments on rats and observations on man, that a small initial dose of 1-2 c.c. should be given, to be followed in a week by a second dose of 2-4 c.c. It appears that there are two other species of fleas of the genus Xenopsylla—viz., *X. brasiliensis* and *X. astia*—besides the originally known species *X. cheopis*, which, however, forms 80 per cent. of the three species concerned. Whether they all transmit plague is a question which must arise. The results of the examination of rats in the laboratory show that both in the case of *M. rattus* and *M. decumanus* there is a rise above the mean in the rate of infection in the latter half of January, whereas the rise above the mean in human plague mortality occurs in the first half of March. The fall below the mean occurs at the same time for both species of rats and for man—viz., in the first half of June. The summit of the infection for *M. rattus* precedes that of *M. decumanus* by a fortnight, while the infection of the latter and the mortality in man reach their maximum at the same time—viz., in the latter half of April.

It is disheartening to see in connection with the prevalence of guinea worm in the town of Ranebennur that years have passed in a fruitless discussion of various plans to improve the water supply of this town. The guinea worm infection is 1·45 per cent. In the village of Desai it is calculated that the extermination of guinea worm would result in a net gain of 219 rupees per annum. Here, as elsewhere, sanitation always means a net cash gain in the end. The nature of rat-bite fever is unknown, but the fact that salvarsan rapidly cures it suggests a spirochæte origin. A "number of cases" came under observation; but why not state the actual number? The report, though short, contains much of interest and evidence of good, sound work.

J. W. W. S.

NOTES.

WE record with deep regret the death on September 16, in his seventy-third year, of Sir Lauder Brunton, Bt., F.R.S., consulting physician to St. Bartholomew's Hospital, and of high distinction by his work and teaching in physiological medicine.

WE regret to see in the *Morning Post* the announcement of the death of Prof. Pierre Duhem, professor of theoretical physics in the University of Bordeaux, and the author of several works of wide interest on the history of natural philosophy and physical subjects.

ONE of the incidental effects of the European war upon America is the stimulus it has given to the adoption of the metric system. Very many American factories now turning out munitions for the Allies are working almost entirely in metric dimensions. Even locomotives are being manufactured in metres and millimetres. "The same thing, in all likelihood," says the New York *Evening Post*, "is taking place in England, which is furnishing munitions for Russia and other of her Allies."

A NEW YORK telegram announces the death on September 18, at sixty-six years of age, of Mr. Seth Low, president of Columbia College from 1889 to 1901, during which period the college became Columbia University. Referring to his work for the university, the *Times* says: "He did much by his businesslike administration, his liberality (he personally contributed 200,000*l*. to the fund which enabled it to be removed to its magnificent site on Morningside Heights, New York City), and his especial interest in the department of political science."

THE Sociedad Argentina de Ciencias Naturales, of Buenos Aires, which issues the journal *Physis*, has arranged to hold meetings similar to those of the British Association, every two years, in one of the towns of the Argentine. No scientific assembly of this kind has hitherto been held in South America. The first meeting will be held at Tucuman in the last week of November next, in commemoration of the first centenary of the declaration of the independence of the Argentine Republic in 1816. Tucuman is the busiest and most populous town in the north of the republic. It possesses a university, a Museum of Natural History, of which Prof. M. Lillo is director, two agricultural experiment stations, and other institutions of scientific interest. The Governor of the State, Don Ernesto Padilla, is honorary president of the local committee for the meeting. The president of the whole assembly will be Prof. A. Gallardo, director of the Buenos Aires Museum; and the Minister of Public Instruction will be the honorary president. There will be nine sections, which, with their presidents, will be as follows:—I., Geology, Geography, and Geophysics, M. Enrique Hermitte; II., Palæontology, M. Carlos Ameghino; III., Botany, Prof. C. M. Hicken; IV., Zoology, Dr. E. L. Holmberg; V., General Biology, Anatomy, and Physiology, Prof. J. Nielsen; VI., Anthropology, M. J. B. Ambrosetti; VII., Physical and Chemical Sciences, Prof. E. H. Ducloux; VIII., Applied Natural Sciences, M. T. Amadeo; IX., Education in the Natural Sciences, Prof. V. Mercante. The general secretary of the Congress is Prof. M. Doello-Jurado, to whom communications should be addressed at rue Perú No. 222, Buenos Aires.

The *Morning Post* of September 13 gives a brief account of a ship constructed of concrete with steel ribs, ordered by M. Broström, the Swedish Minister of Marine. The ship appears to be about one thousand tons in displacement, and resembles a large barge It is said that it is proposed to construct concrete ships of from 15,000 to 20,000 tons displacement, and a vessel of 3000 tons is now under construction. Our contemporary is not correct in describing this ship as the first stone vessel ever floated. Thus *Engineering* of June 14, 1912, gives a description and drawings of the first reinforced-concrete pontoon built in this country and used for sludge pumping on the Manchester Ship Canal. This vessel was constructed on the Hennebique system, designed by L. G. Mouchel and Partners, of Westminster, and was 100 ft. long by 28 ft. wide by 8·5 ft. deep; there were four transverse and two longitudinal bulkheads, and a complete installation of steam-pumping machinery. The first reinforced-cement boat appears to have been built by M. Lambot-Miravel in 1849, and was exhibited at the Exposition Universelle of 1855. An early example of ferro-concrete barge-building is the vessel completed in 1906 for M. Grancher, of Aveyron, in France, and employed regularly for sand dredging. Numerous other barges and pontoons of this type of construction have been built for use on the Tiber, Panama Canal, and elsewhere. There are, no doubt, possibilities in the development of ferro-concrete vessels, but we do not expect to hear in the near future of Transatlantic liners built on this plan.

In the autumn of 1815, the year of Napoleon's final downfall, the Société helvétique des Sciences naturelles was founded at Geneva. It may, however, be called the offspring of two earlier societies, one representing the physical, the other the biological side of science, the older of which dated from 1791, and had thus survived the troubles inflicted by the French revolution. Small at first, it grew rapidly, and among the foreigners who attended its jubilee were Frankland and Tyndall. From the first it was a publishing society, and has now issued a fiftieth volume, in commemoration of its centenary, which was celebrated last year. This consists of reports from leading members of the society, which cover every branch of its work in the past and at the present time, together with short biographical notices of the workers themselves, many of them never to be forgotten by any scientific lovers of the Alps. The result is a very interesting volume, which will also have a permanent value in facilitating reference to the more important papers—and these are not few—which have been published by the Society. It has dealt with almost every branch of natural knowledge, for a mountain chain like the Alps propounds to the physical geologist not a few difficult problems, and as its climatic zones range from temperate to polar regions, it affords successive illustrations of their flora and fauna. The volume, in short, summarises the work of at least three generations of enthusiastic naturalists, workers at geology, physical geography, and meteorology, botany and zoology, past and present, and archæology (among whom we must not forget the earliest investigators of pile dwellings). One of the society's committees has also greatly aided in the systematic study of glaciers. It is interesting to learn that the idea of these having once extended far beyond their present limit occurred independently, in the year of the society's birth, to an engineer, Ignace Venetz, and to a chamois hunter of the Val de Bagnes named Perraudin.

The *Electrician* was started as a weekly journal in 1861, when telegraphy was almost the only electrical industry. It came to an end in 1864, but was revived in 1878, at a time when the applications of electricity were becoming more numerous, and since then has always occupied a leading place amongst the electrotechnical journals. In commemoration of the appearance of the 2000th number, which was issued on September 15, special articles are included in the number dealing with the development of the various branches of the electrical industry, and written by experts. As they touch on the principal events only, they are not too long for the general reader, and should prove of great value to the worker in one branch who wishes to know something of the history of those parts of the industry with which he is not immediately brought into contact. In addition to these historical articles there are others dealing with the present position of affairs in the industry and in the country which deserve careful consideration. Dr. Walmsley, as a teacher, urges the authorities to stop depleting the universities and technical colleges of the engineering and chemical students whose services will be so much needed by the country when the war is over. While on one hand the report of the Committee of the Privy Council for Scientific and Industrial Research expresses the pious hope that "voluntary efforts of manufacturers in friendly union" will succeed in raising the general level of manufacture in this country, on the other we find Mr. Swinburne putting forward the view that the manufacturer should be left to work out his problems in his own way.

In the September issue of *Man* Prof. Seligman illustrates and describes a primitive form of reaping knife used by the sedentary Arab tribes of northern Kordofan. It can scarcely be called a sickle, consisting of an iron blade, more or less razor-shaped, and having at right angles at each end a small tang, which is thrust into a wooden handle. The blades are said to be made by the Arabised descendants of the pre-Arab iron-working Nuba, who still dwell on the hills which dot the plains of northern Kordofan. In reaping the dura the heads are cut off, with only a few inches of stalk, the stems being left in the ground until thoroughly dry, when they are pulled up and used for thatching, fencing, and other purposes. He remarks that this example may possibly indicate the purpose of a form of stone knife found in Europe in Neolithic times, as in the pile dwellings of Locras, whence comes the specimen now in the Sturge collection.

Mr. W. H. D. Le Souef has reprinted from the Journal of the Royal Geographical Society of Australasia an interesting paper on "Aboriginals' Culinary Methods and Kitchen Middens." He remarks that, as regards food, little came amiss to them that was not absolutely poisonous. They did not eat any animal or bird they found dead unless they knew how it had been killed, and not even then unless it was fairly fresh, as they objected to meat that was much fly-blown. Slightly tainted meat did not trouble them much; they only cooked it a little more. Some of the mounds at which they used to cook their food are of large extent, as much as 100 ft. in diameter. Unfortunately many of these have been occupied by rabbits, and have thus suffered much injury. As many of the kitchen middens along the coast are becoming eroded, the author suggests that a photographic record of them should be prepared before it is too late.

In the Memoirs of the Connecticut Academy of Arts and Sciences (vol. v., 1916, pp. 1–96, plates i.–xxxix.) Dr. G. F. Eaton publishes an exhaustive report on the human skeletons from Indian graves at Machu Picchu, Peru, obtained by the Yale University Expedition of 1912. Most of the burials were in caves, and the mummies seem to have been placed sitting in the contracted position. A large proportion of the skeletons were imperfect, and Dr. Eaton suggests that many deficiencies were caused by accident when the mummies were temporarily removed from their burial places during festivals, in accordance with a well-known custom under the rule of the Incas. Of 164 skeletons collected, no fewer than 109 were certainly of females, while most of the male skeletons represented individuals of inferior physical development. Bronze and bone implements, objects of green chloritic schist, earthenware spindle-whors, and fabrics both of llama's wool and of vegetable fibre, besides a large collection of well-preserved pottery, are also described and figured. The rare articles of post-Columbian or European origin are to be regarded as having been introduced after the original burials.

Since the classic work of Gaudry on the late Miocene or early Pliocene mammals occurring in bone-beds at Pikermi, near Athens, discoveries of deposits containing similar mammalian remains have multiplied in eastern Europe. During recent years many have been made, especially in southern Russia, and various preliminary notices of them have appeared. Madame Marie Pavlow has now thoroughly investigated these discoveries, and published the results in a handsome memoir which forms the third and fourth livraisons of vol. xvii. of the *Nouveaux Mémoires* of the Imperial Society of Naturalists of Moscow. A description of the geological formations whence the fossils were obtained is appended by Prof. Alexis P. Pavlow. So far as known, the Russian fauna, with the usual preponderance of Hipparion, is remarkably like that of Pikermi, the only striking difference being the absence of the true Rhinoceros. After describing remains of giraffes, Madame Pavlow discusses a well-preserved skull of Palæotragus, which she maintains is an antelope, not a giraffe, as supposed by Forsyth Major. There are also remains of other well-known antelopes and gazelles, a few fragments of deer, and a fine skull of the large pig, *Sus erymanthius*. Several skulls of a hornless rhinoceros, Aceratherium, closely related to a species found at Maragha, in Persia, are important as making known several growth-stages. The numerous skulls and jaws of *Hipparion gracile* are also valuable for the same reason. Teeth of Mastodon, Dinotherium, and Orycteropus occur, and there are some fragments of Carnivora, including the skull of a large cat related to the American Miocene Pogonodon. Madame Pavlow has already made many welcome contributions to our knowledge of the newer Tertiary mammals of Russia, and she is to be congratulated on the manner in which she has presented the latest results of her researches.

Before the war Russian men of science, and especially biologists, had to send a very considerable proportion of their writings abroad for publication, and the German journals thus became the common medium for much of the best Russian work. Soon after the outbreak of war efforts were made to remedy this state of affairs; of the new journals, Profs. Skimkewitch and Dogiel are editing the *Russian Journal of Zoology*, Profs. Sewertzoff and Elpatiewsky the *Revue Zoologique Russe*, and Prof. Dogiel the *Archives Russes d'Anatomie, d'Histologie et d'Embryologie.* The first number of the latter has just appeared; it contains an article in English by A. Maminov on "The Cultivation of Connective Tissue of Adult Mammals *in vitro*," and two memoirs in French, one by the editor on the structure of sensory nerve-endings in the beak and tongue of birds, and another by A. N. Sewertzoff on the morphology of the skull and head muscles of Cyclostomes. The excellence of these researches, no less than of the typography and illustrations, is a happy augury of the success of this new journal, on which Prof. Dogiel of Petrograd is to be heartily congratulated. It is of particular interest to note that, in spite of the enormous drain on the Imperial finances, the Minister of Public Instruction, Count Ignatiev, made the publication of this journal possible by a Government subsidy.

In the Nouveaux Mémoires de la Société Impériale des Naturalistes de Moscou, M. G. A. Belogolovy records some very remarkable experiments on the development of the frog Pelobates. The experiments were undertaken with the view of throwing some light upon the factors that are concerned in bringing about the phenomena of recapitulation in ontogeny. Their significance from this point of view may be regarded as somewhat obscure, but at any rate they have yielded some very curious results, and perhaps it is not too much to say that they have opened up a new field in the domain of experimental embryology and pathology. The author's intention was to rear the embryos as parasites upon adults of the same species, instead of as free-living individuals in their normal aquatic environment. He introduced the eggs into the body-cavity of the adult through an incision in the body-wall, and found that they attached themselves to the surface of the various viscera, etc., and in the course of a few weeks developed into highly abnormal structures, sometimes permeated by blood capillaries apparently derived from the tissues of the adult, through which they derived their nutriment. These results will probably be of interest to pathologists rather than to embryologists, especially from the point of view of those engaged in cancer research. The necessary operation appears to be a very simple one, but the animals treated as hosts to the parasitic embryos remained alive but for a few months, and then only when kept in water. The memoir is well illustrated, the histological features of the parasites being represented in two very beautiful and elaborate coloured plates.

The *Bull. Imp. Acad. Sci.* (Petrograd, May, 1916) contains the description of a new species, differing in many essentials from other species, of Helicoprion, *Helicoprion clerci*, so named in honour of Onisime Jegorovič Klerk (O. Clerc), president of the Ural Naturalists' Society. Accompanying the description are drawings in natural size of the five fragments found at Krasnoufimsk. So far only two species have been discovered in Russia—*Helicoprion bezsonovi* and another, hitherto undescribed, found by A. P. Ivanov in the Government of Moscow. The well-known American naturalist, C. R. Eastman, directed attention in 1905 to the instructiveness and unexpectedness of certain palæontological discoveries of recent years, pointing out specially Pareiasaurus among the Reptilia, Helicoprion among the Pisces, and Dæmonohelix among the problematical forms. The nature of this last fossil has now been finally settled. Eastman, as an ichthyologist, focussed his attention on Helicoprion and allied forms, Edestus and others. Since then the interest in them has not waned, and the literature of the subject grows apace.

THREE valuable essays appear in the Proceedings of the Birmingham Natural History and Philosophical Society, vol. xiv., part 1. The first of these is by Mr. Leonard J. Wills, on "The Structure of the Lower Jaw of Triassic Labyrinthodonts." The author's investigations were based upon fragments of Labyrinthodont mandibles found in the Lower Keuper Sandstone of Bromsgrove, Worcestershire. The author comes to the conclusion that the Stegocephalian mandible helps to bridge over one of the gaps between the fishes and the reptiles. The jaw of the latter can be derived from the Stegocephalian mandible by a fusion or suppression of some of the elements, such as was probably taking place, even in Permian and Triassic times, in the case of the coronoid bones. The second concerns the geology of the eastern boundary fault of the South Staffordshire coalfield. The author, Mr. W. H. Foxall, describes the coal-beds, the Red beds, the Bunter Pebble beds, and the Glacial drift. The third, illustrated by numerous photographs and diagrams, is contributed by Prof. W. S. Boulton, who deals at length with the problems presented by an Esker near Kingswinford, South Staffordshire. The events recorded, the author believes, happened towards the close of "the Ice age, when the ice had ceased to advance; when, indeed, it was melting faster than it could be replenished from the northern Highlands, and the ice-front, in consequence, was slowly retreating northward."

SOME authoritative statement is required to discourage the popular belief that the heavy rains experienced this summer are connected with the bombardment in France and Flanders. In the Meteorological Office Circular, No. 3 (August 21) there is a note on the subject. Experiments to test this hypothesis have been made in Europe, America, Alaska, and Australia, but without result, and there is no evidence of any such influence. Furthermore, the energy of the heavy bombardment now proceeding, even if applied entirely to the removal of the heat required to produce rain, which it is not, would be inadequate for the purpose. Nor must the spells of brilliantly fine weather be forgotten. These occurred while the bombardment was proceeding.

IN an article in the *Geographical Review* for August, 1916 (vol. ii., No. 2), on the pirate coasts of the Mediterranean, Miss E. C. Semple points to the parallel between the hunting grounds of the German and Austrian submarines and those of the ancient and mediæval corsairs. Mediterranean piracy has recrudesced whenever maritime political control is relaxed, and certain localities determined by geographical conditions are the natural hunting-ground of the sea-robbers. The configuration of the basin has always compressed traffic into certain narrow routes. From these routes traffic is unable to deviate, as it can in the open ocean. The nodal points on the routes—that is, where land restricts traffic to a more or less narrow strait—have been especially favourable to pirates. Not only are they more sure of much prey at these points, but they stand a better chance of escape to their lurking places along the indented coasts. The paper is an excellent survey of the physical conditions of the Mediterranean that on one hand favoured legitimate seamanship, and on the other that debased form which manifests itself as piracy.

THE report for 1915 of the director of the Liverpool Observatory, Bidston, shows that the ordinary work of the observatory has been carried out during the past year, while progress has been made in at least one direction. Besides the Milne seismograph, a new instrument, designed by Mr. J. J. Shaw, has been erected to record the tilt produced by the oscillations of the tidal load in the neighbourhood, and is working with good results. The number of earthquakes registered during the year is 195. A small record was obtained of the Carlisle earthquake of October 2, the oscillations of which lasted for a quarter of an hour.

ATTENTION may be directed to the Monthly Record of Meteorological Observations, published by the Meteorological Service of Canada, of which we have received the number for March. It contains in a convenient form the complete meteorological data of some thirty stations in Canada, and also from Newfoundland and Bermuda. The publication contains two maps, one illustrating the total precipitation for the month, and the other the departure from the average temperature for the month. In addition to the stations providing detailed records, there are a large number for which only the monthly means and the extremes are given. There is, of course, a lack of data from the north of Canada. The monthly record contains no discussion of the data.

THE value of fique, the fibre of *Furcraea gigantea*, in Colombia is emphasised in a short article in Kew Bulletin No. 7 by Mr. M. T. Dawe, Director of Agriculture in Colombia. It is used for the soles of the native shoes or alpargatas, sacks, girths, ropes, matting, and even for roofing the houses. For the latter purpose the green leaves are used, and the article is illustrated by a photograph showing a cottage thatched with the leaves of fique. Hand-prepared fibre is sold in the Bogotá market at *6d.* per lb., but by using modern machinery a profit of 19*l.* per ton might be expected if the fibre sold at its present wholesale price of 160 dollars per ton. On export with a selling price of 25*l.*–30*l.* per ton a profit of 5*l.*–10*l.* per ton should be realised.

WITH a view to the ultimate production of a portable dry storage cell, M. Charles Féry has, with the help of his pupil, M. E. Fournier, examined quantitatively the chemical changes which take place in the ordinary storage cell. His results will be found in the January number of the *Journal de Physique*. He finds that neither the simple theory of sulphation of both positive and negative plates first put forward by Gladstone and Tribe, nor the later theories involving the production of an unstable higher sulphate at the positive plate are in agreement with the measurements. In the first place, the amount of sulphuric acid which disappears during the discharge of the cell is half that required by the double sulphation theory. In the second place, the change of weight of the positive plate is much less than it should be according to that theory, and takes place in the opposite direction. His final conclusion is that the reactions which take place during discharge of the cell may be represented by the equation

$$Pb + H_2SO_4 + Pb_4O_7 = PbSO_4 + H_2O + 3PbO_2,$$

or possibly by

$$Pb + H_2SO_4 + Pb_2O_5 = PbSO_4 + H_2O + 2PbO_2.$$

The former involves the production of 15 grams of peroxide per ampere hour, the latter 10·4. In actual practice 12 to 14 grams are produced.

OUR ASTRONOMICAL COLUMN.

THE VARIABLE NEBULA IN CORONA AUSTRALIS.—A somewhat extended investigation of this remarkable object—N.G.C. 6729—has been made at Helwân with the Reynolds 30 in. reflector, and a brief account of the observations, with illustrations, has been given by J. H. Reynolds (*Monthly Notices*, R.A.S., vol. lxxvi., p. 645). The thirty-seven photographs taken during 1914 and 1915 clearly demonstrate that the nebula is variable in form as well as in brightness, and it seems probable that its variability is closely related to that of the variable star R Coronæ Australis, to which it appears to be attached. The appearance is such as might be expected if the nebulous matter was discharged from the star when at its maximum brightness and illuminated by it.

Further particulars are given by Mr. Knox Shaw, who took the photographs. The forms of the nebula can be classified into seven types, ranging from the first, in which the nebula is very bright and attached to the star, to the seventh, where the nebula is very faint and entirely detached. There is, however, no simple relation between the form of the nebula and the magnitude of the star; the nebula is brightest when the star is brightest, but is not always of the same form for a given magnitude of the star. It seems quite possible that the apparently imperfect correspondence between the variations of the nebula and those of the star may be caused by the presence of absorbing matter lying between them and the earth. If this absorbing matter were of varying thickness and in motion, it would naturally complicate the phenomena, but it is not suggested that this is the main cause of the variability.

PROPER MOTIONS BY THE BLINK-MICROSCOPE.—A further report on the use of the blink-microscope (see NATURE, vol. xcvi., pp. 237 and 438) in the detection and measurement of proper motions has been issued by Mr. Innes (Union Observatory Circular, No. 35). The greater part of the report refers to the comparison of eight astrographic plates taken at Greenwich, at intervals approximating to twenty years, and forty-three proper motions of stars ranging in magnitude from 7·1 to 13·5 are tabulated. As an indication of the rapidity of work by this method, Mr. Innes states that the investigation of the eight regions, including the identifications and reductions, occupied only twenty-four hours, although there was no attempt to make a record. Every pair of plates confirmed the impression that the vast majority of stars, bright and faint, are relatively fixed, and the measures were made on this assumption, the numerical work then being very slight. If plates are taken with a view to their ultimate examination by the blink-microscope, Mr. Innes considers that long exposures should be given, as crowded regions are a great advantage. Triple images are unnecessary, and double images are also superfluous if a third plate be available.

THE PERIOD OF U CEPHEI.—A discussion of Wendell's observations of this well-known eclipsing variable has been undertaken by Martha B. Shapley (*Astrophysical Journal*, vol. xliv., p. 51). The observations were made at Harvard during the years 1895–1912 with a polarising photometer, the total number of comparisons being 17,296; they have a special value because the instrument, method of observing, and comparison star were the same throughout this long period. As the light at minimum is constant for about two hours, Wendell observed mainly the steepest part of the ascending or descending branch, and in most cases the time at which the star was at a specified magnitude—say, 8·40—can be determined from the observations with an uncertainty of less than a minute. Variations in the mean phases of both steep branches are apparent, and there is evidence that the variation is not in the duration of minimum, nor due to variability of the comparison star, but a definite change in the light period. When all the observations since the time of discovery in 1880 are considered, it is evident that they are not satisfied either by Chandler's elements (1903) or by those of Wendell (1909). The latter serve best as a working formula at the present time, but would probably predict the minima too early. The variations are apparently very complex, and no attempt has yet been made to obtain an analytical expression for them. Wendell's formula is

$$\text{Min.} = \text{J.D. } 2407890{\cdot}3007 + 2{\cdot}4928840\text{d. E}$$

with zero phase at the midpoint of minimum light. The mean magnitude at minimum is 9·14, and at maximum 6·81.

MR. JOHN ANGELL.

ON September 9 there passed away in the person of Mr. John Angell a figure notable in the educational world of Manchester. He was born in London in 1824, and in his early educational career was chemical assistant to Prof. Thos. Graham, F.R.S., professor of chemistry in University College, London, and was hon. secretary to the Birkbeck School Committee, whose school was the first established in Great Britain with the object of demonstrating both the desirability and the possibility of teaching soundly and rationally the elements of science as leading everyday subjects in the ordinary day school. In 1852 he accepted an appointment at the Salford Mechanics' Institute as head of the Boys' School established therein, and five years later became the organiser of the day and evening classes of the Manchester Mechanics' Institution, then established in a new and commodious building in that city, where he remained for twelve years, resigning his position in 1869 to accept the senior science mastership in the Manchester Grammar School, then under the vigorous direction of Mr. F. W. Walker, afterwards master of St. Paul's School, London. Mr. Angell remained at this post for eighteen years, during which period he greatly raised the reputation of the school by his energetic and intelligent teaching of science, especially in the subject of physics. He was an enthusiastic disciple of George Combe, whose teaching, as exhibited in his work, "The Constitution of Man," as he said, "completely revolutionised the course of my life." He was an ardent and enlightened exponent of the "Socratic" method of instruction, which he applied with much success in the courses he gave in chemistry, physics, and physiology to day and evening pupils during his career at the Manchester Mechanics' Institution. In 1868 the Institution was visited by a French Imperial Commission appointed to visit and report upon secondary education in England and Scotland. In its report it has nothing but praise for the methods of teaching in use. "If he selects a reagent, it is because some pupil suggested it; if he obtains a gas in his analysis, he has already caused his students to predict its nature. . . . 'My object,' as this excellent teacher told us, 'is to train the intellect through the study of science.'" His work as a teacher received the approval of such men as Drs. Joule and Angus Smith, and Profs. Clifton, Williamson, and Roscoe. He ceased his duties as a teacher in 1887, but continued his keen interest in scientific subjects in association with many of the literary and scientific societies of Manchester of which he was an active member almost to the day of his death at the ripe age of ninety-two. He was the author of many once widely used science text-books.

AURORA AND MAGNETIC DISTURBANCES OF AUGUST 27, 1916.

WITH reference to the aurora reported by Mr. W. F. Denning at Bristol on August 27, between 2 and 4 a.m. G.M.T. (NATURE, August 31, p. 551), the Director of the Meteorological Office notes a report received from Mr. J. Ernest Grubb, observer at Seskin, near Carrick-on-Suir, Co. Waterford, Ireland, that aurora was visible there on the night of August 26 between 10.5 and 10.40 p.m. G.M.T. The greatest display noted by Mr. Grubb occurred about 10.25 p.m., when streamers from N.W. to N.N.E. stretched to within 20° or 30° of the zenith. The light was sufficiently brilliant to illuminate the interior of a room facing W.N.W.

At Eskdalemuir, Dumfriesshire, in spite of a cloudy sky, auroral glow in the N.W. was reported by the observer at 9 p.m. on August 26 and 1 a.m. on August 27. The magnets at Eskdalemuir and Richmond (Kew Observatory) were considerably disturbed, especially at the former station. The full amplitude of the disturbance there in the north and vertical components cannot be assigned, owing to the limit of registration being passed, but the range in each element considerably exceeded 400 γ ($1\,\gamma \equiv 1 \times 10^{-5}$ C.G.S.), and in the west component it was fully 300 γ. At Kew the ranges of the horizontal force and vertical force were approximately 250 γ and 200 γ respectively. Declination at Kew had a range of 27′, the most rapid movements occurring early on August 27; the extreme easterly position was reached at about 2.5 a.m., and the extreme westerly at about 2.35 a.m.

A notable feature, especially at Eskdalemuir, was the "sudden commencement," introducing the storm at about 7.45 p.m. on August 26. Its oscillatory character was particularly well shown in the north component, a very rapid fall of 11 γ preceding a rapid rise of 100 γ. After this commencement the horizontal component at Eskdalemuir and Richmond (Kew Observatory) remained above its normal value until about 10 p.m., when it fell below normal and remained so, while oscillating considerably, during the rest of the disturbance. The depression in the horizontal component at Kew Observatory at 6 a.m. on August 27, when the storm was nearly over, exceeded 100 γ. An interesting feature in the vertical force curves at Eskdalemuir towards the end of the storm after 6 a.m. on August 27 is a series of oscillations of short period, averaging about 4·6 minutes, which recall a similar phenomenon observed there in the storm of November 5-6, 1915.

THE display of Aurora Borealis on August 26–27 was observed by Dr. John Satterly in Canada. Writing from Jackson's Point, Lake Simcoe, Ontario, Dr. Satterly says that on August 26 the whole northern sky from horizon to zenith was illuminated for several hours. On the horizon there was a strong yellowish glow with streamers radiating upwards. Arcs of light encircled the zenith, and flickering bands and patches of colour were seen in middle altitudes. The smallest newspaper headlines could be read at 11 p.m. On August 28 the northern lights were feeble, but at 10.30 p.m. (Eastern time) an immense riband of light, practically a complete semicircle, spread across the sky. It extended from the east and rose a few degrees south of Jupiter, threaded Pegasus diagonally, cut Cygnus, passed through Lyra to the north of Vega, and dipped down through Hercules to the west. Stars in their apparent rotation passed across it, so that the band was fixed relatively to the earth. The arc intersected the Milky Way at about 60° or 70°, very nearly at the zenith; it was much brighter and narrower and more definite than the Milky Way. No portion of the arc appeared in the northern sky. At 11.15 p.m. the western half faded away gradually, and at 11.30 p.m. the eastern half vanished.

THE SAKURA-JIMA ERUPTION OF JANUARY, 1914.

PROF. OMORI has recently published a second valuable memoir on the eruption of Sakura-jima, which occurred on January 12, 1914.[1] The volcano lies in Kagoshima Bay, in South Japan, a few miles to the east of the city of Kagoshima. Until the last eruption Sakura-jima was an island. It is now connected by a lava-stream with the east side of the bay. The part of the bay lying to the north of Sakura-jima ranges in depth from 70 to 107 fathoms, and is apparently of the same origin as the deep lakes which are found behind the sea-coast volcanoes of Usu-san and Tarumai-san.

Displacements of the Ground.—Soon after the eruption it was noticed that the sea-level had undergone an elevation relatively to the adjoining coast. At high tides the low districts at the south end of Kagoshima were flooded. Along the north-west and north coasts of Kagoshima Bay the rise of the water was still greater, embankments and stone walls being damaged and extensive rice-fields devastated. The amount of the sea-level elevation was nearly a metre at Kagoshima and two metres or more in Sakura-jima. The apparent sea-level elevation was greatest at the end of 1914, after which it began to decrease.

Prof. Omori attributes this change to the depression of the ground in the neighbourhood of Sakura-jima in consequence of the great eruption. This depression was revealed with greater precision by a renewal of the Military Survey levelling of the district and of the levelling along the railway lines near Kagoshima Bay. Prof. Omori has represented the results on a map on which are drawn the curves of 50, 100, 300, and 500 mm. depression. The curves of 300 and 500 mm. run close to the coast of the northern portion of Kagoshima Bay. The axes of these curves, which are directed north and west respectively, intersect in a point lying off the north coast of Sakura-jima, and Prof. Omori regards this point as indicating the centre of the area of greatest depression of the ground. The total depression-volume within the 100-mm. curve is 1·35 c. km. The aggregate volume of lava flows and pumice and ash ejection during the recent explosion is about 2·2 c. km.

It is important to notice that the point of maximum depression, which probably coincides with the principal centre of the lava reservoir, lies, not under Sakura-jima, but in the region between it and the active volcano of Kirishima.

The triangulation surveys of 1898 and 1914 also reveal considerable displacements, both horizontal and vertical, in Sakura-jima, while the coast of the island is everywhere depressed. Three points in the interior have been raised 0·14 and about 9·7 and 10·4 metres. The horizontal displacements in the north-west of the island vary from 2·04 to 3·62 metres towards the south, and in the west and north by amounts from 1·08 to 4·52 metres towards the north and north-east. The north and south portions of Sakura-jima have thus been displaced outwards in contrary directions.

[1] "The Sakura-jima Eruptions and Earthquakes." II. Bull. Imp Earthq. Inv. Com., vol. viii., 1916, pp. 35–179. The first memoir was noticed in NATURE, vol. xciv., p. 289; see also vol. xcii., pp. 716–17.

Moreover, displacements of 0·53 to 0·95 metre along the west coast of Kagoshima Bay converge with those in the west and north of Sakura-jima towards an elliptical area which agrees roughly with the area of greatest depression.

Propagation of Sound-Waves.—Prof. Omori divides the sounds which accompanied the eruption into three groups: (1) the early sounds heard from about 10 a.m. to the afternoon of January 12; (2) the strong detonations from 6.30 p.m. on January 12 to 6 a.m. on January 13; and (3) the much weaker sounds of the after-explosions for about ten days following the great eruption. All these sounds were heard within two entirely detached areas, and it is remarkable how similar these areas are in form and to some extent in magnitude. The area which includes the volcano extends in each case in an easterly direction, the mean radius of the boundary being 111, 114, and 102 km. for the above three classes of sounds. The second area lies to the north of the other, and is elongated from west to east, the mean radial distance of its central line from the volcano being 195, 177, and 196 km. The width of the silent zone was 40–50 km. for the strong detonations and about 108 km. for the after-explosions, the axis of the silent zone, in both cases, being at a distance of about 120 km. from Sakura-jima. The greatest distance to which the detonations were heard is about 500 km. (or 310 miles) towards the north-east, but the air-vibrations were strong enough to shake houses and doors for about 85 km. farther in the same direction.

C. DAVISON.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION E.

GEOGRAPHY.

OPENING ADDRESS (ABRIDGED) BY EDWARD A. REEVES, F.R.A.S., F.R.G.S., PRESIDENT OF THE SECTION.

THE surveying equipment of the pioneer explorer of early days, say, of from twenty to sixty years ago, usually consisted of a sextant and artificial horizon, a chronometer or watch, prismatic compass, boiling-point thermometers, and aneroid. With the sextant and artificial horizon the astronomical observation for latitude and longitude were taken, as well as those for finding the error of the compass. The route was plotted from the compass bearings and adjusted to the astronomically determined positions. The latitudes were usually from meridian altitudes of the sun or stars, and longitudes from the local mean time derived from altitudes east or west of the meridian, compared with the times shown by the chronometer, which was supposed to give Greenwich Mean Time.

The sextant, in the hands of a practical observer, is capable of giving results in latitude to within 10″ or 20″, provided it is in adjustment, but the difficulty is that the observer has no proper means of testing for centring and graduation errors.

The great drawback to the sextant for survey work is that it is impossible to take accurate rounds of horizontal angles with it, since, unless the points are all on the same level, the angles must be too large. It is essentially a navigator's instrument, and nowadays has been almost entirely superseded by the theodolite for land-surveying.

As regards the longitude, the difficulty was always to obtain a steady rate for the chronometer, owing principally to the unavoidable oscillations and concussions met with in transit. Formerly it was customary to observe lunar distances for getting the Greenwich Mean Time instead of trusting to the chronometers, but these, even with the utmost care, are very unsatisfactory.

In more recent years the occultation of a star method of finding the Greenwich Mean Time superseded almost entirely the lunar distance, but all these so-called "absolute" methods of finding longitude are fast becoming out of date since the more general introduction of triangulation and wireless telegraphy.

Heights of land were usually obtained by the boiling-point thermometer or aneroid.

This, then, was the usual equipment of the pioneer. With such an outfit the greater part of the first mapping of Africa and other regions of the world was carried out, with results that were more or less trustworthy according to the skill of the explorer and the time and opportunities at his disposal.

In recent years considerable improvement has been made in the instruments and methods of the geographical surveyor; the introduction of the invar tape for the measuring of the base lines, the more general application of triangulation, the substitution of the theodolite for the sextant, the use of the plane-table for filling in the topographical details of the survey, the application of wireless telegraphy to the determination of longitudes, these and other improvements have all tended to greater accuracy and efficiency in geographical and topographical mapping, so that in many respects the rough approximate methods of the earlier explorers are fast being superseded by instruments and methods more in keeping with modern requirements in map-making.

Still, the principle underlying all surveying is the same, and the whole subject really amounts to the best and most accurate methods of measurement with a view of representing on a plane, on a greatly reduced scale, the leading features of a certain area of the earth's surface in their relatively correct positions; and so it resolves itself into geometrical problems of similar angles and proportional distances. This being the case, it is clear that it becomes in the main a question of correct angular and linear measurements, and all the improvements in survey methods have had for their object the increased accuracy of accomplishing this, together with greater facility for computing the results.

What we do now is exactly what was attempted by the early Greek geometricians and others in ancient times, only we have far more accurate instruments. If, for instance, we compare our modern micrometer theodolite with the old scaph of the Greeks the contrast is striking, although both had the same object in view as regards taking altitudes of heavenly bodies. Many of the old instruments, in spite of their great size, were extremely rough, and the angles could only be read with approximation or to a great extent by estimation, while the theodolite, which is now generally used on geographical surveys, although it has circles of only five inches in diameter, can, by means of the micrometers, be read to 2″ of arc, or even to 1″ by careful estimation. This, when one comes to think of it, is a triumph of refinement, since it really means that we can measure to within about 1/80,000 part of an inch, which is something like the space occupied by 1″ on the arc of a circle of 5-in. diameter. At least this is the theoretical accuracy, but in practice there are, of course, errors in sighting, setting the micrometer wires, and those arising from other sources which have to be taken into consideration.

The continued striving after greater accuracy of measurement applies not only to angular measuring instruments, but to linear distance measurement as well; and the improvements in apparatus for this purpose, could we follow them in detail, would be most interesting. From the rough methods that would suggest themselves naturally to early intelligent men, to the modern base-line apparatus, and accurately computed sides of a geodetic triangulation, is a far cry, and the advance in this matter is certainly remarkable.

So far what I have said has had chiefly to do with some of the earlier attempts at surveying and map-making, and the instruments and methods by which these have been carried out; and I will now try to give you an outline of what has been done in comparatively recent times, and state briefly the present position of various parts of the world as regards the condition of their mapping and the survey basis upon which their maps depend.

Little by little civilised man, by his daring, his love of adventure, and the necessities of events and circumstances, has penetrated into the unexplored parts of the earth and pushed back the clouds and mists that so long shrouded them from his knowledge, until at the present time the regions that are entirely unmapped are very few indeed, and do not amount to more than about one-seventh of the whole land-surface of the globe, including the unexplored areas of the polar regions, which may be either land or water. Not content with a mere vague acquaintance, he has striven for greater accuracy, and has turned to various branches of science and called them to his aid, in order that he may obtain more correct knowledge and a better comprehension of the earth's features. To enable him to fix with definiteness the position of places upon its surface, map out the various land-forms, and obtain their accurate measurements, he has consulted the astronomer and mathematician. Commencing with the rudest instruments and measuring apparatus, these, as greater accuracy was required, have gradually been improved, until the present-day appliances and equipment of a surveyor are wonders of refinement and delicacy.

I have attempted to form an estimate of the condition of the world's surveys for 1860 and 1916; and, taking the total area of the land-surface of the earth together with the unknown parts of the Arctic and Antarctic regions which may be either land or water, to be 60,000,000 square miles, I have obtained the following results:—

	1860 Sq. stat. miles — Proportion to whole	1916 Sq. stat. miles — Proportion to whole
1. Mapped from accurate topographical surveys based on triangulation or rigorous traverses	1,957,755 = 0·0326 or roughly $\frac{1}{30}$	8,897,238 = 0·1482 or roughly $\frac{1}{7}$
2. Mapped from less trustworthy surveys, chiefly non-topographical	2,017,641 = 0·0336 or roughly $\frac{1}{30}$	5,178,008 = 0·0866 or just over $\frac{1}{12}$
3. Mapped from route traverses and sketches	25,024,360 = 0·4170 or roughly $\frac{3}{7}$	37,550,552 = 0·6258 or little less than $\frac{2}{3}$
4. Entirely unsurveyed and unmapped	30,997,054 = 0·5166 or just over $\frac{1}{2}$	8,350,794 = 0·1391 or little less than $\frac{1}{7}$

These proportions can perhaps be more clearly seen from the following diagram (Fig. 1), on which numbers and tintings have the same significance as on the maps and table.

From the figures here given it is plain that with the same rate of progress as that of the past sixty years or so it would take more than four hundred years more to complete the accurate trigonometrical surveying and topographical mapping of the earth's land-surface, including the parts of the polar regions that may possibly be land—that is, the 60,000,000 square miles which we have taken for this total area; but this will certainly not be the case, since the rate at which such surveys have been carried out has been greatly accelerated during recent years, owing to the rapidly increasing demands for accurate topographical maps, improvements in methods, and other causes, so that it will possibly not be half this time before all the parts of the earth's surface that are likely to be of any use to man as settlements, or capable of his development, are properly surveyed and mapped. There are, of course, regions, such as those near the poles and in the arid deserts, that are never likely to be accurately triangulated and mapped to any extent, and it would be mere waste of time and money to attempt anything of the kind.

From its very foundation the Royal Geographical Society has had a remarkable influence on the surveying and mapping of the earth's surface, and especially those parts of it which have been previously but very imperfectly known or entirely unexplored. I think it must be admitted that this influence has increased as years have gone by, and it is no exaggeration to say that it has done more in this respect than any other body. It is therefore perhaps fitting that I should give some account of what has been accomplished, as it has a direct bearing on route-surveying and mapping by travellers and explorers. It is not only by the awarding of annual medals to explorers whose journeys have resulted in an increase to our geographical knowledge, and the more accurate surveying and mapping of little-known parts, that the society has stimulated and encouraged geographical research, but it has also assisted financially numerous expeditions, and the money thus granted has enabled many a man to carry out his explorations to a successful issue,

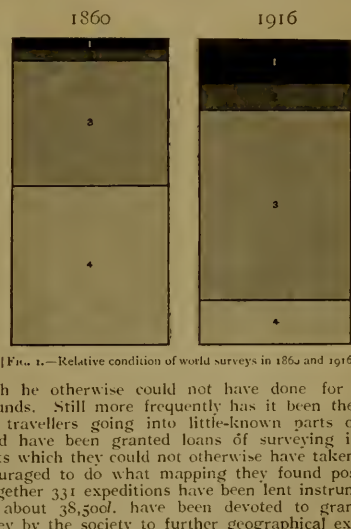


FIG. 1.—Relative condition of world surveys in 1860 and 1916.

which he otherwise could not have done for want of funds. Still more frequently has it been the case that travellers going into little-known parts of the world have been granted loans of surveying instruments which they could not otherwise have taken, and encouraged to do what mapping they found possible. Altogether 331 expeditions have been lent instruments, and about 38,500*l*. have been devoted to grants of money by the society to further geographical exploration and surveying.

There is still another way, by no means the least important, in which the Royal Geographical Society has done much to promote geographical surveying, and that is by providing suitable instruction in the work of surveying for travellers. It is all very well to grant money and lend instruments, but the important thing is to know how to make good use of the money and the instruments so as to take proper advantage of opportunities afforded and to produce the best surveys and maps of the regions visited. In the early days of the society a man had to pick up the requisite knowledge as best he could, but in 1879 a scheme of proper instruction was started at the suggestion of the late Sir Clements Markham, who was then one of our honorary secretaries. This had small beginnings, but in recent years has made rapid strides, until at present it forms one of the most important parts of the society's work. This course of instruction in geographical surveying, which has now been in existence for about thirty-eight years, was first conducted by my predecessor, the late Mr. John Coles, and, since he resigned in 1900, has been under my charge. Altogether 725 surveyors and explorers have received instruction, without reckoning special large classes of forty or fifty men which during the past few years, until the outbreak of war, were sent to us by the Colonial Office to learn the more elementary parts of compass-traversing and mapping.

Now as regards the future. The demand for properly trained geographical surveyors has been steadily increasing in past years, and is likely to be still greater as time goes on. After the termination of the war there will be much work to be done, especially as regards the surveying of new boundaries, and freshly acquired districts in Africa and elsewhere; and it would be wise to make preparations for this well ahead.

The future surveyor will be in a much better position than his predecessors, not only on account of the improvements in instruments and apparatus for his work, but because, in many parts, a good beginning has been made with the triangulation to which the new surveys can be adjusted. In Asia a considerable amount of new work of this kind has been done over the frontier of India in recent years by the Survey of India, among the more important of which are the connecting of the Indian triangulation with that of Russia by way of the Pamirs, the surveys of Sir Aurel Stein, Dr. de Philippi, and others. The many boundary surveys that have been carried out in Africa, the triangulations of Egypt, the Sudan, East and South Africa, and other parts of the continent are well advanced, and will be of the utmost value to the future surveyor. One of the most important lines is the great triangulation which, it is hoped, will some day run across the continent from south to north, from the Cape to Egypt. Owing to the energies of the late Sir David Gill, this important chain of triangles has already got so far as the southern end of Lake Tanganyika; the part to the west of Uganda, near Ruwenzori, has also been finished, and it now remains to carry the chain through German East Africa and down the Nile Valley. The latter, it is hoped, will by degrees be accomplished by the Sudan and Egyptian Survey Departments, although it may be delayed for some years yet; and the former, which was to have been undertaken by the Germans, it is to be hoped will, after the war, be accomplished by British surveyors, through—not German East Africa—but newly acquired British territory. Running right through parts of Africa that are but imperfectly mapped in many districts, the stations of this triangulation will be invaluable for the adjustment of any network of triangulation for future surveys in the interior, and, indeed, has already been utilised for the purpose.

The carefully carried out boundary surveys between various countries of South America will be of the greatest assistance in future exploration and survey in the interior of that continent, wherever they are available, while the Survey Departments of Canada and the United States are doing excellent work and extending their surveys far into the imperfectly mapped regions of North America. So, altogether, the surveyor of the future will soon have a good foundation of trustworthy points to work from. It is important to remember that running a chain of triangles across a country, though important as a framework, does not constitute a map of the country; and what is wanted is a series of good topographical maps, based upon triangulation, showing the leading features with sufficient accuracy for the purposes of ordinary mapping, so that on scales of 1 : 250,000, or even 1 : 125,000, there is no appreciable error.

As regards instruments, the astrolabe à prisme is being increasingly used for taking equal altitude observations with most excellent results, but at the present time the 5-in. transit micrometer theodolite, already referred to, is perhaps all that is required for general work. It has now been thoroughly tested and found most satisfactory. As regards smaller instruments, there is the 4-in. tangent-micrometer theodolite, and for rapid exploratory survey, where weight is a great consideration, a little 3-in. theodolite has been found useful.

For base-line measurement the invar tape should be taken on all serious work, and for filling in the topographical features a good plane-table is doubtless the instrument to use. In mountainous regions and in some other special conditions photographic surveying doubtless has a future before it, and in military operations when the photographs are taken from aircraft it has proved itself invaluable; but in ordinary surveying it is, I think, not likely to take the place of well-established methods. The introduction of wireless telegraphy for the determination of longitude is likely to increase in usefulness. Good examples of the work done with it have lately been given in the *Geographical Journal* and elsewhere.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE.

Macmillan and Co., Ltd.—The Potato, Prof. A. W. Gilbert and others, illustrated; The Strawberry in North America, S. W. Fletcher, illustrated; A Manual of Fruit Diseases, Prof. L. R. Hesler, illustrated; A Manual of Dairy Products, Prof. W. A. Stocking, illustrated; The Pruning Manual, Prof. L. H. Bailey, new edition, illustrated. *Oxford University Press.*—Agriculture in Oxfordshire, the first of a series of monographs on the English Counties, prepared by the Institute for Research in Agricultural Economics in the University of Oxford, illustrated.

ANTHROPOLOGY AND ARCHÆOLOGY.

F. Alcan (Paris).—Les Races et les Nationalistes en Autriche-Hongrie, Prof. Auerbach. *G. Bell and Sons, Ltd.*—Modern Man and His Forerunners: a Short Study of the Human Species, Living and Extinct, Dr. H. G. F. Spurrell, illustrated; Savage Survivals, J. H. Moore, illustrated. *Cambridge University Press.*—Jataka Tales, H. T. Francis and E. J. Thomas, illustrated; The Ancient Cross Shafts at Bewcastle and Ruthwell, enlarged from the Rede Lecture delivered before the University of Cambridge on May 20, 1916, by the Right Rev. Dr. G. F. Browne, illustrated. *Longmans and Co.*—The Folk-Element in Hindu Culture: a Contribution to Socio-Religious Studies in Hindu-Folk Institutions, Prof. Benoy Kumar Sarkar, assisted by Hemendra K. Rakshit. *John Murray.*—The Ages of Man, C. Sayle; The Lost Cities of Ceylon, G. E. Mitton, illustrated. *Oxford University Press.*—The Drama of Savage Peoples, L. Havemeyer. *Seeley, Service and Co., Ltd.*—Prehistoric Man and His Story, Prof. G. F. Scott Elliot, illustrated.

BIOLOGY.

F. Alcan (Paris).—L'Evolution des Plantes, Prof. N. Bernard; Théorie de la Contre-évolution, Dr. Larger. *D. Appleton and Co.*—The Book of Forestry, F. F. Moon. *E. Arnold.*—Arboreal Man, Prof. F. Wood Jones, illustrated; the Migrations of Fish, Prof.

A. Meek, illustrated. *Cambridge University Press.*—The Anthocyanin Pigments of Plants, M. Wheldale; Algæ, vol. i., Myxophyceæ, Peridinieæ, Bacillarieæ, Chlorophyceæ, together with a brief summary of the occurrence and distribution of Freshwater Algæ, Dr. G. S. West (Cambridge Botanical Handbooks). *Cassell and Co., Ltd.*—An Introduction to a Biology, the late A. D. Darbishire. *Hodder and Stoughton.*—Wild Animal Ways, E. Thompson-Seton, illustrated; The Hunting Wasp, J. H. Fabre. *T. C. and E. C. Jack, Ltd.*—Wild Flowers of Britain through the Camera, a series of 100 plates, selected and described by M. Skene; Wild Birds of Britain through the Camera, a series of 100 plates, selected and described by F. B. Kirkman. *Longmans and Co.*—British Birds, written and illustrated by A. Thorburn, vol. iv. *Macmillan and Co., Ltd.*—Nature in Australasia, for Boys and Girls, Jane Ada Fletcher, illustrated; Around the Year in the Garden, F. F. Rockwell, illustrated. *Methuen and Co., Ltd.*—Secrets of Earth and Sea, Sir Ray Lankester, illustrated. *John Murray.*—What is Instinct? Some Thoughts on Telepathy and Subconsciousness in Animals, C. B. Newland; Recent Progress in the Study of Variation, Heredity, and Evolution, Dr. R. H. Lock, new edition, revised by Dr. L. Doncaster, with a Biographical Note by Mrs. R. H. Lock; Form and Function: a Contribution to the History of Animal Morphology, E. S. Russell, illustrated; Vegetable Fibres, Dr. E. Goulding (Imperial Institute Handbooks); The Study of Animal Life, Prof. J. A. Thomson, new edition, illustrated. *Oxford University Press.*—Three Lectures on Experimental Embryology, Capt. J. W. Jenkinson, illustrated, with a short biographical notice of the author by Dr. R. R. Marett. *Bernard Quaritch.*—The Birds of British Guiana, based on the Collection of F. V. McConnell, C. Chubb, with a preface by Mrs. F. V. McConnell, vol. ii. *Grant Richards, Ltd.*—Insect Enemies, C. A. Ealand, illustrated. *George Routledge and Sons, Ltd., and Kegan Paul and Co., Ltd.*—The Fisherman's Entomology, M. E. Mosely, a Supplement to F. M. Halford's The Dry-Fly Man's Handbook, illustrated. *Whittaker and Co.*—Some Researches in Plant Physiology, Atkins. *John Wiley and Sons, Inc. (New York).*—Handbook for Rangers and Woodsmen, J. L. B. Taylor; Modern Propagation of Tree Fruits, Prof. B. S. Brown; A Practical Entomology for Schools, E. D. Sanderson and Prof. L. M. Peairs; Farm Forestry, Prof. J. A. Ferguson. *Williams and Norgate.*—Plant Seeds and Currents in the West Indies and Azores, H. B. Guppy.

CHEMISTRY.

Cambridge University Press.—Chemistry and Technology of Oils and Fats, F. E. Weston and P. J. Fryer; Chemistry of Dyeing, Dr. L. L. Lloyd and M. Fort (Cambridge Technical Series). *Chapman and Hall, Ltd.*—A Method for Identification of Pure Organic Compounds, Dr. S. P. Mulliken, vol. ii.; Manual for the Essence Industry, E. Walter. *Gauthier-Villars and Co. (Paris).*—Conférences de Chimie minérale faites à la Sorbonne, M. Guichard, new edition. *Crosby Lockwood and Son.*—Manuals of Chemical Technology, edited by Dr. G. Martin, vol. viii., The Minor Elements: their Occurrence and Industrial Uses, S. J. Johnstone. *Longmans and Co.*—The Right Hon. Sir Henry Enfield Roscoe, P.C., D.C.L., F.R.S.: a Biographical Sketch, Sir Edward Thorpe; Chemistry, Second Stage, F. P. Armitage, with assistance from L. S. Dawe. *Macmillan and Co., Ltd.*—A Text-Book of Thermo-Chemistry and Thermo-Dynamics, Prof. O. Sackur, translated from the German by Dr. G. E. Gibson. *George Routledge and Sons, Ltd., and Kegan Paul and Co., Ltd.*—Chemical Discoveries and Inventions of the Twentieth Century, Sir W. A. Tilden, illustrated. *John Wiley and Sons, Inc. (New York).*—A Laboratory Manual of Organic Chemistry for Medical Students, Dr. M. Steel; Laboratory Manual of Bituminous Materials, P. Hubbard.

ENGINEERING.

D. Appleton and Co.—Field Book for Railway Engineers, J. B. Henck; City Planning, edited by J. Nolen. *E. Arnold.*—The Principles of Electrical Engineering and their Application, Prof. Gisbert Kapp, two vols., illustrated. *Cambridge University Press.*—Naval Architecture, J. E. Steele. *Chapman and Hall, Ltd.*—Bridge Engineering, J. A. Waddell, two vols.; Graphics of Machine Design, E. S. Andrews; Power Transmission by Leather Belting, R. T. Kent; Principles of Oil and Gas Production, Prof. R. H. Johnson and L. G. Huntley; Elements of Refrigeration, Prof. A. Greene; The Planning of the Modern City, N. P. Lewis. *Constable and Co., Ltd.*—The Flying Machine from an Engineering Standpoint, F. W. Lanchester (a reprint of the James Forrest Lecture, 1914, including a discussion concerning the theory of sustentation and the expenditure of power in flight); Some Modern Methods of Ventilation, with Special Reference to Public Buildings, R. Grierson, illustrated; Mining and Mine Ventilation, J. J. Walsh, illustrated. *Electrician Printing and Publishing Co., Ltd.*—The Theory of the Submarine Cable, Dr. H. W. Malcolm; Electric Measuring Instruments: their Design, Construction, and Application, Dr. C. V. Drysdale and A. C. Jolley; and new editions of Wireless Telegraphy and Telephony, Handbook of Formulæ, Data, and Information, Dr. W. H. Eccles; Primary Batteries: their Construction and Use, W. R. Cooper; Electric Mains and Distributing Systems, J. R. Dick and F. Fernie; Submarine Cable Laying and Repairing, H. D. Wilkinson; Manual of the Telephone, W. Aitken. *Crosby Lockwood and Son.*—Oil-field Development: a Guide to the Exploration of Petroleum Lands, and a Study of the Engineering Problems connected with the Winning of Petroleum, including Statistical Data of Important Oil-fields, Notes on the Origin and Distribution of Petroleum, and a Description of the Methods of Utilising Oil and Gas Fuel, A. B. Thompson, illustrated. *Longmans and Co.*—Strength of Ships, A. J. Murray, with diagrams; Practical Shipbuilding: a Treatise on the Structural Design and Building of Modern Steam Vessels, A. C. Holms, two vols., new edition. *Methuen and Co., Ltd.*—The Elements of Engineering Drawing, E. Rowarth, illustrated. *Scott, Greenwood and Son.*—Calculations for Steel Frame Structure, W. C. Cocking; Elementary Mathematics for Engineers, E. H. Sprague (Broadway Series of Engineering Handbooks). *Whittaker and Co.*—Oil, Gas, and Petrol Engines, Garrard; High-Speed Internal Combustion Engines, Judge; Electric Traction, Dover; Telegraphy, Herbert, new edition; Modern Milling, Pull; Continuous Current Motors and Control Apparatus, Maycock; Construction of Aeroplanes, Judge. *John Wiley and Sons, Inc. (New York).*—Municipal Engineering, A. P. Folwell; Elements of Refrigeration, Prof. A. M. Greene; Mechanical Equipment of Buildings, L. A. Harding and A. C. Willard; Modern Underpinning, L. White and E. A. Prentis, jun.; Applied Mechanics, vol. ii., Strength of Materials, Prof. C. E. Fuller and W. A. Johnston; The Mining Engineers' Handbook, edited by Prof. R. Peele; Valuation, Depreciation, and the Rate Base, C. E. Grunsky, assisted by C. E. Grunsky, jun.

GEOGRAPHY AND TRAVEL.

Cambridge University Press.—The Earliest Voyages Round the World, 1519–1617, edited by P. F. Alexander, illustrated (Cambridge Travel Books); Bengal, Bihar, and Orissa, Sikkim, L. S. S. O'Malley.

illustrated (Provincial Geographies of India). *Macmillan and Co., Ltd.*—In Far North-East Siberia, I. W. Shklovsky (Dioneo), translated by L. Edwards and Z. Shklovsky, illustrated. *John Murray.*—A Holiday in Umbria, with an Account of Urbino and the Cortegiano of Castiglione, Sir T. G. Jackson, Bart., illustrated; Hunting Pygmies, Dr. W. E. Geil, illustrated. *Oxford University Press.* Historical Geography of the British Dependencies, edited by Sir C. P. Lucas, vol. vii., India, part i., History down to 1861, P. E. Roberts. *T. Fisher Unwin, Ltd.*—Two Summers in the Ice-Wilds of Eastern Karakoram, F. B. Workman and W. H. Workman, illustrated; A Naturalist in Borneo, the late R. W. C. Shelford, edited by Prof. E. B. Poulton, illustrated; Summer Holidays in the Alps, the Rev. Prebendary Durham, illustrated.

GEOLOGY AND MINERALOGY.

Chapman and Hall, Ltd.—Microscopic Determination of the Opaque Minerals: An Aid to the Study of Ores, Dr. J. Murdoch. *Oxford University Press.*—The Origin and Meaning of some Fundamental Earth Structures, C. F. Berkey.

MATHEMATICAL AND PHYSICAL SCIENCES.

D. Appleton and Co.—The Book of Electricity, A. F. Collins. *G. Bell and Sons, Ltd.*—Arithmetic, F. W. Dobbs and H. K. Marsden, part ii.; Commercial Arithmetic and Accounts, A. R. Palmer and J. Stephenson, part iii., also the complete book; Dynamics: a companion text-book to Fawdry's Statics; Analytical Geometry of the Straight Line and Circle, J. Milne; Arithmetic for Preparatory Schools, T. Dennis; Differential Calculus for Colleges and Secondary Schools, Dr. C. Davison. *Cambridge University Press.*—Collected Scientific Papers, the late Prof. J. H. Poynting; Model Drawing, Geometrical and Perspective, with Architectural Examples, C. O. Wright and W. A. Rudd, illustrated; Physics for Engineers, J. P. Yorke. *Chapman and Hall, Ltd.*—Mathematics for Engineers, W. N. Rose; Ten British Mathematicians of the Nineteenth Century, A. Macfarlane; Engineering Applications of Higher Mathematics, Prof. V. Karapetoff, five vols., part ii., Problems on Hydraulics, part iii., Problems on Thermodynamics, part iv., Problems on Mechanics of Materials, part v., Problems on Electrical Engineering. *Constable and Co., Ltd.*—Atoms, J. Perrin, translated by D. Ll. Hammick, illustrated. *Gauthier-Villars and Co. (Paris).*—Œuvres d'Halphen publiées par les soins de C. Jordan, H. Poincaré, E. Picard, avec la collaboration de E. Vessiot, tomes ii., iii., et iv.; Bases théoriques de l'Aéronautique: Aérodynamique, Prof. N. Joukowski, translated by S. Drzewiecki; Cours d'Hydraulique, Prof. J. Grialou. *Hodder and Stoughton.*—Our Own and other Worlds, J. Hamilton. *Longmans and Co.*—Principles of Electric Wave Telegraphy and Telephony, Prof. J. A. Fleming, new edition, illustrated; Differential Equations, Dr. H. Bateman; Housecraft Arithmetic, T. Mellor and H. H. Pearson. *John Murray.*—David Gill: Man and Astronomer, Prof. G. Forbes. *Oxford University Press.*—The Casting Counter and the Counting-Board: a Chapter in the History of Numismatics and Early Arithmetic, F. P. Barnard, illustrated. *S.P.C.K.*—The Rain Children: a Fairy Tale in Physics, T. H. Orpen, illustrated. *University Tutorial Press, Ltd.* Advanced Text-Book of Magnetism and Electricity, R. W. Hutchinson. *John Wiley and Sons, Inc. (New York).*—Field Astronomy, Prof. A. H. Holt; Histology of Medicinal Plants, W. Mansfield; Lessons in Pharmaceutical Latin and Prescription Writing and Interpretation, Prof. H. C. Muldoon.

MEDICAL SCIENCE.

F. Alcan (Paris).—Méthode de traitement des fractures, Prof. P. Delbet; La fièvre paratyphoïde, Prof. A. Rathery; Précis résumé de chirurgie de guerre, Drs. P. et J. Fiolle. *W. Heinemann.*—Psychoneuroses in War, M. D. Eder; The Practitioner's Pocket Pharmacology and Formulary, Dr. L. Freyberger; and new editions of The Treatment of Infantile Paralysis, Dr. R. W. Lovett, illustrated; Treatment of Tabetic-Ataxia by the Aid of Gymnastic Exercise, Dr. H. S. Frenkel, revised and enlarged by Dr. L. Freyberger, illustrated; A Manual of Practical X-Ray Work, Dr. D. Arthur and J. Muir, illustrated. *Masson et Cie. (Paris).*—Collection Horizon: Petits Précis de Médecine et de Chirurgie de Guerre:—La Fièvre typhoïde et les Fièvres paratyphoïdes (Symptomatologie, Etiologie, Prophylaxie), H. Vincent and L. Muratet; Traitement des Fractures, Prof. R. Leriche, two vols., tome i., Fractures Articulaires, illustrated; Les Formes anormales du Tétanos, Courtois-Suffit and Giroux. *Methuen and Co., Ltd.*—Crowley's Hygiene of School Life, Dr. C. W. Hutt, new edition, illustrated.

TECHNOLOGY.

Cambridge University Press.—The Development of English Building Construction, C. F. Innocent, illustrated; Architectural Building Construction: a Text-book for the Architectural and Building Student, W. R. Jaggard and F. E. Drury, vol. i., illustrated (Cambridge Technical Series). *Chapman and Hall, Ltd.*—The Canning of Fruits and Vegetables, J. P. Zavalla. *Hodder and Stoughton.*—Automobile Repairing Made Easy, V. W. Pagé, illustrated; Modern Starting, Lighting, and Ignition Systems, V. W. Pagé; The Model "T" Ford Car: Its Construction, Operation, and Repair, V. W. Pagé, illustrated. *George Routledge and Sons, Ltd., and Kegan Paul and Co., Ltd.* Flour Milling: a Theoretical and Practical Handbook of Flour Manufacture for Millers, Millwrights, Flour-milling Engineers, and others engaged in the Flour-Milling Industry, P. A. Kosmin, translated by M. Falkner and T. Fjelstrup, and revised by E. Bradfield, illustrated; Photography in Colours: a Book for Amateurs and Students of Physics, Dr. G. Lindsay Johnson, new edition, illustrated. *John Wiley and Sons, Inc. (New York).*—Plain and Ornamental Forging, E. Schwarzkopf; Drawing for Builders, R. B. Dale.

MISCELLANEOUS.

F. Alcan (Paris) Traité de Psychologie, Prof. G. Dumas. *D. Appleton and Co.*—Vocational Psychology, H. L. Hollingworth; Scientific Management and Labour, R. F. Hoxie. *Cambridge University Press.*—Catalogue of Scientific Papers, fourth series (1884–1900), compiled by the Royal Society of London, vol. xv., Fitting-Hyslop; Comptes Rendus of Observation and Reasoning, J. Y. Buchanan; The Psychology of the Organized Group Game, with Special Reference to its Place in the Play System and its Educational Value, M. J. Reaney (The British Journal of Psychology Monograph Supplements). *Cassell and Co., Ltd.*—All About Inventions and Discoveries, F. A. Talbot, illustrated. *Chapman and Hall, Ltd.*—Scientific Spiritualism, Rev. J. Marchant; Handbook to the History of Philosophy, Rev. J. O. Bevan. *Constable and Co., Ltd.* Practical Surveying, E. McCullough, illustrated. *The Open Court Company.* The Works of William Oughdred, Prof. F. Cajori; George Boole's Collected Logical Works, vol. i., Ernst Mach's Civilization and Mechanics, Principles of the Theory of Heat, and Knowledge and Error. *Oxford University Press.*—The Idea of God in the Light of Recent Philosophy: The Gifford Lectures in the University of Aberdeen, 1911 to 1913, Prof.

A. S. P. Pattison; Sadoleto on Education, a translation of the De pueris recte instituendis, with notes and introduction, by Prof. E. T. Campagnac and K. Forbes. *Seeley, Service and Co., Ltd.*—Aircraft of To-Day, Lieut. C. C. Turner, illustrated; Marvels of Scientific Invention, T. W. Corbin, illustrated; Marvels of Aviation, Lieut. C. C. Turner, illustrated; War Inventions, and How they were Invented, C. R. Gibson, illustrated; The Wonders of the Submarine, T. W. Corbin, illustrated. *T. Fisher Unwin, Ltd.*—Essays: Scientific and Literary, Dr. A. E. Shipley, illustrated; Hausa Botanical Vocabulary, J. M. Dalziel.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The urgency in the demand for the training of colour chemists and dyers has led to a reorganisation of this department of the university. The newly appointed head of the department is Mr. A. G. Perkin, F.R.S., who is assisted in the theoretical and practical teaching of colour chemistry by Dr. J. B. Oesch, formerly colour chemist in one of the chief Continental factories, whilst that of dyeing is under the special supervision of Mr. G. H. Frank, Mr. P. King, former chemist to Messrs. Courtaulds, Ltd., and Mr. A. E. Woodhead. In addition to systematic instruction in the above branches of technology, opportunities will be afforded to students of hearing special courses of lectures on "Cellulose" by Mr. C. F. Cross, on "The Distillation of Coal Tar" by Mr. H. P. Hird, and on "Colour in its Relation to Constitution" by Prof. E. R. Watson, of Dacca University.

At the request of British Dyes, Ltd., a laboratory has been set apart for the accommodation of a staff of chemists working on behalf of this firm, and will be exclusively in charge of a member of the university staff. The department is controlled by the Textile Industries and Dyeing Committee of the university, consisting of well-known representatives of both industries. The aim of the newly organised department is therefore to render service to the colour-making and dyeing industries by offering special training in these branches, whilst giving assistance to the enterprise promoted by Government money.

MR. E. A. WOODS, of New College, Oxford, has been awarded a Burney Yeo scholarship for 1916 at King's College Hospital Medical School.

MR. W. NEILSON JONES, late assistant-lecturer in botany at Bedford College for Women, N.W., has been appointed lecturer and head of the department in botany of the college.

THE sum of 300*l.* has been left to the Bristol General Hospital by Dr. W. Barrett Roue to found a scholarship for medical students of the hospital. The scholarship will be known as the "Barrett Roue Scholarship."

BY the will of Sir James Sivewright, whose death was announced last week, legacies are bequeathed of 5000*l.* to Milne's Institution, Fochabers, and of 10,000*l.* to the University of Aberdeen, for the purpose of providing bursaries for students coming from the county of Morayshire.

THE resignation of Dr. R. Armstrong-Jones of the medical superintendency of the Claybury County Asylum was announced in our issue of August 10. To mark the esteem in which Dr. Armstrong-Jones is held by the staff of the asylum a silver tea and coffee service was presented to him by the staff on September 7. Dr. Armstrong-Jones will continue to lecture on mental diseases at St. Bartholomew's Hospital.

THE calendar for the current session of Birkbeck College, London, provides full particulars of the numerous day and evening classes in the subjects included in university faculties of arts, science, laws, and economics. The character of the work accomplished at this institution is well summarised in the final report of the Royal Commission on University Education in London (1913). The commissioners write: "We think that the original purpose of the founder of Birkbeck College and the excellent work that institution has done for the education of evening students who desire a university training mark it out as the natural seat of the constituent college in the faculties of arts and science for evening and other part-time students."

THE prospectus and time-table of the Belfast Municipal Technical Institute for the current session show convincingly the care and thoroughness with which the Technical Instruction Committee of the city has provided instruction in the principles of the arts and sciences which bear directly or indirectly upon the trades and industries of Belfast. The prospectus describing the work of the various departments runs to 384 closely printed pages, and every subject likely to be of service to the men and women engaged in the city's industries seems to be included in the time-table. The day technical college provides instruction in the science and technology of mechanical engineering, electrical engineering, the textile industries, and pure and applied chemistry. The Queen's University of Belfast and the Corporation of Belfast have entered into an agreement whereby the institute is recognised as a college in which students of the University may pursue a course of study qualifying for a degree of the University.

THOUGH the governors of the Royal Technical College, Glasgow, in view of the war, reserve full power to modify the arrangements announced in the recently published calendar for the session 1916–17, they again offer suitable educational facilities for those who wish to qualify themselves to enter upon one of the industrial professions, or to follow one of a number of selected trades. Complete courses of instruction are provided in mathematics, physics, chemistry, the principles of engineering, and other subjects, and in their application to industries and arts. The college is affiliated to the University of Glasgow, and candidates for the degree of B.Sc. in applied science may attend the necessary qualifying courses either in the University or in the college. The University of Edinburgh, too, has recognised the day classes of the college as qualifying for its degree in science. Numerous important firms have expressed their willingness to allow a selected number of their apprentices facilities for carrying out a scheme of college study conjoined with practical work, and some are willing to recognise the time spent in college as part of the apprenticeship period.

NOTHING perhaps could be more opportune to the cause of educational reconstruction than the recent publication by the Board of Education of the pamphlet entitled "The Admiralty Method of Training Dockyard Apprentices." By its system of training the Admiralty has succeeded in providing on one hand a body of leading technical experts in shipbuilding and engineering, and on the other a body of skilled workmen among whom the labour troubles that have so sorely affected employers elsewhere are practically unknown. Moreover, not only have the Admiralty and a considerable proportion of the larger shipbuilding and engineering firms throughout the country thus obtained their managers, designers, and other lower-grade officials, but the foundation of the

Navy of Japan was likewise laid by the products of this remarkable scheme. It is only natural, therefore, to inquire what are the fundamental characteristics of a system that has achieved such a unique success. The details are described in the pamphlet already mentioned; but it may be stated that the underlying principles consist in the adoption of a military form of organisation dependent almost exclusively upon individual merit, and a method of admission to its ranks as broad as democracy itself. Apprentices enter the Royal Dockyards as the result of a competitive examination, and they are compelled to continue their education by attending the Dockyard schools for twelve hours a week (two afternoons and three evenings), of which seven and a half hours are given by the Admiralty. Apprentices pay no fees for attending the schools, are provided with text-books and stationery free of cost, and are paid their usual wages for the afternoons on which they are at school. Perhaps the most astonishing feature of the whole system lies in the fact that this remarkably democratic scheme was quietly inaugurated in the least expected of our national institutions, and in a time when practically every other form of high professional training in the country was a class privilege. In a crisis like the present, therefore, when the whole of the virtues of a nation are powerless without outstanding leadership and genius, the moral is plain.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 4.—M. Camille Jordan in the chair.—G. **Bigourdan**: The conference of longitudes of 1634. A historical account of Morin's proposals.—P. **Zeeman**: Direct measurement of the axial velocity of water in Fizeau's experiment. The axial velocity was formerly determined by measuring the whole of the water passing through the tube, giving the mean velocity, and using the coefficient 0·84 to determine the axial velocity. As this coefficient is liable to uncertainty, a new alternative method is described, based on the introduction of very small air bubbles into the flow, and observing their trajectory by means of a rotating mirror. This has led to an unexpected result: the axial velocity varies in a complicated manner along the tube, so that there is no one axial velocity. The extreme variation is more than 10 per cent. Finally, a standardised Pitot tube was used to measure the velocities at a large number of points, with satisfactory results.—J. **Bougault**: The preparation of acylsemicarbazides, starting from the semicarbazones of α-ketonic acids. The oxidation of semicarbazones by iodine and sodium carbonate, by a quite unexpected reaction, gave a semicarbazide according to the equation, $R.C(CO_2H):N.NH.CO.NH_2+O = CO_2+R.CO.NH.NH.CO.NH_2$. The reaction is completed at the ordinary temperature, and its generality is shown by the examples given, in which R is $(C_6H_5.CH_2)$, $(C_6H_5.CH_2.CH_2)$ (C_6H_5), and $((CH_3)_3.C)$. Of the four semicarbazides thus prepared, three are new.—M. **Luizet**: Shooting star with a persistent luminous track. This meteor left a line of light which, after taking a wavy form, broke up into several fragments. Some of these combined together, taking the shape of an elongated bulb. This disappeared four minutes after the first disruption of the meteor.—J. L. **Dantan**: Observations on the larva of *Ostrea edulis*.—M. **Ranjard**: The first hundred cases of deafness treated by Marage's method at the *Centre de rééducation auditive* of the 8th district. The treatment of deafness by the method of Marage has been proved to be useful from the military, financial, and social points of view. Only 16 per cent. of the cases gave negative results under the treatment.—J. **Danysz**: The causes of the disturbances observed after the injection of products of the arsenobenzene group, and anaphylactic crises. A study of the conditions producing a precipitate in the veins after injection of arsenobenzene derivatives.—L. **Camus**: The preparation, properties, and advantages of a homogeneous vaccine.

BOOKS RECEIVED.

The Punjab, North-west Frontier Province, and Kashmir. By Sir J. Douie. Pp. xiv+373. (Cambridge: At the University Press.) 6*s*. net.

Le Principe de Relativité. By E. M. Lémeray. Pp. 150. (Paris: Gauthier-Villars et Cie.) 3.75 francs.

Cours d'Hydraulique. By Prof. J. Grialou. Pp. vi+536. (Paris: Gauthier-Villars et Cie.) 20 francs.

The Influence of Joy. By G. Van Ness Dearborn. Pp. xviii+223. (London: W. Heinemann.) 5*s*. net.

Wratten Light Filters. Third edition. Pp. 72. (London: Kodak, Ltd.) 1*s*.

The Photography of Coloured Objects. Second edition. Pp. 118. (London: Kodak, Ltd.) 1*s*.

The Birds of Shakespeare. By Sir A. Geikie. Pp. x+121. (Glasgow: J. Maclehose and Sons.) 3*s*. 6*d*. net.

Rev. William Hall's Visible Astronomical Compass. (London: J. D. Potter.) 1*s*. net.

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

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THURSDAY, SEPTEMBER 28, 1916.

INDUSTRIAL ASSOCIATIONS.

WITHIN the last few days we have been given further evidence by manufacturers and commercial men of their intention to organise themselves for the protection and development of British trade and industry, and to provide substantial funds for the promotion of these objects. A circular has been issued by the Executive Council of the Federation of British Industries, which includes many leading representatives of manufacturing and producing industries, inviting firms to join the federation, and to pay an annual subscription of 100*l.* until at least the year 1919. The main objects of the federation are the organisation and development of industry now and after the war, in co-operation with labour and in conjunction with the Government and Government departments. In furtherance of like interests, the Committee of Financial Facilities for Trade has just recommended to the President of the Board of Trade that a British Trade Bank should be established with a capital of 10,000,000*l.*, with the objects, among others, of establishing an information bureau, co-operating with merchants and manufacturers, and affording financial support to promising enterprises. It is suggested that any financial assistance given by the Government to undertakings in connection with what are known as "key" industries should be granted through the medium of the commercial information bureau. A couple of months ago we described the formation of the Association of British Chemical Manufacturers, with a subscription based *pro rata* on the size of the subscribing undertakings; and the steps taken to organise the British engineering industry into an association were outlined in our issue of August 24. At a meeting held at the Mansion House on September 20 to promote the organisation of British electrical and allied manufactures it was pointed out that the approximate aggregate capitalisation of our engineering works is now 400,000,000*l.*, so that an annual subscription of one-tenth of 1 per cent. of the capital would provide an income of 400,000*l.*

These and other signs show that our leading business men are prepared to do their part towards strengthening British industry and commerce for the competitive struggles of the future. In the case of most of the recent organisations reference is made to the necessity of providing facilities for scientific research; and this point was particularly mentioned by Sir Oliver Lodge at the Mansion House meeting. The inter-connection between science and every branch of engineering is already largely recognised, but we still await the production of a scheme which will show exactly what should be done to promote their practical co-operation. We have had a number of committees and advisory councils appointed, but most of them have devoted themselves chiefly to the collection and collation of opinions, and have originated little in the way of constructive plans of procedure. It is perhaps not so necessary now as it was to convince men of business that scientific research is the basis of progressive industry; what is now required of scientific men and their committees is the preparation of practical plans of campaign which can be placed before associations of manufacturers. We believe that when these schemes are available there will be little difficulty in securing the funds to put them into practice.

One such plan, national in scope and bold in conception, was sketched by Dr. Kenneth Mees in an address printed in NATURE of July 13 and 20. It asked for the establishment of a national industrial research laboratory with a staff of two thousand men, half of whom would be scientifically trained, while the other half would be assistants and workmen. The annual upkeep was estimated to cost about 800,000*l.*, but after a few years the laboratory would probably be self-supporting, and might, indeed, make an annual profit on the original investment. Several years ago Sir Oliver Lodge showed how the University of Birmingham alone could make profitable use of five millions, one million of which would be for a real attempt at scientific research in all departments. He pointed out that hitherto the ideas of this country in education and scientific research have been conceived on a wholly inadequate scale, and without proper appreciation of the vast extent of territory awaiting exploration. The most useful thing that could be done at the present time would be to concentrate attention upon the construction and details of schemes of this kind instead of lamenting the assumed indifference of manufacturers to the help which science can give them. The various committees now in existence would then be in the position of boards of directors having before them for consideration definite plans for the development of their businesses, instead of mere letters of complaint at want of enterprise.

There must, of course, be a joining up of those who are attacking the industrial reorganisation of the Empire with those who are working for educational reconstruction; and we look to the Science Committee recently appointed by the Government to assist in this end. The Right Hon. F. Huth Jackson, who was one of the members of the committee recommending the formation of the British

Trade Bank already mentioned, acknowledged in his speech at the meeting on the neglect of science held last May at the Linnean Society that, as a banker, he had found it a serious drawback to be ignorant of even the most elementary knowledge of the natural sciences. "Perhaps," he added, "if my education had not been neglected on those lines, I should in some cases have been able to avoid supporting some processes of manufacture which were in themselves wrong, or futile, while in other cases I might have been tempted to depart from the very rigid banker's attitude of refusing to give support to any new idea." It is to be hoped that the day is near when no educational course will be considered to be complete unless it includes instruction in the broad facts and principles of natural science, so that men in all walks of life may be able to appreciate possible directions of advance. Scientific thoroughness in detail, and sound factory management, are no doubt two of the conditions of industrial success, but banking facilities are another, and whether they are rightly or wrongly offered often depends, as Mr. Huth Jackson said, upon the possession of sufficient scientific knowledge either to discriminate between undertakings, or to know when to call for expert advice.

It is neither desirable nor necessary that every pupil in school or student at college should be compelled to take up science courses of a specialised kind, but it is essential that they should understand something of the place of science in modern life. Business cannot be learnt in a university or in a technical college, but breadth of view can be gained there, and all can learn that the attitude of mind induced by scientific education is just what is required for the successful development of industry. The changes which have taken place in the condition and needs of business life in recent years render it absolutely necessary to employ men of scientifically trained minds, not only among the captains of industry, but also among what may be termed the non-commissioned officers, and even in the rank and file. Our manufacturers are combining in their own interests, and are prepared to co-operate with education and science in national reconstruction. The time has come for the production of schemes of scientific instruction and research, practical enough to appeal to manufacturers and commercial men, and intended to promote the advance of the organised community. We look to the various committees, boards, and advisory councils lately established to see that the opportunity is not wasted in the further statement of axioms and postulates which are now taken for granted by all intelligent people.

SCIENCE AND THE SAVANT.

Les Allemands et la Science. By Prof. Gabriel Petit d'*Alfort* et Maurice Leudet du *Figaro*. Préface de M. Paul Deschanel. Pp. xx + 374. (Paris: Librairie Félix Alcan, 1916.) Price 3.50 francs.

THE articles collected in this volume were written by twenty-eight prominent representatives of science and art in France to amplify and enforce for the general public the protest made by the Academy of Sciences in November, 1914, against the German manifesto of October 30 of that year, wherein ninety-three "German intellectuals" claimed for their *Kultur* the hegemony of the world of science.

The book reminds one of an "air with variations." The theme is an oft-quoted remark of Pasteur's: "La science n'a point de patrie; mais l'homme de science en a une." The aria is the admirable preface by M. Paul Deschanel, President of the Chamber of Deputies. In the twenty-eight variations, along with a good deal of repetition about scientific ideas as distinguished from scientific material, there are very marked differences of treatment according as the writer envisages *la science* or *l'homme de science*. The tone ranges from extreme bitterness in an article on "La Thérapeutique Commerciale des Allemands," by Gaucher, and mordant irony in Delage's "Histoire Naturelle du Doctus Bochensis," to an amiable letter by Grasset, who insists that science has no country and will not follow the German savants in their excursion outside the region of science into that in which political or national animus is possible. In the circumstances it is difficult to regard so cosmopolitan an attitude as quite fitting the case. There is more ring of sympathetic resonance in Prof. A. Dastre's views about German mysticism and materialism in relation to science and its progress.

Emile Picard raises the practical question of international co-operation in science after the war, and thereby reminds us that science is not independent of the savant. Science has no country, but the progress of science can only find expression through organisations which have national characteristics. In the long run, truth is the only consideration; but the truths of science are not recognisable at all while they are still in embryo in the researcher's brain, and are not always recognised when they have reached the stage of manuscript or print. The spectacles of prejudice may bring some aspects of truth into brilliant focus, but may distort others beyond recognition; and prejudice may be characteristic of nations as of men. It never helps the progress of science; but unfortunately it may affect the development of the truths of science in other ways. The life of true genius may be too short for the struggle against prejudice, for genius is not always sufficiently self-conscious and self-assertive to make headway in a prejudiced environment.

Even genius must begin its scientific career with education; and facilities for education, which include the beginnings of research, afford an opportunity for discouraging genius that is not in line with national prejudice. Science cannot disregard the prejudices of men of science, and these essays show to what disastrous conditions the neglect of that fact has led.

While we in this country were priding ourselves upon our institutions for higher education untrammelled by any consideration except money, and the petty rivalries of corporate bodies, without any formal co-ordination or collective responsibility for meeting the country's requirements, the German State provided ample facilities for education which necessarily attracted students from all countries not so well provided—our own, France, the United States, Japan, and everywhere else. Like the French, we regarded these facilities as an admirable example of magnanimous self-interest and public spirit. We have made a mistake; and our national educational authority, when we get one, would do well to take note of the contribution to the history of science which these nine-and-twenty brief essays provide.

STAR-BEARINGS FOR NIGHT-MARCHING.

(1) *Steering by the Stars for Night-flying, Night-marching, and Night Boat-work between Latitude* 40° *N. and* 60° *N.* With Sketch-maps and Directions for finding the Selected Stars. By Dr. J. D. White. Pp. 32. (London: J. D. Potter, n.d.) Price 1*s.*

(2) *The Stars as Guides for Night-marching in North Latitude* 50°. By E. Walter Maunder. Pp. 72. (London: Charles H. Kelly, 1916.) Price 2*s.* net.

MOST persons who spend any considerable time out in the open during the night not only may at times admire the splendour of the vault of heaven on a clear night, but also learn to recognise the principal features of stellar distribution, and even gain familiarity with the effects of the diurnal and annual apparent motions. Such first-hand knowledge may perhaps be somewhat vague, but a little tuition can render it precise and useful. The necessities of the present time have emphasised one practical application. The heavens encircle the sky-line as with a vast compass-card that with a little skill he who runs may read. We have before us two little books, both written with the identical intention of facilitating the employment of this compass. The only difficulty arises in middle latitudes from the rotation of what is termed in old books the oblique sphere. This difficulty is surmounted in both in the same way, namely, that recently advocated by Lieut.-Col. Tilney, which requires that the progressive true bearings of a few selected conspicuous stars shall be provided. The two books present the data very differently.

(1) In "Steering by the Stars" the true bearings are tabulated for twenty guide stars for five different latitudes, and for each hour of sidereal time linked to G.M.T. by an auxiliary table. The bearings are given in whole degrees clockwise from N = 0° to 360°. By some curious accident the bearing of Spica at setting is twice given incorrectly (pp. 17 and 23). The sketch-maps showing the selected stars are too small to be useful, but probably those whom this very practical book may assist already know the stars.

(2) In "The Stars as Guides" the data, prepared solely for latitude 50° N. and referred to local time, are introduced in descriptive text, gathered in tables, and, again, shown in map form, always subdivided in a way to help assimilation. Separate tables for the eight chief compass bearings give the day of the month for each hour of the night at which the guide stars come on the bearing. The twenty-four maps are the chief feature of the book. The stars are boldly shown in white on a black ground, plotted on bearings (both compass-card and angular). The year is divided into six bi-monthly periods on six series of maps. Each series contains four maps showing the stars in the N., E., S., and W. The apparent paths of sixteen guide stars are represented, with hourly positions marked. The use of the maps is straightforward and is explained on one page of the book. We have noticed only a single slip. Aldebaran is not at the *point* of the Hyades.

The theory is simple; accidents of topography are complications even on the best starlit nights. There is no doubt that a continent might be crossed with the aid of the stars, but a night-march from, let us say, Balham to Fulham might be fraught with unpleasant surprises if sole reliance were placed on stellar guidance.

H. E. Goodson.

GENERAL CHEMISTRY.

(1) *A Senior Experimental Chemistry.* By Dr. A. E. Dunstan and Dr. F. B. Thole. Pp. xiii + 522. (London: Methuen and Co., Ltd., 1916.) Price 5*s.*

(2) *A Class-book of Chemistry.* By G. C. Donington. Part iv., *Metals.* Pp. vii + 401 to 534. (London: Macmillan and Co., Ltd., 1916.) Price 2*s.*

(3) *Physical Chemistry for Schools.* By Dr. Henry Hortsman Fenton. Pp. viii + 215. (Cambridge: At the University Press, 1916.) Price 3*s.* 6*d.* net.

(1) YET another text-book of inorganic chemistry! This one is intended for "boys in the upper forms of secondary schools and students in technical institutes." It will be found useful by many others also. It is difficult nowadays to present a systematic course of inorganic and general chemistry with any novelty, nor is the ground covered by the present book very different from that covered by others. What is characteristic is the experimental nature of the treat-

ment. Although the course is systematic the endeavour has been made, and made with considerable success, to bridge the gap which too often, unfortunately, separates the lecture from the laboratory. The book is written on the sound principle of uniting the lecture and the laboratory, and for that reason it will probably earn a place for itself among chemical manuals.

(2) This is the fourth and concluding part of the late Mr. Donington's well-known "Class-book of Chemistry." It contains a more extensive and detailed treatment of metals than that already given in an earlier part. The descriptions are lucid, and numerous illustrative experiments have been inserted. The concept of ions in solution, and of reversible reactions, are early introduced, and good accounts are given of electro-chemical processes of extraction and refining. The earlier parts have rendered useful service to the teaching of elementary chemistry, and the present volume is up to the level of those previously issued.

(3) Dr. Fenton's book is significant in being the first serious attempt to deal with a problem of importance—namely, that of introducing a certain amount of instruction in physical chemistry into the school curriculum. Hitherto physical chemistry has suffered not a little from the general impression that it is only for those who possess a more or less advanced knowledge of mathematics. The present work ought to do much to remove this erroneous impression. Of course, one has to bear in mind the immaturity of the pupil, and there are aspects of the subject which should not be attempted. There is no reason, however, why the elements of the kinetic theory and its simpler applications should not be taught. Thermodynamical relations, in the reviewer's opinion, are much too abstract to be dealt with adequately at this stage. This is exemplified in one or two places in the present work, where an attempt is made to deal with them. Thus on p. 25 the logarithmic expression for work done in the expansion of a gas is given, but it is not pointed out that this is the *maximum* work, and that as a matter of fact the work might be anything from zero up to this limit. This would necessitate an account of what is meant by maximum work, and this in turn a statement of what is meant by thermodynamic reversibility. No mention of these points is made, although on p. 169 the term "maximum work" is used in connection with the calculation of the p.d. of an electrode. The greater part of the book is of course devoted to kinetic molecular conceptions, and the treatment is highly successful. The concluding chapter on technical applications is of special importance, as it will serve to do away to a certain extent with another very erroneous idea about physical chemistry, that it has nothing to do with practical problems. As a matter of fact it has everything to do with such problems, and the attempt to inculcate this upon the youthful mind is as praiseworthy as it is necessary.

W. C. McC. L.

INDUSTRY AND COMMERCE.

(1) *Factories and Great Industries, with some Account of Trade Unions, Old-Age Pensions, State Insurance, the Relief of Distress, Hospitals.* By F. A. Farrar. Pp. 90.

(2) *Trade and Commerce, with some Account of our Coinage, Weights and Measures, Banks and Exchanges.* By A. J. Dicks. Pp. 94.

(3) *Ships, Shipping, and Fishing, with some Account of our Seaports and their Industries.* By G. F. Bosworth. Pp. 86. (Cambridge: At the University Press, 1916.) Price 1*s*. 6*d*. each.

THESE three books are the first of a series which is designed to give children information on the industrial and commercial condition of their own country. They deal, generally on historical lines, with the nature of the principal industries, with the machinery of commerce, and with the development of shipping; while forthcoming volumes are announced on agriculture and mining.

The first volume under notice contains brief accounts of the Industrial Revolution; the textile industries; leather, paper, and printing; some great manufacturing towns; trade unionism; factory legislation; and provision for unemployment, sickness, and poverty. The second describes weights, measures, and the coinage; the Post Office; food supply; imports and exports; banking and exchange; trade marks, patents, limited liability, underwriting, the customs and excise. The third volume traces the growth of the ship from early times; the mercantile marine and the great ocean highways; the Royal Navy and its dockyards; the fishing industry; Lloyd's and its work; Trinity House and the lighting of the coast; the Port of London and other great ports. The writing is simple without being very inspiring; the books are well printed on good paper; and each volume contains some twenty illustrations, comprising half-tones, line drawings, and maps.

The series is suitable for boys of fourteen years of age or thereabouts, and the books may be used as supplementary readers in the upper classes of elementary schools and in the lower classes of evening schools. It is to be welcomed as supplying just that information which is necessary to create a sane outlook upon the problems of industry and commerce which, as citizens, boys will be called upon to exercise judgment. It is no use treating citizenship as a collection of ethical principles tacked on to a description of representative government and the administration of justice. The deeper problems of politics are even now, and to a still greater extent in the future will be, technical problems, requiring for their comprehension an adequate knowledge of the way in which this industrial system of ours has come into being, and a general sense of the direction in which it is tending.

Our only fear is that the price of the books will lead to their being used singly, and the pupils will obtain only a partial view. The whole series will be equivalent to a single volume of about 120,000 words, but will compare unfavourably with such a volume in unity and coherence. It is unfortunate that there is so much freedom of choice and so narrow a range of price in books for elementary schools; for unless we can have a more definite practical aim in this and other types of education we must expect variety of training and outlook to give us a babel of tongues instead of a clear, resonant voice upon matters of national welfare.

OUR BOOKSHELF.

The Thermodynamic Properties of Ammonia. Computed for the use of Engineers from new experimental data derived from investigations made at the Massachusetts Institute of Technology. By F. G. Keyes and R. B. Brownlee. Pp. v+73. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 4*s*. 6*d*. net.

This book contains the results of an experimental investigation carried out during the course of several years in the Research Laboratory of Physical Chemistry of the Massachusetts Institute of Technology. The object of the research has been to determine the vapour-pressure curve and the specific heat-capacity of liquid ammonia and the isotherms of the substance, so that the already existing data might be critically examined and supplemented and the results obtained used as a basis for the computation of a new table of the thermodynamic properties of ammonia which would prove useful in controlling the performance of refrigerating machines.

The first part of the book deals with the fundamental thermodynamic relations and a discussion of the data and the computations. The various formulæ involving the relations between the entropy, Gibbs's heat-function, the latent heat, the specific heats along the saturation line, the ordinary specific heats, etc., are obtained and tabulated for convenience. There are discussions on the methods employed to calculate the heat of vaporisation, the specific heat of liquid ammonia, and the entropy and specific heat of ammonia vapour.

The second part of the book gives some forty pages of tables, in which the thermodynamic properties of the saturated and superheated vapour are given with the temperature as independent variable in one set and the pressure in another. A Mollier diagram, in which heat-content is plotted against entropy, is added at the end of the volume.

The book should prove of the greatest service in engineering practice, especially for those who have to deal with refrigerating machines. The tables are given in a very convenient form, and the explanatory matter at the beginning is adequate and lucid.

J. R.

The Journal of the Institute of Metals. Vol. xv. Edited by G. Shaw Scott. Pp. viii+392. (London: Published by the Institute of Metals, 1916.) Price 21*s*. net.

This volume contains the papers presented at the annual meeting of the institute, with the discussion and correspondence to which they gave rise, together with abstracts of papers relating to the non-ferrous metals and the industries connected therewith. Among the papers is the Third Report to the Corrosion Committee, of which an account was given in Nature on April 6. The paper by Mr. Withey on the analysis of aluminium and its alloys is a very good piece of work which will probably constitute the standard of reference for some years. The aluminium of to-day is liable to contain copper, iron, zinc, silicon, silica, nitrogen, and sodium. It contains notably more copper than the metal produced ten years ago, but in other respects is a purer metal.

Prof. Stansfield's paper on electric furnaces as applied to non-ferrous metallurgy contains much interesting and valuable information. Furnaces are classified under two main headings: (*a*) those in which metals are reduced from their ores; (*b*) those in which metals are heated, melted, refined, and distilled. The former are electrolytic furnaces, and are used for the production of metals by the electrolysis of their fused salts. Aluminium, sodium, potassium, magnesium, calcium, barium and strontium are produced largely, if not exclusively, in this manner; and other metals, such as zinc, are occasionally so obtained. The latter are electrothermic smelting furnaces, and are used for the production of metals from their ores with the aid of electrically generated heat. Occasionally the metal is present in the ore in the native state, but usually it is found as an oxide or other chemical compound, from which it must be liberated by a chemical reaction involving the use of carbon or some other reagent in addition to the necessary electrical heat.

LETTERS TO THE EDITOR.

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

Science in Education.

We hear much of the place of science in education, but it seems sometimes as if its advocates would say: "When I mention science I mean experimental science, and not only experimental science, but industrial science, and not only industrial science, but paying science"—to paraphrase Thwackum.

Let us look at the French conception of science, as summarised in two fat volumes describing its progress in France, for the San Francisco Exhibition. In one volume are philosophy, sociology, education, mathematics, astronomy, physics, chemistry, mineralogy, geology, palæontology, biology, medicine, and geography. In an equal volume are Egyptology, classical archæology, history, art, linguistics, Indics, Sinics, Hellenics, philology (Latin and Celtic), French language and literature, Italian, Spanish, English, German, law, and economics.

Now, this is what science means to France How shall we give it honour here? The study of man holds as large a place as the study of Nature. And in this study of man language is the servant, and not the exclusive master, as it has been made in England.

One of the first steps required seems to be to put the study of man in its place as part of the essential education for all, quite independent of the minority who specialise in dead languages. We need to teach in every school the course of civilisation, its successes and its failures, the grandeur of the characters and thoughts which have stimulated action, to show man as the most potent and ruling influence upon Nature. At present, to even the small minority who master dead languages for effective use, most of the literature is unknown, and the physical facts of civilisation are ignored. The time spent in general education upon dead languages—mostly ineffective—would suffice for a fair acquaintance with both man and Nature, if practically used. F.R.S.; F.B.A.

The Third Fossil Tsetse-Fly.

AMONG some fossil insects collected in the Miocene shales of Florissant, Colorado, by Mr. Geo. Wilson, and transmitted to me by Mr. F. H. Ward, I find a beautifully preserved tsetse-fly. The insect is intermediate in size between the two fossil species previously found (both of which may be seen in the British Museum), and is evidently distinct. It may be called *Glossina veterna*, n.sp., and will be best distinguished by the following measurements in millimetres: length 12·5, length of wing 10·9, length of proboscis 4·1, length and width of abdomen each 5·0. The body and legs are brown or black, the abdomen without dark bands; the wings are hyaline, faintly brownish. The scutellum has long marginal and apical bristles, exactly as in the living species. The post-alar and first dorso-central bristles are also well preserved and normal. The anterior basal cell of the wing is about 0·6 mm. broad at end, its truncate apical end is short, and the lower margin does not bulge much near the end. The abdomen is hairy, as in living species. This excellent specimen affords additional evidence for the existence of two tsetse-flies in the American Miocene, astonishing as the fact is. The new species is nearest to *G. osborni*, but is too large to be the female of that form.

T. D. A. COCKERELL.

University of Colorado, Boulder, August 31.

The Designation of Hours.

A PROPOS the alteration of official time, now imminent: would it not be a good plan to suggest a modification of time nomenclature? As follows: Midday is 12 noon; well and good. Half an hour later is 12.30 p.m., and we have the confusing spectacle of 11.30 p.m. arriving eleven hours *afterwards*! I suggest, as long as the 24-hour system is followed, that each 12-hour cycle be definitely marked off. Thus half-past 12 (day-time) would be 0.30 p.m., to be followed, quite logically, by 1 p.m., 1.30 p.m., etc., up to 12 p.m. Half-past 12 at night would be 0.30 a.m. Comparison could then be made with the 24-hour system, unless indeed the powers that be are foolish enough to label the first half-hour of each new day 24.30 a.m.—to be followed by 1 a.m. C. H. COLLINGS.

3 Tollington Place, Tollington Park, N., September 18.

ARCHÆOLOGY OF THE MIDDLE AMERICAS.[1]

THE work before us is the third volume of a series devoted to the archæology of the Latin Americas, in which the author contrives to give a general account of this enormous field, mainly based upon a widely scattered and not always easily accessible literature, from the earliest Spanish chronists to the present plethora of Americanists. There are few readable works which take a wider and more scientific view of the main questions, whilst the flood of the more professional publications deals with smaller areas and often intensely with abstruse detail of one or other of the numerous problems.

FIG. 1.—Greater Antilles: Wooden idol. (Scale, one-sixth.) From "Central American and West Indian Archæology."

In this quarter of the globe, from Mexico and the Antilles, and extending far down in western South America, a peculiar and unique kind of civilisation developed, and culminated in two widely separated centres, not in the steamy-hot tropical lands, but literally above them, in the uplands, where a more invigorating climate still repaid agricultural toil. Having dealt first with the Mexican-Maya civilisation, which has spread its influence in ever-weakening waves down to Panama, the author devoted his second volume to South America, the civilisation of which centred in the Peruvian highlands.

Having first treated these north and south centres, with their radiating influence into the Middle Americas, he has shorn these by anticipation. From a broad point of view the present volume could therefore deal only with what was left over, and this residue is of minor importance, since it applies to peoples with a civilisation not exactly degenerate, but approaching the original stratum, which had not risen to anything great of its own.

[1] "Central American and West Indian Archæology: Being an Introduction to the Archæology of the States of Nicaragua, Costa Rica, Panama, and the West Indies." By T. A. Joyce. Pp. xvi+270. (London: Philip Lee Warner, 1916.) Price 12s. 6d. net.

The first and larger portion of the book deals with the archæology, ethnology, linguistic divisions, habits, and beliefs of the ancient inhabitants of the present States of Nicaragua, Costa Rica, and Panama. The people belong to the same stock, with modifications, which stretched from the Sonoran region through the whole of Central America far into the western—let us say Andine—portion of the southern continent, leaving the bulk of the latter to what may be called the typical neo-tropical races, notably Guarani, Tupi, Arawak, and Caribs. In conformity with the configuration of the isthmus, the influence from the Inca centre was insignificant in comparison with that from the Maya-Mexican. It is the reverse with the fauna and flora, which naturally date from much earlier epochs with broader contact.

The last hundred pages are devoted to the West Indies. These fairest and most fertile islands being subject to earthquakes, volcanic eruptions, and hurricanes, it is, according to our author, not surprising that their inhabitants developed a religious system which consisted in the main of a propitiation of the powers of Nature. Nevertheless, according to the testimony of C. and F. Columbus, father and son, they seem to have been a kindly, honest, and generous folk, to whom contact with the Spaniards meant speedy extermination.

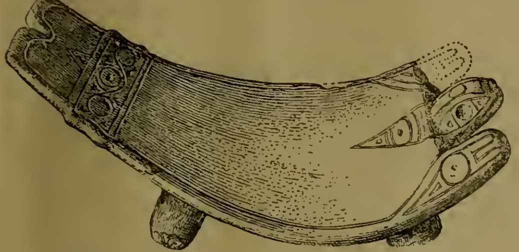

FIG. 2.—Porto Rico: Stone seat. (Scale, one-third.) From "Central American and West Indian Archæology."

The original stock of the whole archipelago were Arawaks from the southern continent, and were in turn followed by the more bellicose Caribs, who at the time of their discovery were in possession of the Lesser Antilles and fast extending into some of the greater islands. They had a patriarchal system, with caciques or small chiefs. A tie of friendship was the mutual exchange of their names. They practised the couvade. The Arawaks were armed with sword-clubs and javelins, hurled by means of ornamented spear-throwers. The chief weapon of the Caribs was the bow. The male prisoners were eaten. There is no evidence that stone weapons were used, the blades of stone found being tools. Charms were made of wood and stone, images of man and animals. Interesting are the stone collars which are said to be the translation into stone of originally a wooden hoop, a tree-fork bent and fixed by bandages into this shape. The enclosing of a spirit in such a circle is connected with tree-worship. Beautiful stone collars are found also in the Maya-Mexican countries.

But there is very little known about such and similar curiosities beyond the often gratuitous accounts of the old chronists, and the same applies to the beliefs and habits of these vanished people. Some are no doubt of genuine indigenous origin; others point to the western or to the southern mainland, just as one would expect. Since these islanders used dug-outs, large enough for even long voyages, it is not surprising that their kind of civilisation—as shown by their weapons, ornaments, stone masks, figurines, pottery, etc.—was more or less alike all over the archipelago.

THE ABNORMAL PROPAGATION OF SOUND BY THE ATMOSPHERE.

MR. S. FUJIWHARA has recently published a second valuable memoir on the abnormal propagation of sound-waves in the atmosphere (Bull. Centr. Meteor. Observatory of Japan, vol. ii., 1916, pp. 1-82). As in his previous paper (NATURE, vol. xcii., 1914, p. 592), he ascribes the peculiarities investigated to variations of the air-temperature and of the velocity and direction of the wind, and he concludes that the structure of the upper atmosphere may be inferred from the form of the region of audibility.

The present memoir consists of two chapters. The first is theoretical, and deals with the modes of propagation of sound-waves through the atmosphere, the structure of which may be one of the five types observed by Capt. C. J. P. Cave at Ditcham Park, Petersfield, Hants. He shows that the region of audibility, including the sound-source (or proximate region), may in many cases be of triangular, or rather fish-tail, form, the axial direction of which may be not only in the direction of the wind then prevailing, but also in any other direction, at right angles or even opposite to that of the wind; for it depends chiefly on the direction of the wind in the lower stratum of the atmosphere with respect to that at the earth's surface. In other cases the proximate region may assume a spiral form, with the vertex at the source of sound and extending in the sense of the veering of the wind in the upper atmosphere. The regions of audibility due to winds at different heights may overlap one another. Detached regions of audibility may appear in a zone subtending an angle of less than two right angles at the sound-source, and they may be of any form. If the wind remains steady in direction and velocity in the upper layers, or if there is a decrease in velocity in the upper atmosphere, detached regions should not occur. With an increase of velocity in the upper atmosphere, detached regions may occur in the same direction as the proximate region. But if there should be a reversal or great change of direction in the upper layers, or if the upper wind should blow from a distant low-pressure centre with frequent reversal in the lower layers, detached regions should be more often present than absent.

In the second chapter Mr. Fujiwhara compares his theoretical investigations with the results of sixty-five explosions during the years 1912 and 1913, for the most part those of the Asama-yama, in Central Japan. These show that the axis of the region of audibility may or may not agree with the direction of the wind at a moderate height; that in some cases the regions of audibility are triangular or spiral in form; that detached regions may occur on the same side of the source, while sometimes a very large detached region may be found in company with a very small one at the source; and, lastly, that detached regions of audibility and a silent region may appear in any direction and at any distance according to the prevailing condition of the weather. In Japan the monsoon exercises a powerful influence on the propagation of sound-waves in the atmosphere, and this accounts for the observed differences in summer and winter. In summer the formation of the detached region of audibility is rather common, and takes place towards the west or south-west of the source, while in winter the phenomenon occurs more rarely and is then caused by an approaching cyclone. C. Davison.

SIR LAUDER BRUNTON, BT., F.R.S.

On the 16th of the month this distinguished physician passed away after a long illness, borne with rare fortitude. Although retired from private practice, Brunton was far indeed from retirement in respect of those public causes to which, with the pious tenacity of his race, he devoted much of his life, and a fervour almost religious in its depth and constancy. Some weeks before his death the present writer had visited Lauder Brunton, and witnessed both the distress under which he laboured and the ingenious methods he had devised for keeping the evil at bay; not in the desire of a mere prolongation of life, though this indeed were no unworthy intention, but in order to cherish the fire of its last embers for those humane ends which he had so ardently at heart. It was therefore with admiration that, about three weeks before his decease, the writer received from his friend now silent a long and important letter covering certain documents and proposals on the subject of physical education, a movement to which, in his later years, Brunton had given no little energy and guidance, especially for the sake of children and young people, and which he was pressing forward almost with his latest breath. Fortunately, he has worked with comrades and assistants who will not fail to keep his lamp alight, nor let any of his last counsels be forgotten.

At St. Bartholomew's Brunton proved to be not only a distinguished man of science, but also of much accomplishment and success in the practice of his art. Like James Goodhart of Guy's, who died but a short while before him, he won the faith and attachment of a large *clientèle* by merit pure of all self-seeking. Although these great teachers were not quite alike in the ways of their medical observation, yet to the particular skill of each were added kindliness of heart and an earnest sympathy which won the confidence of the sufferers who sought their aid. If Brunton had not the imposing personal presence of certain eminent physicians of the past, no one could speak with him without being affected by his gentle, persuasive enthusiasm, and that faith in his art and in mankind which engendered alike faith and hope in those who only too often sorely needed these blessings.

Lauder Brunton was one of the first of the scientific practising physicians who used no empirical remedies without seeking to discover their mode of action, and by pharmacological and other research endeavoured to add to their number. Bence Jones, Golding Bird, Pavy, were of the generation before him, it is true; but few physicians whose interests before all else were, and still remained, clinical, had likewise followed scientific investigation so systematically and in so disinterested a spirit. Moreover, in his particular departments of science Brunton was a pioneer, especially in pharmacology and in the physics of the circulation. With a mind strengthened by the seriousness and philosophical temper of his great university of Edinburgh, Brunton, after graduation, spent two or three years in foreign study, for the most part in Germany; and no British physician had a better knowledge than he of German teachers, German industry, and of that necessary condition—the German tongue. Thus for him the war was full of sadness.

In this brief tribute no attempt can be made even to indicate the character and extent of Brunton's scientific work, pharmacological, clinical, and hygienic. His contributions are only partially presented, indeed, in the two or three portly octavos in which many of them were recently reprinted. But if to the chief or to the more familiar of his works some allusion may be made, it would be to his researches with Fayrer into venoms—a successful attempt to clarify a very ancient and chequered story, as the historian of medicine well knows; to his part as one of the Commission which reported on Pasteur's treatment of hydrophobia; to his services on the Hyderabad Commission on the effects of chloroform, by which, if its results were doubted in some quarters and in others enlarged, nevertheless the whole problem was raised to the plane of its infinite importance; to his work on tuberculosis, which was informed by the spirit of a social prophet; and to his researches on the dynamics of the circulation. Herein he made the beneficent discovery of the nitrites as palliative, or better than palliative, in that awful malady angina pectoris, a discovery deserving to rank with that of Peruvian bark in the cure of ague. If, as the present writer has remarked elsewhere,[1] the discovery arose accidentally from

[1] "Diseases of the Arteries," 1915.

the use of a graphic curve which betrayed the inadequacy of the sphygmograph to follow the finer movements of the artery, yet how many brilliant discoveries have arisen from accidents ot manipulation or interpretation! To have discovered the means of controlling one of the most cruel ills to which man is subject is perhaps the laurel wreath amid the many memorials of one who, in his humanity, would have prized this above all rewards.

By academic and official decorations Lauder Brunton was richly distinguished; but perhaps, in his loyal and patriotic heart, the honour of none of these was to be compared with the glory of his younger son, a promising Cambridge medical graduate, who last year gave his life on the field of battle for his country—a glory, but also a sorrow which, falling but a brief five years after Lady Brunton's death, deepened the shadows of his latter days. Happily his elder son, also on military service, and his devoted daughters were still spared to him. C. A.

The death of Sir Lauder Brunton on September 16, in his seventy-third year, has deprived the world of a great physician, and brought sorrow to a wide circle of friends. Largely by his vivifying studies and teaching, pharmacology has become a definite branch of science. Practical medicine depends on physiology, pharmacology, and pathology, and all three tend more and more to become subdivisions of the all-embracing science of chemistry. In no departments of the healing art is the influence of laboratory methods more apparent than in those directed to the study of disorders of digestion and diseases of the circulation; and in both these directions Sir Lauder Brunton was a pioneer worker. He had the clearest conceptions of clinical facts, and possessed to an unusual degree the practical quality of being able to apply extensive knowledge of physiological medicine to the work of the hour. His stimulating personality will be widely missed by his professional brethren as well as by many who have benefited by his work and advice.

Thomas Lauder Brunton was born at Hiltons Hill, Roxburgh, in 1844, and received his medical training at the University of Edinburgh, where he had a distinguished academic career, and graduated M.B., C.M. with honours in 1866, receiving also the gold medal for his thesis. In the following year he became B.Sc., in 1868 he obtained the M.D., and two years later the D.Sc., in the meanwhile having also studied at Paris, Vienna, Berlin, and Leipzig. Settling in London, he became lecturer on materia medica at the Middlesex Hospital in 1870 and assistant physician at St. Bartholomew's Hospital in 1875, to which school he remained attached as lecturer, physician, and consulting physician.

Early in his career Brunton's inclinations leaned towards the scientific side of medicine, and at the early age of thirty he was elected F.R.S. in recognition of his admirable work on the physiology of digestion and secretion, on the chemical composition of the blood, and on the actions of the two drugs, digitalis and mercury.

Brunton's post at St. Bartholomew's carried with it the lectureship on materia medica and therapeutics, and he turned his attention to the effects of medicines and instituted many experimental investigations on the actions of drugs upon himself and upon animals. In 1885 he published his well-known book on "Pharmacology, Materia Medica, and Therapeutics," which passed through many editions in this country and abroad. This appeared at an opportune moment, and largely owing to his work and writings pharmacology became separated from materia medica and established as a branch of physiology.

In 1886 he was appointed a member of the Commission to report upon Pasteur's system of inoculation for hydrophobia, and in 1889 a member of the Nizam of Hyderabad's Chloroform Commission. For the latter a considerable amount of experimental work was carried out and a valuable report issued, though no very definite conclusions as to the action of chloroform were arrived at. In the meantime, Brunton had become one of the best-known consulting physicians in the country, and in the art of treatment he was most resourceful. He introduced a new class of remedies, the vaso-dilators, into medicine, and by the use of amyl nitrite for angina pectoris was the first to employ a remedy because its physiological action was opposed to the pathological condition existing in this disease, viz. rise of blood-pressure.

In 1900 he was knighted, and nine years later was given a baronetcy, and he was the recipient of many honours from universities and societies at home and abroad. He was also Gulstonian and Croonian lecturer and Harveian orator of the Royal College of Physicians of London. Several works emanated from his pen, notably the "Introduction to Modern Therapeutics," illustrating the connection between the chemical structure and physiological action of drugs, "Disorders of Assimilation," and "Therapeutics of the Circulation."

Sir Lauder Brunton, outside his professional work, was keenly interested in all schemes in favour of national health, of school hygiene, of physical culture and military training, in the furtherance of which he gave bountifully of his time and energies.

NOTES.

Geologists will regret to hear of the death of Mr. R. J. L. Guppy at his home in the island of Trinidad on August 5, and within a few days of celebrating his eightieth birthday, Mr. Guppy having been born in London on August 15, 1836. In early life he qualified as a civil engineer, and afterwards travelled through Australia, Tasmania, and New Zealand. On joining his family in Trinidad in 1859, he took part in the construction of the Cipero Railway, but later becoming interested in the educational work of the colony, he was appointed Chief Inspector of Schools. Mr. Guppy, however, will be better remembered for his researches on the geology of Trinidad and the other West Indian islands. On this subject he contributed upwards of fifty papers, several of which were published by the Geological Society of London. He accumulated a great knowledge of the Tertiary faunas of that region, and did much towards rendering a correlation of the various horizons represented. His earlier memoirs dealt with the San Fernando deposits of Trinidad containing Orbitoidal and other fossils, which at first he regarded as of older Miocene age, but which afterwards he more correctly assigned to the younger Eocene or Lower Oligocene. He was always an ardent student of natural history, being particularly interested in the recent and fossil mollusca, and was also an authority on the rich deposits of petroleum which have made Trinidad so famous. Some years ago he was instrumental in acquiring for the British Museum the second largest known Pleurotomaria, possessing a height of 150 millimetres, which was discovered off the island of Tobago. Mr. Guppy was a corresponding member of the Zoological Society of London, and of the New York and Philadelphia Academies of Science. He had served as president of the Scientific Association of Trinidad, and was the first presiding officer of the Royal Victoria Institute Board. Much work yet remains to be accomplished among the Tertiary rocks of Trinidad, as many of the geological horizons are still in confusion and imperfectly understood; but whatever is attempted in the future, there is no doubt that Mr. Guppy's valuable memoirs will always furnish us with an important basis for later investigations on so interesting a subject.

MR. E. G. KENSIT, who fell in action at Delville Wood on July 17, was a great-nephew of the late Dr. Harry Bolus, and became a member of the staff of the Bolus Herbarium in the Botanical Department of the South African College in 1912. In August, 1915, he enlisted in the South African contingent for service overseas. After a period of training at Potchefstroom, he was sent to Egypt, and served through the Senussi campaign. The circumstances of the death are described in the following extract from the *Cape Times* of August 30:—"On the colonel of his regiment calling for a volunteer for the purpose of reconnoitring the enemy's line and securing certain information, Kensit was among those who stepped forward, and his offer was accepted. He was seen to be hit as he crawled away, but he continued with his task, and after an interval crept slowly back, hampered by his wound. On reaching the parapet he was assisted to surmount it. He was able to give the officer all the information that was wanted, but he had no sooner done so than he rolled over—dead."

WE regret to learn that Mr. Gustav Mann died at Munich on June 22, in his eighty-first year. To him we owe our knowledge of the botany of the Cameroon Mountain, for he was the pioneer of botanical exploration in this region when he was attached to Dr. Baikie's Niger Expedition in 1859 as botanical collector for Kew. He ascended Clarence Peak, in Fernando Po, and made extensive collections of plants from the mountains of western tropical Africa, which have been described in papers presented to the Linnean Society. He then went out to India, and after serving for a year as assistant in the Government cinchona plantations was transferred in 1864 to the Bengal Forestry Department. From 1868 he served in Assam, and in 1882 was appointed Conservator of Forests, which position he held with distinction until his retirement in 1891.

WE learn from the *British Medical Journal* that Lieut.-Col. G. M. J. Giles, Bengal Medical Service (retired), died at Plymouth on August 24, aged sixty-two. In his early service he spent some years as surgeon naturalist in the Indian survey ship, the Royal Indian Marine steamer *Investigator*, and in 1886–87 accompanied the late General Sir William Lockhart on an exploring expedition in the Pamirs. He was the author of works on kala-azar and beri-beri, mosquitoes, climate and health in hot countries, and tropical climatology.

A FEDERATION of British Industries has been formed to provide a body capable of representing the interests of the British manufacturing and producing industries. The objects of the federation may be summed up briefly as the organisation and development of industry now and after the war, in co-operation with labour and in conjunction with the Government and Government departments. The federation will at once concern itself with the reconstruction of British trade after the war; the development of sources of supply of raw materials; and questions arising out of the transition from war to peace, such as measures to mitigate possible unemployment during that period. Every effort is to be made to ensure that in future no important action affecting British industry shall be taken by the Government without due weight being given to the views of manufacturers. A condition of membership is an annual subscription of 100*l*. a year, with an obligation to continue such subscription until June 30, 1919. Mr. F. Dudley Docker, C.B., is the president of the federation.

THE recently issued report (Cd. 8346) of the Committee on Financial Facilities for Trade to the President of the Board of Trade recommends the establishment of a British Trade Bank, constituted under Royal Charter, to fill the gap between the home banks and the Colonial and British-foreign banking houses, and to develop facilities not provided by the present system. It is proposed that the bank should have a capital of 10,000,000*l*., and should, among other activities, inaugurate an information bureau, co-operate with merchant and manufacturer, and become a centre for syndicate operations. The bureau, it is suggested, should be independent of the Commercial Intelligence Branch of the Board of Trade, and would not necessarily deal only with schemes in which the bank proposed to take financial interests, but might be made a centre for the investigation of other projects. The report urges that if financial assistance is given by the Government to undertakings in connection with what are known as "key" industries, the business should be done through the new bank. The committee thinks that such a bank would, with efficient management, not only be a great boon to British trade, but also should prove a commercial success.

AN important addition to the art collections of the Philadelphia Museum is reported in the Museum Journal for last March. Mrs. Dillwyn Parrish, of London, has presented five Roman mosaics in memory of her late husband. Of these, the two most interesting specimens from the point of view of size come from Carthage; the other three, smaller, but charming, examples, are said to have been obtained in Rome. The Carthage mosaics are examples of *opus vermiculatum*—cubes of marble or other material disposed so as to attain to a pictorial effect. One of the Italian pieces, representing a duck, has much in common with some of the mosaics found in the House of the Faun in Pompeii. Another, considerably later in date, represents two griffins facing an urn, and is an example of the stiff, conventional, unimaginative work of the second century A.D. On the other hand, the lack of imagination is in some degree made up by the great technical skill shown in the treatment of the griffins, the colour being obtained by the use of cubes of opaque glass applied to the wings and tongues of the beasts.

The deficiencies of modern India in the matters of house building and sanitation are a cause almost of despair to the authorities. No problem is so difficult as that of sanitation, because the official runs the constant risk of offending some religious or social prejudice. But it is not because their own writers have neglected the subject that the present condition of things has arisen. In the June issue of the Journal of the Bihar and Orissa Research Society Dr. Mahamahopadhyaya Ganga Nath Jha has collected the ancient Sanskrit laws on the subject. They deal with the sanitation of houses, and provide minute directions on the right uses of food and drink. Much of this is, no doubt, academic, and the rules on these subjects are the speculations of philosophers which in many cases could not have been brought into actual practice. But many of them are judicious, and may help the officer of health in preaching the value of sanitation. The pandit ends by saying:—"From the above it will be seen that the old people of this country knew and practised many laws of health and sanitation which have been forgotten, with results that all deplore."

The *Indian Journal of Medical Research* for July (vol. iv., No. 1) contains several important papers. Dr. Soparkar describes a method for cultivating the tubercle bacillus from sputum after destruction of adventitious micro-organisms by treatment with caustic soda. Dr. Agnes Scott writes on osteomalachia, and Major McCarrison, I.M.S., describes the successful experimental production of congenital goitre in goats by feeding them with cultures of micro-organisms grown from the fæces of goitrous individuals (goats). He concludes, therefore, that congenital goitre is due to the action on the fœtal thyroid of toxic substances derived from the maternal intestine.

On July 29, 1915, the Government passed the Milk and Dairies (Consolidation) Act, 1915, which consolidated in one Act the 1914 Bill and previous Acts of Parliament. The Act, however, does not come into force until such date as the Local Government Board may by Order appoint. As the Bill was passed by mutual consent of all sections of both Houses, it cannot be expected to include far-reaching improvements in the milk supply. It does, however, provide that the Local Government Board may issue "Orders," upon which the success of the Act will almost entirely depend. With the view of defining what may be considered the requirements necessary to improve the milk supply, representatives of the National Clean Milk Society, the Society of Medical Officers of Health, and the Sanitary Inspectors' Association have formulated a series of recommendations which have been forwarded to the President of the Local Government Board, and a copy of which we have received. These recommendations have been conceived in a moderate spirit, and their adoption would do much to improve the general milk supply. They do not, however, include a clause prohibiting the addition of skimmed milk to milk, a matter of some importance.

Before the war the United States imported annually from Germany as much as 300,000 tons of potash. The failure of this source of supply has induced the Department of Agriculture to make the experiment of extracting potash from kelp. It is believed that the vast beds of this weed off the coast of California will suffice to furnish all the future needs of the country, and large quantities are already being placed on the market from this source. But, according to *California Fish and Game* for July, fears have been expressed that the cutting of the kelp will have an injurious effect upon the fisheries of the State, and this because of the protection afforded by the weed to the beaches, and the danger of exterminating the clams and spiny lobsters which live more or less within the protection of the kelp. They also fear that the young fish, especially barracuda, which are in the habit of seeking refuge here, will be driven away, and further that such fish as spawn here will similarly be destroyed. These several objections have now, however, been carefully examined, and it is pointed out that the kelp-cutters, or reapers, do not cut below 6 ft., thus leaving ample shelter. It may be, indeed, that the cutting will prove actually beneficial, since it will be less easily torn up by storms. The species of kelp which is thus being harvested is *Macrocystis pyrifera,* a plant which ranges in length from 100 to 300 ft.

In the *Journ. Agric. Research* (vi., No. 14) Mr. V. L. Wildermuth describes the life-history of a lacewing fly (*Chrysopa californica*). The larvæ of Chrysopa are well known as beneficial insects on account of their habit of feeding on "greenfly" (aphids). *C. californica* lives as a larva for about sixteen days, during which it undergoes two moults, and eats from 74 to 160 full-grown aphids, besides a still larger number of young ones.

An excellent twenty-page pamphlet by the Rev. Jas. Waterston on "Fleas as a Menace to Man and Domestic Animals" forms No. 3 of the British Museum's Economic Series. The structure and life-history of the insects are described in sufficient detail, and readers are warned of the great danger to be feared from those species which act as carriers of the plague-bacillus between rats and human beings. There are many instructive and illuminating statements, such as an observation quoted from Prof. Osborn, who once collected a teaspoonful of fleas' eggs from the dress of a lady who had been fondling a kitten!

In the *Entomologists' Monthly Magazine* for August Mr. E. Meyrick publishes a "Note on Some Fossil Insects," dealing particularly with a hindwing, of Upper Triassic age, from Queensland, which has been named *Dunstania pulchra* and referred to the Lepidoptera by Mr. R. J. Tillyard. Mr. Meyrick points out that the nervuration of this hindwing would indicate a highly specialised Lepidopteran type, if the insect to which it belongs were really a moth. As the wing further possesses a corneous margin "altogether abnormal, no other Lepidoptera showing a trace of it," he is inclined, though with some hesitation, to suggest that it must be referred to a Homopterous insect. Incidentally he supports the Lepidopteran nature of Butler's *Palaeontina oolitica*, emphasising its affinity to the family of the "swift-moths" (Hepialidæ).

The annual report of the Dove Marine Laboratory for 1916 contains an important paper by Prof. A. Meek on the method of estimating the age of fishes by inspection of the annual growth-rings on the scales. This method was extended by Lea, Dahl, and Hjort some years ago in this way: Assuming that the growth-rates of the scale and body of the fish (the herring) are strictly proportional, it ought to be possible to determine the age of the same individual in successive years by measuring the distances between the focal point of the scale and the margins of each of the rings. But application of this method led to some apparently anomalous results, and Lea's conclusions were criticised by Miss Rosa Lee, of the English Board of Agriculture and Fisheries. It appeared as if there was a contraction of growth of scale relative to the growth of the body, and the Norwegian investigators sought to explain this by postulating elimination of the fish exhibiting the more rapidly growing scales. In the publication now noticed Prof. Meek shows that there is not exact correlation between growth of body and of scale; the latter grows at first less rapidly than, then at the same rate as, and finally more rapidly than does the body. Curves of growth are probably exponentials and show this imperfect proportionality. Selection does indeed take place; there is a tendency (in the case of the herring) for fish of the same phase of sexual maturity to shoal together, so that those which are (sexually) younger tend to join with shoals of their own phase, and *vice versâ*. In the same publication Mr. B. Storrow applies the principle to the growth-rate of other fishes.

PROF. E. W. SINNOTT contributes to the *American Naturalist* (l., No. 596) an essay on the "Comparative Rapidity of Evolution in Various Plant Types." He concludes that the most recently evolved members of the North Temperate flora are herbaceous in habit, that herbs tend to be grouped in fewer and larger genera and families than shrubs and trees, and that herbs, with their rapid multiplication of generations, must be "in most cases undergoing evolutionary development much more rapidly than are trees and shrubs." The most ancient Angiosperms were probably woody, and "herbaceous vegetation has made its appearance in comparatively recent geological time."

IN his history of Ethiopian earthquakes (*Boll. Soc. Sismol. Ital.*, vol. xix., pp. 293–350) Prof. L. Palazzo has added to our knowledge of the seismic regions of Africa. His catalogue, which closes with the year 1912, contains 142 entries, all but seven since the beginning of the nineteenth century. He shows that the seismicity of Erythræa is higher than was supposed, and that the earthquakes sometimes attain a destructive intensity, while those which occur near the coast are occasionally accompanied by sea-waves. As to their origin, some are purely volcanic, but the majority he classes under Mercalli's heading of perimetric or intervolcanic.

DR. A. CAVASINO has recently published a valuable memoir on the after-shocks of the Italian earthquake of January 13, 1915 (*Boll. Soc. Sismol. Ital.*, vol. xix., 1915, pp. 219–91). These were recorded at the geodynamic observatory of Rocca di Papa, which is about forty miles from the epicentral area. The earthquake occurred at 7.53 a.m., and, owing to the strength of the shock, all the seismographs in the observatory were suddenly thrown out of action. Within three-quarters of an hour the more sensitive instruments were repaired, including the Agamennone microseismometrograph, the records of which are here considered. The loss of the earlier records of after-shocks is of little consequence, for, at Rome, the seismogram of the principal earthquake obliterated those of the after-shocks, and, moreover, the ground during the first hour was in such a state of continual agitation that individual shocks could not be distinguished. The number of after-shocks registered during the first twenty hours was 302, and during the first six months 1280. Dr. Cavasino considers that the distribution in time of these after-shocks does not follow Omori's well-known law deduced from the after-shocks of the great Japanese earthquakes.

THE Geologists' Association (Proc., vol. xxvii., 1916, p. 1) publishes a beautifully illustrated paper by Prof. Garwood on "The Faunal Succession of the Lower Carboniferous Rocks of Westmorland and North Lancashire," which serves, with its maps, as a guide to a very attractive district, including the high moors of Shap and the picturesque fault-blocks of the Arnside shore. In the same volume (p. 79) Mr. P. G. H. Boswell describes the constitution of the North Sea drift as found across eastern England. His mechanical analyses usefully distinguish this drift from the later Glacial brick-earths; but why does he use such expressions as $\frac{1}{4}$ and 1/100 of a millimetre? The remarkable variety and beauty of the mineral fragments in this mixed material are pointed out by one who clearly loves his subject.

THE "Rainfall of India" for 1914, which is the twenty-fourth year of issue, is collected from the returns published by the various Provincial Governments, and is issued in one volume by the Meteorological Department of the Government of India under the superintendence of Dr. G. C. Simpson, officiating Director-General of Observatories. The volume gives the monthly and annual rainfall, as well as the average rainfall for about 3000 stations in India, from the records taken daily at 8 a.m. The number of rainy days is given, and although the rainfall is measured to hundredths of an inch, a "rainy day" is taken as that on which a tenth of an inch or upwards has fallen, and the normal number of rainy days given in some cases is also calculated on the same assumption. The value of a "rainy day" being ten times as great in India as in England is regrettable, and some adjustment may be found possible when a change is made to meet the registration by the new units of measurement now generally adopted in this country and elsewhere. The normals used for the comparison are those revised to 1910 for the whole of India, and are mostly for at least thirty or forty years.

THE Bureau of Standards of the Department of Commerce of Washington issues a Scientific Paper, No. 286, on "The Determination of Aluminium as Oxide." The author, Mr. William Blum, finds that, to avoid loss of alumina, a hot 2 per cent. solution of ammonium chloride should be used for washing the precipitate, as this facilitates coagulation. Methyl red is used as an indicator of the optimum condition of alkalinity, since it shows a sharp colour change at the desired point. The quantitative reasons for its selection are interestingly stated. The elimination of other substances from the precipitate is considered. A copy of the paper will be sent free on application to the Bureau of Standards.

THE new American journal, *Aviation and Aeronautical Engineering*, contains much of interest, and should prove a successful enterprise, both in the States and elsewhere. The second number is specially worthy of note on account of the scientific nature of the contents. There is an excellent article on "Aviation and Aerography," in which the importance of meteorological research as a help to aviation is strongly emphasised. A short note entitled "An English Photograph of Great Interest" shows a very keen appreciation of the merits of the Royal Aircraft Factory machines, and of their inherent stability. An article on "Steel Construction of Aeroplanes" contains an account of a method of construction which must eventually supersede wood for the larger machines. Perhaps the most interesting item from a scientific point of view is the second part of "A Course in Aerodynamics and Aeroplane Design," written from the Massachusetts Institute of Technology. The authors treat of the elements of aerodynamical theory, and if future articles of the series are as clearly written as that in the present number, they should prove of considerable value to those who need an introduction to the subject.

FROM the reports of the behaviour of the recording instruments at a number of magnetic observatories in different parts of the world during the solar eclipse of August 21, 1914, Dr. Bauer and Mr. Fisk, of the Department of Terrestrial Magnetism, Washington, have drawn some preliminary conclusions as to the effects of eclipses on solar terrestrial magnetism, which will be found in the June number of *Terrestrial Magnetism and Atmospheric Electricity*. At stations from which the eclipse was visible it appears to have changed slightly the daily march of the declination needle. At four British and Danish stations for which curves of the daily change of declination are given the normal motion of the needle to the west was arrested, and in some cases reversed, a short time before totality of the eclipse. Outside the region of visibility of the eclipse no magnetic effects were observed. These results appear to justify more extensive preparations for observing the effects of the solar eclipse due June 8, 1918.

MESSRS. KODAK, LIMITED, have issued a new and much improved edition of their "Wratten Light Filters" (1*s*.), in which they describe some ninety colour screens. Of those previously catalogued eleven are omitted and twenty-nine new filters are introduced, the latter including a series of nine made to equalise the tints of various artificial lights for facilitating photometric work. The transmissions of nearly all the filters are given in very clearly expressed curves, a vast improvement on the reproductions of spectrographs taken with a graduating wedge in front of the slit, as given in the previous editions. For those who need more exact data the actual readings obtained by the use of the spectrophotometer are given in copious tables, and will prove of great value. "The Photography of Coloured Objects," another of Messrs. Kodak's publications, has been revised, and now includes "Orthochromatic Filters," which was until now published separately. For the benefit of any who do not know this volume, we may say that it gives a clear and accurate account of the principles involved, and points out objects of many kinds that are really "coloured," though they do not appear to be.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET.—Prof. Strömgren reports that Encke's comet was observed by Dr. Max Wolf on September 22. At 9h. 41·5m., Königstuhl mean time, its position was R.A. 22h. 28m. 39s., declination 7° 8′ 5″ S. The magnitude of the comet was 16·5.

THE NEBULA H II. 78 LEONIS.—It is interesting to note that Mrs. Isaac Roberts is continuing her detailed studies of nebulæ photographed at Crowborough by the late Dr. Isaac Roberts. The subject of a recent paper (Monthly Notices R.A.S., vol. lxxvi., p. 647) is the nebula H II. 78 Leonis (N.G.C. 3367), photographed in 1902. The nebula extends for about 2′ from north to south, and 2·5′ in the direction at right angles, and is described as a left-hand spiral with a bright stellar nucleus. The nucleus is encircled twice by the spiral arm, which shows numerous condensations. With the aid of the Roberts "pantograver," measures were made of many of the bright nebulous knots, and of nineteen stars which appear in the neighbourhood of the nebula. All the measured objects are clearly indicated in a key chart, and the tabulated data will doubtless be of considerable value in subsequent investigations of relative motions within the nebula.

PHOTOGRAPHS OF MARS.—In the September number of the *Observatory* an account of a minute examination of photographs of Mars taken at Flagstaff by Dr. Lowell and his co-workers is given by G. H. Hamilton. The photographs were studied without reference to maps of the planet, and details common to three or more of the images, of which there were sometimes as many as four dozen on a single plate, were inserted in sketches. Subsequent comparisons in all cases showed a very close agreement with the accepted maps in the observatory. One of the sketches, from photographs taken on March 15 of the present year, is reproduced, and shows an abundance of detail, including numerous canals. Mr. Hamilton is of opinion that the linear character of the canals, as represented by Dr. Lowell, is completely confirmed by the photographs. By the use of a finely divided transparent scale, it was found possible to obtain satisfactory measurements of the positions of the principal markings, due allowance being made for halation.

SPECTRUM OF THE NEBULA H IV. 39 ARGÛS.—An account of the spectrum of H IV. 39 Argûs (N.G.C. 2438) has been given by Dr. Max Wolf (*Sitz. Heidelberg Akad. d. Wiss.*, March, 1916). The spectrum was photographed at the Königstuhl Observatory, Heidelberg, on February 20, with an exposure of five hours. The nebula is very faint, and direct photographs show it to be of annular form with an eccentrically situated stellar nucleus; the eastern side of the ring is the brighter, and the nucleus lies nearer the western edge. The spectrum is almost identical with that of the ring nebula in Lyra, but much fainter. In order of brightness the lines are λ 373, 387, 434 (Hγ), 469, 501, and 397; there is possibly also a faint line at 352. As in the Lyra nebula, a distribution of the different gases in layers is indicated by the varying distances to which the lines extend. The line 373 reaches furthest outwards, but has a marked minimum in the interior of the ring. The lines 387 and 434 reach further towards the centre; and, in striking contrast with the other lines, 469 (*i.e.* 4686, of "proto-helium") is brightest within the ring, and extends only a small distance from the nucleus.

THE UNITED STATES NATIONAL RESEARCH COUNCIL.

AN account of the inauguration and organisation of the National Research Council of the United States was published in our issue of August 3 last (vol. xcvii., p. 465), and the article pointed out that from the cordial interest shown by all who had learnt of the work in its early stages, it was evident that so soon as a widespread request for co-operation could be extended it would meet with general acceptance. A preliminary report of the Organising Committee to the president of the U.S. National Academy of Sciences, published in the August issue of its Proceedings, shows that this expectation has been justified, and some of the first instances of co-operation are given. Prof. G. E. Hale, chairman of the committee, has also sent to the *New York Times* an account of what is being done in the United States to mobilise science for industrial progress and military efficiency, and we reprint his letter below. It will be seen that the president of the Throop College of Technology in Pasadena, California, an institution which gives special attention to research, hearing of the plans of the Research Council, offered the assistance and co-operation of the recently endowed research laboratory of chemistry, and secured at once an additional endowment of 20,000*l*. for scientific research. In somewhat similar circumstances a gift of 100,000*l*.

has been made to the Massachusetts Institute of Technology, with the expectation that much of the income will be used for research. A resolution of the New York Engineering Foundation expresses approval of the co-ordination and federation of the research agencies of the United States undertaken by the National Academy, and also willingness to assist. The foundation has offered its entire income for the coming year—including a special gift of 1000*l*.—towards the expenses of organisation and to provide a New York office for the council. Resolutions of a similar kind are to be proposed to other scientific societies in the States.

At its annual meeting in April the National Academy of Sciences volunteered to organise the scientific resources of educational and research institutions in the interest of national preparedness. This offer, which was immediately accepted by President Wilson, has led to the establishment of the National Research Council.

Public welfare and national security depend upon industrial progress and military efficiency; and these, in turn, result from practical applications of scientific knowledge. A superstructure, no matter how perfect, must have firm foundations, and thus the development of our industries must go hand in hand with the advancement of knowledge through research.

It is equally true that the mobilisation of industry, so successfully undertaken by the national engineering societies in co-operation with the Naval Consulting Board, must be accompanied by the mobilisation of science. This necessity has been recognised in England by the establishment of an Advisory Council for Scientific and Industrial Research, and in Australia by the organisation of a National Institute of Science and Industry. Thus it is expected ultimately to overcome the telling advantages, both in war and in peace, which Germany has long enjoyed because of the organisation and development of her scientific resources.

Paul Deschanel has remarked of French men of science: "Ils pensent que défendre la vérité est le meilleur moyen de servir la patrie." Thus the duties of a National Research Council should not be confined to the necessities of war or the development of American industries. We should recognise, with Carty, the engineer, that when adapted to practical uses the "results of the pure men of science become of incalculable value to the industries as a whole." And we should not fail to perceive that every form of scientific research contributes to human progress.

Euclid, working out problems in pure mathematics in Alexandria, prepared the way for the calculations of the engineer. Galileo, discovering the satellites of Jupiter, convinced the world of the truth of the Copernican theory, broke down absurd medieval conceptions which prevented scientific progress, and stimulated exploration and advance in every field. Pasteur, studying the optical properties of certain crystals with no thought of practical result, was led to his investigations of bacteria and his epoch-making discoveries for the benefit of mankind.

Thus scientific research in any field, whether for the advancement of knowledge or for direct industrial or military application, is a most fundamental form of national service, which should be encouraged by every possible means. The work of the Research Council will thus relate to public welfare in times of peace even more truly than to national security in the event of war.

During our Civil War the need of scientific advice was often felt by our Government. Accordingly, the National Academy of Sciences was chartered in 1863 by Act of Congress, which stipulated that "the academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art. . . ." During the war, and frequently in later years, the academy has been consulted by Congress, by the President, and by various members of his Cabinet. It is thus the agency naturally chosen for the organisation of the National Research Council.

The purpose of the council is to bring into co-operation existing governmental, educational, industrial, and other research organisations, with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defence, and such other applications of science as will promote the national security and welfare.

The council will be composed of leading American investigators and engineers, representing the Army, Navy, Smithsonian Institution, and various scientific bureaus of the Government; educational institutions and research foundations, and the research laboratories of industrial and manufacturing establishments.

Research committees of two classes will be appointed:—

Central committees, dealing with various departments of science, comprised of leading authorities in each field, selected in consultation with the president of the corresponding national society.

Local committees in universities, colleges, and other co-operating institutions engaged in scientific research.

The organising committees will recommend to the National Research Council the following plan of procedure, approved by the council of the National Academy, but open to such modification as the Research Council may deem desirable:—

(1) The preparation of a national census of equipment for research, of the men engaged in it, and of the lines of investigation pursued in co-operating Government bureaus, educational institutions, research foundations, and industrial research laboratories; this census to be prepared in harmony with any general plan adopted by the proposed Government Council of National Defence.

(2) The preparation of reports by special committees, suggesting important research problems and favourable opportunities for research in various departments of science.

(3) The promotion of co-operation in research, with the object of securing increased efficiency; but with careful avoidance of any hampering control or interference with individual freedom and initiative.

(4) Co-operation with educational institutions, by supporting their efforts to secure larger funds and more favourable conditions for the pursuit of research and the training of students in the methods and spirit of investigation.

(5) Co-operation with research foundations and other agencies desiring to secure a more effective use of funds available for investigation.

(6) The encouragement in co-operating laboratories of researches designed to strengthen the national defence and to render the United States independent of foreign sources of supply liable to be affected by war.

To meet immediate needs, the following committees have already been completely or partially organised and are at work:—

Nitric Acid Supply, appointed in co-operation with the American Chemical Society, to investigate processes for the fixation of nitrogen, in order to select the best means of preparing the nitric acid required in the manufacture of powder and high explosives.

Preventive Medicine, appointed in co-operation with the Committee of Physicians and Surgeons, to develop and utilise new methods of preventive medicine for the protection of troops in the field.

Organic Chemicals, appointed in co-operation with the American Chemical Society, to secure co-operation among chemists in researches required for the manufacture of dyestuffs, synthetic medicinals, and other chemicals made scarce by the war.

Communications, appointed in co-operation with the American Physical Society and the American Institute of Electrical Engineers, to develop and apply the most effective devices for military communications, the detection of submarines, and other similar purposes.

Committees for the promotion of research in applied mathematics, astronomy, physics, chemistry, botany, zoology, and various other branches of science will also be organised by the council.

The most cordial spirit of co-operation has been shown by every individual and institution hitherto invited to take part in the work. Universities, research foundations, and industrial laboratories, in the event of war, would place every facility at the disposal of the Government. In times of peace they will co-operate with the council in the advancement of research. The Engineering Foundation, under the auspices of the United Engineering Societies, has passed resolutions commending the purposes of the council, and offering it a New York office in the Engineers' Building and the services of an executive secretary. Substantial contributions to a general expense fund have already been received. It is evident that so soon as a general request for co-operation can be issued it will meet with the widest acceptance.

Throop College of Technology, in Pasadena, Cal., has recently afforded a striking illustration of one way in which the Research Council can secure co-operation and advance scientific investigation. This institution, with its able investigators and excellent research laboratories, could be of great service in any broad scheme of co-operation. President Scherer, hearing of the formation of the council, immediately offered to take part in its work, and with this object he secured within three days an additional research endowment of 100,000 dollars. The spirit of national service and the increased appreciation of the value of science, which have resulted from the European war, should lead to many similar gifts elsewhere.

The following letter from the President shows his approval of the council's plans and his active assistance in completing its organisation:—

"Dr. William H. Welch, President of the National Academy of Sciences, 807 St. Paul Street, Baltimore, Md.:—

"My Dear Dr. Welch,—I want to tell you with what gratification I have received the preliminary report of the National Research Council, which was formed at my request under the National Academy of Sciences. The outline of work there set forth and the evidences of remarkable progress toward the accomplishment of the object of the council are indeed gratifying. May I not take this occasion to say that the departments of the Government are ready to co-operate in every way that may be required, and that the heads of the departments most immediately concerned are now, at my request, actively engaged in considering the best methods of co-operation? Representatives of Government bureaus will be appointed as members of the Research Council as the council desires.

"Cordially and sincerely yours,

"(Signed) WOODROW WILSON."

Arrangements will be made to hold a meeting of the council soon after the appointment of the representatives of Government bureaus.

GEORGE ELLERY HALE.

THE GOVERNMENT CINCHONA PLANTATIONS IN BENGAL.

THE fifty-fourth annual report of the Government Cinchona Plantations and Factory in Bengal for the year 1915–16 is as interesting and valuable a document as that for 1914–15 noticed in these columns last year. In the previous report the scientific side of the work for the past ten years was reviewed, while in that now under notice a review of the financial side of the operations for the past sixteen years is given. Since April, 1900, to March, 1916, the total expenditure amounted to 42,65,600 rupees and total receipts to 39,30,000 rupees. The deficit of 3,35,600 rupees is, however, not a sign of financial mismanagement, but is an indication of remarkable and highly successful administrative ability. The deficit was incurred within the period 1905–14, during which time the department was being greatly improved. The explanation, which is simple, is given in the words of the report, as the excellent work which is being done by Major Gage and his staff is deserving of wider recognition.

"About the beginning of the 1905–15 period it was seen that the demand for quinine—since 1892 in excess of the yield from plantation bark—was exceeding the factory output capacity, and that as more than 90 per cent. of the world's supply of bark and quinine was in the hands respectively of Java planters and about a dozen manufacturers, the risk of the formation of a 'Trust' and the abolition of an open market was not to be taken lightly. It was foreseen that, if while there was still an open market large quantities of bark and quinine were purchased at the lowest rates ever touched, it would allow the formation of a reserve of quinine large enough to meet the increase in demand and to serve as a stand-by in case of a severe malarial epidemic, what time the plantations were being extended on a scale large enough to render the department independent of external supplies and prices.

"So during 1908–14 large sums were expended on purchase of bark and quinine at very low rates and on extra extensive plantations. Subsequent developments have thoroughly justified the then heavy expenditure. For instance, if the annual quinine yield from the plantations had remained at its 1905 figure of 9000 lb., Government would have had to pay during 1913–15 at least 7,74,000 rupees in purchase of enough bark or quinine to make up the quantity (74,000 lb.) distributed during these years, whereas it cost Government to make the quantity required above the 1905 output level less than 3,08,000 rupees. In those two years alone Government saved at least 4,66,000 rupees, which exceeds the deficit for a period of sixteen years. The deficit will speedily be replaced by a surplus yearly increasing, and meanwhile it is covered many times over by readily realisable assets."

These assets include (1) additions to factory and machinery that have quintupled its 1900 output capacity; (2) 2418 acres afforested with timber and fuel trees; (3) 2295 acres planted with cinchona 7,69,085 rupees in value; (4) a reserve of 165,000 lb. of quinine valued at 18,97,500 rupees, and other manufactured products, bark, etc., valued at 2,05,055 rupees —a total of 29,18,000 rupees. The total return for the 42,65,600 rupees expenditure is therefore in cash and assets 68,48,000 rupees. Nothing is claimed for value of factory, etc., in the estimate.

From this explanation, with conditions of presentment as stringent as few companies would think of adopting, the financial side of the department's work is seen to be as satisfactory as the scientific.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION A.

MATHEMATICAL AND PHYSICAL SCIENCE.

OPENING ADDRESS (ABRIDGED) BY PROF. A. N. WHITEHEAD, Sc.D., F.R.S., PRESIDENT OF THE SECTION.

The Organisation of Thought.

THE subject of this address is the organisation of thought, a topic evidently capable of many diverse modes of treatment. I intend more particularly to give some account of that department of logical science with which some of my own studies have been connected. But I am anxious, if I can succeed in so doing, to handle this account so as to exhibit the relation with certain considerations which underlie general scientific activities.

It is no accident that an age of science has developed into an age of organisation. Organised thought is the basis of organised action. Organisation is the adjustment of diverse elements so that their mutual relations may exhibit some predetermined quality. An epic poem is a triumph of organisation—that is to say, it is a triumph in the unlikely event of it being a good epic poem. It is the successful organisation of multitudinous sounds of words, associations of words, pictorial memories of diverse events and feelings ordinarily occurring in life, combined with a special narrative of great events: the whole so disposed as to excite emotions which, as defined by Milton, are simple, sensuous, and passionate. The number of successful epic poems is commensurate, or, rather, is inversely commensurate, with the obvious difficulty of the task of organisation.

Science is the organisation of thought. But the example of the epic poem warns us that science is not any organisation of thought. It is an organisation of a certain definite type which we will endeavour to determine.

Science is a river with two sources, the practical source and the theoretical source. The practical source is the desire to direct our actions to achieve predetermined ends. For example, the British nation, fighting for justice, turns to science, which teaches it the importance of compounds of nitrogen. The theoretical source is the desire to understand. Now I am going to emphasise the importance of theory in science. But to avoid misconception I most emphatically state that I do not consider one source as in any sense nobler than the other, or intrinsically more interesting.

The importance, even in practice, of the theoretical side of science arises from the fact that action must be immediate, and takes place in circumstances which are excessively complicated. If we wait for the necessities of action before we commence to arrange our ideas, in peace we shall have lost our trade, and in war we shall have lost the battle.

Success in practice depends on theorists who, led by other motives of exploration, have been there before, and by some good chance have hit upon the relevant ideas. By a theorist I do not mean a man who is up in the clouds, but a man whose motive for thought is the desire to formulate correctly the rules according to which events occur. A successful theorist should be excessively interested in immediate events, otherwise he is not at all likely to formulate correctly anything about them. Of course, both sources of science exist in all men.

Now, what is this thought organisation which we call science? The first aspect of modern science which struck thoughtful observers was its inductive character. The nature of induction, its importance, and the rules of inductive logic have been considered by a long series of thinkers, especially English thinkers, Bacon, Herschel, J. S. Mill, Venn, Jevons, and others. I am not going to plunge into an analysis of the process of induction. Induction is the machinery and not the product, and it is the product which I want to consider. When we understand the product we shall be in a stronger position to improve the machinery.

First, there is one point which it is necessary to emphasise. There is a tendency in analysing scientific processes to assume a given assemblage of concepts applying to nature, and to imagine that the discovery of laws of nature consists in selecting by means of inductive logic some one out of a definite set of possible alternative relations which may hold between the things in nature answering to these obvious concepts. In a sense this assumption is fairly correct, especially in regard to the earlier stages of science. Mankind found itself in possession of certain concepts respecting nature—for example, the concept of fairly permanent material bodies—and proceeded to determine laws which related the corresponding precepts in nature. But the formulation of laws changed the concepts, sometimes gently by an added precision, sometimes violently. At first this process was not much noticed, or at least was felt to be a process curbed within narrow bounds, not touching fundamental ideas. At the stage where we now are, the formulation of the concepts can be seen to be as important as the formulation of the empirical laws connecting the events in the universe as thus conceived by us—for example, the concepts of life, of heredity, of a material body, of a molecule, of an atom, of an electron, of energy, of space, of time, of quantity, and of number.

But, for the purposes of science, what is the actual world? Has science to wait for the termination of the metaphysical debate till it can determine its own subject-matter? I suggest that science has a much more homely starting-ground. Its task is the discovery of the relations which exist within that flux of perceptions, sensations, and emotions which forms our experience of life. The panorama yielded by sight, sound, taste, smell, touch, and by more inchoate sensible feelings, is the sole field of its activity. It is in this way that science is the thought organisation of experience. The most obvious aspect of this field of actual experience is its disorderly character. It is for each person a *continuum*, fragmentary, and with elements not clearly differentiated. The comparison of the sensible experiences of diverse people brings its own difficulties. I insist on the radically untidy, ill-adjusted character of the fields of actual experience from which science starts. To grasp this fundamental truth is the first step in wisdom, when constructing a philosophy of science. This fact is concealed by the influence of language, moulded by science, which foists on us exact concepts as though they represented the immediate deliverances of experience. The result is that we imagine that we have immediate experience of a world of perfectly defined objects implicated in perfectly defined events which, as known to us by the direct deliverance of our senses, happen at exact instants of time, in a space formed by exact points, without parts and without magnitude: the neat, trim, tidy, exact world which is the goal of scientific thought.

My contention is that this world is a world of ideas, and that its internal relations are relations between abstract concepts, and that the elucidation of the precise connection between this world and the feelings of actual experience is the fundamental question of scientific philosophy. The question which I am inviting you to consider is this: How does exact thought apply to the fragmentary, vague *continua* of experience? I am not saying that it does not apply; quite the contrary. But I want to know how it applies.

The solution I am asking for is not a phrase however brilliant, but a solid branch of science, constructed with slow patience, showing in detail how the correspondence is effected.

The first great steps in the organisation of thought were due exclusively to the practical source of scientific activity, without any admixture of theoretical impulse. Their slow accomplishment was the cause and also the effect of the gradual evolution of moderately rational beings. I mean the formation of the concepts of definite material objects, of the determinate lapse of time, of simultaneity, of recurrence, of definite relative position, and of analogous fundamental ideas, according to which the flux of our experiences is mentally arranged for handy reference: in fact, the whole apparatus of common-sense thought. Consider in your mind some definite chair. The concept of that chair is simply the concept of all the interrelated experiences connected with that chair—namely, of the experiences of the folk who made it, of the folk who sold it, of the folk who have seen it or used it, of the man who is now experiencing a comfortable sense of support, combined with our expectations of an analogous future, terminated finally by a different set of experiences when the chair collapses and becomes fire-wood. The formation of that type of concept was a tremendous job, and zoologists and geologists tell us that it took many tens of millions of years. I can well believe it.

I now emphasise two points. In the first place, science is rooted in what I have just called the whole apparatus of common-sense thought. That is the *datum* from which it starts, and to which it must recur. We may speculate, if it amuses us, of other beings in other planets who have arranged analogous experiences according to an entirely different conceptual code—namely, who have directed their chief attention to different relations between their various experiences. But the task is too complex, too gigantic, to be revised in its main outlines. You may polish up common sense, you may contradict it in detail, you may surprise it. But ultimately your whole task is to satisfy it.

In the second place, neither common sense nor science can proceed with its task of thought organisation without departing in some respect from the strict consideration of what is actual in experience. Think again of the chair. Among the experiences upon which its concept is based I included our expectations of its future history. I should have gone further and included our imagination of all the possible experiences which in ordinary language we should call perceptions of the chair which might have occurred. This is a difficult question, and I do not see my way through it. But at present in the construction of a theory of space and of time there seem insuperable difficulties if we refuse to admit ideal experiences.

This imaginative perception of experiences, which, if they occurred, would be coherent with our actual experiences, seems fundamental in our lives. It is neither wholly arbitrary nor yet fully determined. It is a vague background which is only made in part definite by isolated activities of thought. Consider, for example, our thoughts of the unseen flora of Brazil.

Ideal experiences are closely connected with our imaginative reproduction of the actual experiences of other people, and also with our almost inevitable conception of ourselves as receiving our impressions from an external complex reality beyond ourselves. It may be that an adequate analysis of every source and every type of experience yields demonstrative proof of such a reality and of its nature. Indeed, it is scarcely to be doubted that this is the case. The precise elucidation of this question is the problem of metaphysics. One of the points which I am urging in this address is that the basis of science does not depend on the assumption of any of the conclusions of metaphysics; but that both science and metaphysics start from the same given groundwork of immediate experience, and in the main proceed in opposite directions on their diverse tasks.

For example, metaphysics inquires how our perceptions of the chair relate us to some true reality. Science gathers up these perceptions into a determinate class, adds to them ideal perceptions of an analogous sort, which in assignable circumstances would be obtained, and this single concept of that set of perceptions is all that science needs; unless indeed you prefer that thought find its origin in some legend of those great twin brethren, the Cock and Bull.

My immediate problem is to inquire into the nature of the texture of science. Science is essentially logical. The nexus between its concepts is a logical nexus, and the grounds for its detailed assertions are logical grounds. King James said, "No bishops, no king." With greater confidence we can say, "No logic, no science." The reason for the instinctive dislike which most men of science feel towards the recognition of this truth is, I think, the barren failure of logical theory during the past three or four centuries. We may trace this failure back to the worship of authority which in some respects increased in the learned world at the time of the Renaissance. Mankind then changed its authority, and this fact temporally acted as an emancipation. But the main fact, and we can find complaints[1] of it at the very commencement of the modern movement, was the establishment of a reverential attitude towards any statement made by a classical author. Scholars became commentators on truths too fragile to bear translation. A science which hesitates to forget its founders is lost. To this hesitation I ascribe the barrenness of logic.

It will be necessary to sketch in broad outline some relevant features of modern logic. . . .

I will now break off the exposition of the function of logic in connection with the science of natural phenomena. I have endeavoured to exhibit it as the organising principle, analysing the derivation of the concepts from the immediate phenomena, examining the structure of the general propositions which are the assumed laws of nature, establishing their relations to each other in respect to reciprocal implications, deducing the phenomena we may expect in given circumstances.

Logic, properly used, does not shackle thought. It gives freedom and, above all, boldness. Illogical thought hesitates to draw conclusions, because it never knows either what it means, or what it assumes, or how far it trusts its own assumptions, or what will be the effect of any modification of assumptions. Also the mind untrained in that part of constructive logic which is relevant to the subject in hand will be ignorant of the sort of conclusions which follow from various sorts of assumptions, and will be correspondingly dull in divining the inductive laws. The fundamental training in this relevant logic is, undoubtedly, to ponder with an active mind over the known facts of the case, directly observed. But where elaborate deductions are possible, this mental activity requires for its full exercise the direct study of the abstract logical relations. This is applied mathematics.

Neither logic without observation, nor observation without logic, can move one step in the formation of science. We may conceive humanity as engaged in an internecine conflict between youth and age. Youth is not defined by years, but by the creative impulse to make something. The aged are those who, before all things, desire not to make a mistake. Logic is the olive branch from the old to the young, the wand which in the hands of youth has the magic property of creating science.

[1] *E.g.* in 155? by Italian schoolmen.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—At University College a public lecture—the first of a series of six—will be delivered by Prof. J. A. Fleming on "Long-distance Telegraphy and Telephony," on Wednesday, October 18, at 5.30 p.m. Prof. J. Norman Collie, director of the chemical laboratories, will give a lecture on Tuesday, October 31, at 5.30 p.m., on "The Scientific Work of Sir William Ramsay."

MR. A. L. MACAULAY, a son of Prof. A. MacAulay, has been appointed demonstrator in physics in the University of Melbourne.

THE next election to Beit Memorial Fellowships for Medical Research (of which there will not be more than ten awards) will take place on or before January 1, 1917. Applications must reach the hon. secretary, Beit Memorial Fellowships for Medical Research, 35 Clarges Street, W., on or before October 15.

A SERIES of popular lectures on "The Tropical Countries of the Empire," illustrated by the collections of the Imperial Institute, will be delivered by Miss Edith A. Browne on Wednesdays in October, November, and December, at the Imperial Institute, at 3 o'clock, commencing on Wednesday, October 4. Admission to the series of lectures will be free by ticket, for which application should be made to the director of the Imperial Institute, South Kensington.

IT is announced in the issue of *Science* for September 8 that a recommendation that a fund of more than 600,000*l*. for the treatment of cancerous, nervous, and disabling ailments be given to the University of Pennsylvania Hospital has been made by Dr. W. H. Smith, superintendent of the Johns Hopkins Hospital, Baltimore, who was selected by the trustees of the fund to visit Philadelphia and make a survey of its hospitals and medical work and give his opinion as to where the fortune would work the greatest benefit. The fund is the estate and its increment willed for the purpose by the late Anna J. Jeanes, a noted Friend philanthropist, who died in 1908.

THE governing body of the Northampton Polytechnic Institute, Clerkenwell, E.C., is not this year publishing the usual annual issue of its "Announcements," but will start and carry through during the current session as many of the courses and classes announced for last year as may be justified by the applications for enrolment received at the commencement of the session. It is hoped that day and evening courses will be held in civil, mechanical, and electrical engineering, in technical optics, and in horology. The engineering courses include subsections in automobile work, aeronautics, and radio-telegraphy. In addition there are to be evening courses in electrochemistry, metallurgy, and domestic economy.

THE instruction given in the evening courses in technology in the University of Leeds, a prospectus of which for the current session has been received, are co-ordinated with the city scheme for evening instruction, and Leeds students under twenty-two years of age are required to produce certificates of satisfactory attendance at preparatory classes, or give evidence of adequate preparation. Advanced technological courses are held at the University in civil, mechanical, and electrical engineering, coal-mining, textile industries, tinctorial chemistry and dyeing, leather industries, and geology. The University of Leeds, too, works in co-operation with the Bradford Technical College, from which we have also received a prospectus and time-table. Senior day students of the chemistry and dyeing department of the Bradford College may attend without payment of fee certain lecture courses at the University. University students may similarly attend for work in the college practical dye-house and finishing shed. Third-year students of engineering in the college may attend the University engineering laboratory for work on the refrigerator plant, air-compressor, and hydraulic installation without payment; and University students may similarly attend for work in the college power-house.

A MEETING of the Committee for the Management of the British Prisoners of War Book Scheme was held on Friday last at Whitehall, when the following officers were elected:—Chairman, Mr. A. T. Davies (Board of Education); treasurer, Rear-Admiral J. F. Parry, C.B., hydrographer to the Navy. The appointment of a secretary was held over. A gratifying report was read from the principal examiner to the Board of Trade (Marine Department) on the result of the recent examinations held at the camp at Groningen, in Holland. Evidence is also coming to hand from camps as far distant as Asia Minor of considerable development in the organisation of educational work among the men interned there. From these camps a continuous stream of applications for books for serious study was reported to the committee, who expressed the hope that the public will continue, by offers of suitable books (new or second-hand), to support a war charity the need for which was daily becoming more and more evident and the machinery of which was being increasingly taken advantage of by the friends and relatives of prisoners in all parts of the British Empire. Further particulars respecting this war charity and its work can be obtained on application to Mr. A. T. Davies, at the Board of Education, Whitehall, London, S.W. All communications should have the words "Prisoners of War" written in the left-hand corner of the envelope.

SIR CHARLES WAKEFIELD, Lord Mayor of London, announces that the council of the Lord Kitchener National Memorial Fund has resolved to found a number of scholarships which will enable young Britons destined for a commercial career to travel, study, and gain business experience in the countries of the Allied nations—viz. France, Russia, Italy, Japan, Belgium, Rumania, Portugal, and Serbia. The scholarships will be continued from year to year for all time, and will be of the annual value of about 150*l*. each. They will be for the sons of deceased and disabled officers and men of the Navy and Army, and young men from eighteen to twenty-five years of age who have served with the Forces. The intention is that those elected to hold scholarships should begin their studies almost immediately, that they should receive instruction (*a*) in Russian, French, Italian, and other languages; (*b*) in economics; (*c*) in business principles and business methods (in offices or factories as circumstances may determine), and that immediately at the close of the war they should be sent for a year to travel in one or other of the Allied countries and to continue their studies in that country with the view of gaining (1) a close familiarity with its language, and (2) an intimate knowledge of its commercial methods, needs, and opportunities. In developing this scheme the council is being advised by business men and educational experts, so that in the end it may be carried through with the highest degree of efficiency. Contributions towards the fund necessary to establish the scheme on a sound footing without delay should be sent to the Lord Kitchener National Memorial Fund, Mansion House, London. Envelopes should be marked "Kitchener Scholarships."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 11.—M. Camille Jordan in the chair.—A. **Lacroix**: The constitution of the volcanic rocks of the extreme north of Madagascar and of Nosy bé; the ankaratrites of Madagascar in general. Five complete analyses are given of rocks from the north of Madagascar, four of rocks from the island of Nosy bé, and six of ankaratrites.—E. **Lebon**: A new table of divisors of numbers.—L. **Godeaux**: The involutions belonging to algebraic surfaces.—J. **Guillaume**: Observations of the sun, made at the Lyons Observatory during the first quarter of 1916. The results of observations made on sixty-one days are summarised in three tables, showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—D. **Eydoux**: The modifications of the phenomena of hammering in pipes of variable thickness and diameter.—P. **Zeeman**: The drift of light waves and solar phenomena.—A. **Perot**: The influence of the wind on the conditions of audibility of sound. Gunfire has been heard at a great distance from the battlefield, with an intermediate zone of silence. It is shown that this phenomenon can be explained by assuming that at a certain altitude either there is no wind, or that it is contrary in direction to the wind near the ground-level.—H. **Pellet**: The total destruction of pentoses in the course of alcoholic fermentation. In an attempt to estimate pentoses in the presence of saccharose, by fermenting the latter with yeast, it was found that some pentoses were fermented. Alternative conditions are given under which this fermentation of pentoses can be rendered either total or reduced to negligible proportions.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings No. 8, vol. ii., August 15).—C. D. **Miller**: The absorption coefficients of soft X-rays. The numerical constants in the relation between the absorption coefficients, the density, and the wave-lengths have been accurately determined. The results also indicate that the relationship holds for very much softer X-rays than those of ordinary penetrating power.—E. F. **Smith**: Further evidence as to the relation between crown gall and cancer. There are discussed: fundamental concepts, human and animal tumours for which no cause has been discovered, earlier discoveries in plants, further discoveries, other resemblances of crown gall to cancer in man and animals, possibility of the existence of carcinomas and of mixed tumours in plants, production of embryonal teratomata, and bearing of these discoveries on the cancer problem.—G. H. **Parker**: Locomotion of sea-anemones. The pedal portion of a sea-anemone, like its tentacles, must contain a neuromuscular mechanism sufficient for the activity of that part of its body.—G. H. **Parker**: The behaviour of sea-anemones. Sea-anemones are animals the momentary conditions of which are dependent upon the combined stimuli of their immediate surroundings rather than forms that are greatly influenced by their past history, and their unity is not of a pronounced type; they are more in the nature of a sum of parts than they are organic units of the type of most of the higher animals.—J. P. **Iddings** and E. W. **Morley**: A contribution to the petrography of Japan. Seventeen detailed chemical analyses are given of Japanese lavas.—J. **Loeb** and J. H. **Northrop**: Is there a temperature coefficient for the duration of life? In three series of experiments on the fruit-fly Drosophila it is found that the duration of life in the cases examined has a temperature-coefficient of the order of magnitude which is characteristic for life phenomena and chemical reactions in general.—C. E. **St. John**: The suggested mutual repulsion of Fraunhofer lines. The author is unable to find evidence of the mutual repulsion suggested, and in so far as mutual influence is a necessary corollary of anomalous dispersion in the sun, evidence of this also is lacking.—A. S. **King**: An attempt to detect the mutual influence of neighbouring lines in electric furnace spectra showing anomalous dispersion. Although the material in the investigation is limited by the scarcity of suitable pairs of lines, the lines actually tested have shown no tendency towards a repulsion.—C. A. **Rouiller**: Synthesis of the base $C_9H_{14}ON_2$ derived from methylaminomethyl-3 : 4-dihydroxyphenylcarbinol. A continuation of some work by Abel, with a suggestion as to a relation to work by Curtius.—W. M. **Davis**: (1) Extinguished and resurgent coral reefs. (2) The origin of certain Fiji atolls. The two papers offer a discussion of observations made during the author's Shaler Memorial voyage across the Pacific.—C. **Barus**: Interferometer methods based on the cleavage of a diffracted ray. The prismatic method of cleaving the incident beam of white light is available for the superposition of non-reversed spectra, under conditions where the paths of the component rays may have any length whatever. It is thus an essential extension of the same method as used for reserved spectra heretofore, and also of the methods in which the paths are essentially small.—F. M. **Surface**: The inheritance of certain glume characters in the cross *Avena fatua* × *A. sativa*, var. *Kherson*. A study of inheritance of certain characters, particularly directed towards revealing phenomena of linkage.—C. **Zeleny**: A comparison of the rates of regeneration from old and from new tissue. The data as a whole show clearly that there is no essential difference between the rate of regeneration from new cells and from old cells. The rate of regeneration seems, therefore, to be under central control.—C. **Zeleny**: The effect of successive removal upon the rate of regeneration. Apart from the slowing due to age, there is no indication of the amount of new material that may be produced by regeneration. The actual limitation comes, not from the using up of regenerative energy, but from changes in the non-regenerating part associated with age.—E. **Blackwelder**: The geologic *rôle* of phosphorus. Phosphorus appears in Nature in many forms and in many situations. Its numerous transformations, however, follow an orderly sequence—in a broad way form a cycle which is here discussed in some detail.—J. **Barrell**: Dominantly fluviatile origin under seasonal rainfall of the Old Red Sandstone. Geologists have differed so widely in their conclusions in regard to the nature of the habitat of the early vertebrate faunas the remains of which are found in the formations of the Old Red Sandstone, that the author is led to examine critically the criteria for the interpretation of the facts. He comes to the conclusion that the deposits which make up the Old Red Sandstone, although they undoubtedly contain lacustrine beds and other beds laid down in shifting, shallow, and variable bodies of water, are dominantly fluviatile in origin. The Great Valley in California may therefore in the present epoch, both in physiography and in climate, be cited as a striking illustration of the nature of the Old Red Sandstone basins.—J. **Barrell**: The influence of Silurian-Devonian climates on the rise of air-breathing vertebrates. The evidence for the hypothesis of the continental origin of fishes has been examined, and seems to prevail over that for their marine origin. The author also believes that natural selection, although discredited as a cause determining specific variations, appears nevertheless to be a major factor in evolution.—T. W. **Richards** and C. **Wadsworth** 3d: Density of radio-lead from pure Norwegian cleveite. The density of this lead is found to be 11·273, distinctly less than the density (11·289) of Australian radio-lead, and still less than that (11·337) for ordinary lead, the decrease being almost exactly proportional to the decrease in atomic weight in these samples, so that the atomic volume (18·281) is constant.—National Research Council: A preliminary report to the president of the Academy of the Organising Committee (Messrs. E. G. Conklin, S. Flexner, R. A. Millikan, A. A. Noyes, and G. F. Hale, chairman) of the National Research Council, established by the Academy after conference with the President of the United States for the purpose of co-ordinating the research elements of the country in the interest of national security and welfare.

CAPE TOWN.

Royal Society of South Africa, August 16.—Dr. L. Péringuey, president, in the chair.—R. E. **Walker**: The granite of the Schapenberg, Somerset West. The granite of the Schapenberg is essentially a grey, biotite-granito-porphyry intrusive in fine-grained, argillaceous grits of the Malmesbury series. It is essentially an apophysis of one or other of the two large granite masses—the Kuils River granite and the Sir Lowry's Pass granite—which occur the one to the west and the other to the east of the Schapenberg; most probably of the latter. Both fine- and medium-grained varieties occur. At certain points along the contact the granite, owing to absorption of material from the invaded formation, is andalusite-bearing. The granite, particularly near its margin, has been subjected to pneumatolytic action, which has caused the formation of a series of altered granites ranging from school granite on one hand to greissen on the other. The greissen is a quartz-mica-tourmaline rock resembling, in most respects, that of Grainsgill, described by Mr. Alfred Harker in the Q.J.G.S.—J. S. v. d. **Lingen**: The radial lines in Röntgen interference patterns. The author briefly discussed the theory of radial lines, and pointed out that on Friedrich's assumption these lines ought to be present in all interference patterns. Experiments were then described, which support the view put forward by von Laue and the author, viz. radial lines are caused by weakening of the lattice of a rigid crystal. The pattern of $Mg(OH)_2$, where the water molecules were driven off, and resublimated iodine, were exhibited, as well as the pattern of sylvine obtained by Friedrich. The pattern of this iodine shows the transition stage from a three-dimensional grating to a two-dimensional grating. MgO from $Mg(OH)_2$ shows the two-dimensional grating only. "Baurite from biotite" shows the two-dimensional grating by treating biotite with acids.—E. J. **Goddard**: Some observations on *Ozobranchus branchiatus*. This paper contains an account of the leech (*Ozobranchus branchiatus*). Some historical interest attaches to the form, inasmuch as it was probably the first Annulate noted from the Australasian region. The specimens were obtained as parasites on the green turtle. The somite is represented in a very primitive condition, and it is of interest to note that the limitation of the genus to Chelonia as parasites is possibly, as in that of Branchellion to Pisces, indicative of an old association, and bearing out the morphological evidence that these forms are archaic and primitive, and ancestral to the Gnathobdellida and Herpobdellida. The paper deals with the constitution of the somite in the various regions of the body, and the conclusions to be derived from the same.

BOOKS RECEIVED.

The Flotation Process. Compiled and edited by T. A. Rickard. Pp. 364. (San Francisco: Mining and Scientific Press.) 8*s*. 6*d*. net.

A Glossary of Botanic Terms with their Derivation and Accent. By B. D. Jackson. Third edition. Pp. xi+427. (London: Duckworth and Co.) 7*s*. 6*d*. net.

British and Foreign Marbles and other Ornamental Stones. By J. Watson. Pp. x+485. (Cambridge: At the University Press.) 5*s*. net.

Alternating Currents in Theory and Practice. By W. H. N. James. Pp. vi+353. (Cambridge: At the University Press.) 10*s*. 6*d*. net.

The Royal Horticultural Society's True Work. By A Life Fellow of the Society. Pp. 23. (London: Simpkin and Co., Ltd.) 6*d*. net.

A Bibliography of British Ornithology from the Earliest Times to the End of 1912. By W. H. Mullens and H. Kirke Swann. Part iii. (London: Macmillan and Co., Ltd.) 6*s*. net.

Organic to Human: Psychological and Sociological. By Dr. H. Maudsley. Pp. viii+386. (London: Macmillan and Co., Ltd.) 12*s*. net.

Bacon's War Maps. Europe, embracing all the Countries Involved. (London: G. W. Bacon and Co., Ltd.) 6*d*. net.

The Student's Handbook to the University and Colleges of Cambridge. Fifteenth edition, revised to June 30, 1916. Pp. 14+704. (Cambridge: At the University Press.) 3*s*. net.

Memories. By E. Clodd. Pp. xi+288. (London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

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

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THURSDAY, OCTOBER 5, 1916.

THE ORGANISM AS PHŒNIX.

(1) *Senescence and Rejuvenescence.* By C. M. Child. Pp. xi+481. (Chicago: University of Chicago Press; London: Cambridge University Press, 1915.) Price 10s. net.

(2) *Individuality in Organisms.* By C. M. Child. Pp. x+213. (Chicago: University of Chicago Press; London: Cambridge University Press, 1915.) Price 5s. net.

(1) IN this able study of senescence and rejuvenescence Prof. Child gives us the fruits of fifteen years of research on the age-changes of the lower animals. Much of the book is a record of observations and experiments which have not been previously published; the rest is a thoughtful working-out of a new conception of the organism, which must be taken account of by all biologists. The most prominent new feature is the author's attempt to show that "in the organic world in general rejuvenescence is just as fundamental and important a process as senescence." In the higher forms the possibilities of rejuvenescence seem to be very narrowly limited, and may be scarcely recognisable save in connection with sexual reproduction; but in the simpler organisms, such as the Planarian worms on which the author has published many researches, it is a characteristic feature of life.

In seeking to determine the degree of ageing in an organism we are accustomed to look out for certain structural changes familiar in man and mammals, or we measure the decreasing rate of metabolism per unit of substance. For lower animals, however, other tests must be used; thus advantage has been taken of the general relation between metabolic condition and susceptibility or resistance to cyanides or other narcotics. With differences in susceptibility there also correspond differences in carbon dioxide production as estimated by Tashiro's beautifully delicate "biometer." In other cases the susceptibility or resistance of the organism to the depressing agent may be determined indirectly by the creature's ability to become acclimated to a given concentration.

Numerous experiments on Planarians show that the rate of metabolism, measured by the susceptibility method, decreases with advancing age, and it is concluded that a decrease in rate of metabolism is at least very generally associated with growth and differentiation. An isolated fragment of a Planarian begins by developing a new head and tail, and then undergoes an extensive reorganisation into a new individual of small size. Some parts atrophy and disappear; new parts arise and differentiate; the development in reconstitution is not essentially different from embryonic development. All this and much more is familiar, but the novel point is that the reconstituting Planarians are physiologically younger than those from which the pieces came. As measured by the susceptibility method they exhibit rejuvenescence, and "the degree of rejuvenescence is in general proportional to the degree of reorganisation in the process of reconstitution of the piece into a whole" (p. 118).

The next step in the experimental argument is very interesting: it is the demonstration (by the susceptibility method) that pieces spontaneously isolated in Planarians and Hydroids are physiologically younger than the individuals from which they separate. In other words, rejuvenescence is associated with asexual or agamic reproduction. Furthermore, a Planarian starved for months lives on its own resources and becomes reduced in size. Some cells disappear and others become small. This is well known, but the new fact is that the starving animals undergo rejuvenescence, the degree varying with the degree of reduction. If the susceptibility method is trustworthy they become physiologically younger, and this conclusion was corroborated by estimating the production of carbon dioxide. There is here a strong biological argument for asceticism. The starveling is brought back from an advanced age to the beginning of post-embryonic life; it is almost reborn. "The metabolic current is forced to erode its channel instead of depositing material along its course" (p. 179). Moreover, with certain foods a progressive senescence from generation to generation occurs, while with other foods senescence and rejuvenescence seem to balance in each cycle.

In plants and simple animals, such as polyps, asexual reproduction is frequent, and this brings with it some measure of rejuvenescence. "Often the decrease in metabolic rate with advancing senescence is the primary factor in bringing about physiological isolation of parts, reproduction, and rejuvenescence" (p. 260), and thus senescence may be automatically compensated for. Of great interest, also, are various processes of cellular dedifferentiation which occur in both plants and lower animals, and this also will act as a retardation of senescence. In the higher animals the later atrophic stages of senescence are conspicuous, while in the lower forms they either do not appear or else occur in only a few cells at any given time. "The apparent continuity and irregressibility of senescence in man and the higher forms is responsible for the very general belief that the process is irregressible everywhere, but the plants and lower animals show us clearly enough that this is not the case" (p. 289). In the higher reaches senescence is less frequently interrupted, but it is essentially the same throughout, and occurs "wherever the progressive changes are not balanced or overbalanced by regression." With senescence in man and domesticated mammals everyone is familiar, but what of the alleged rejuvenescence? The author answers that some degree of rejuvenescence occurs in certain tissues, but that on the whole it is grievously limited by the greater stability of the substratum. "For his high degree of individuation man pays the penalty of individual death, and the conditions and processes which lead to death in the end are the conditions and processes which make man what he is" (p. 310).

It might seem that the author's thesis was here petering out, but the next step is important. Prof. Child does not believe much in the "segregation of the germ-plasm"; he thinks that the germ-cells, like the somatic cells, exhibit progressive differentiation and senescence, that "the fully developed gametes are physiologically old, highly differentiated cells, which are rapidly approaching death and in most cases actually do die soon after maturity unless fertilisation occurs" (p. 357). They are of advanced physiological age and low metabolic rate. They must undergo de-differentiation and rejuvenescence before they can enter upon a new period of development. The parthenogenetic egg has not lost its capacity of reacting to isolation, but ordinary gametes can undergo de-differentiation and reconstitution only after fertilisation. In this ingenious way, which cannot be justly represented in brief statement, the author interprets gamete formation as a means of securing rejuvenescence. Reproduction is always the reconstitution of a new organism from a part of one previously existing, but the author stands for the new idea that rejuvenescence occurs during early development, and the zoological evidence that he adduces is very interesting. "The organism, when it begins its active independent life at the end of the embryonic period, is certainly very much younger in every respect than the gametes before fertilisation" (p. 403). It has become younger as it has grown older. This seems a little over-ingenious, but the general idea that the early development means very literally making a fresh start becomes concrete and vivid in the author's exposition.

Let us attempt a more compact statement of the author's interpretation of age-changes. The numerous theories of senescence fall into two groups—those which regard it as an incidental imperfection (due to wear and tear, incomplete elimination of waste products, and so on), and those which regard it as an inevitable feature of development. Prof. Child's experiments point to the second view. After the earliest stages of development there is a progressive change in the direction of greater physiological stability in consequence of changes in the substratum and additions to it in the course of growth and differentiation. As the proportion of relatively stable constituents in the substratum increases, there is a decrease in the metabolic activity of each unit of weight or volume of the organism. Thus cells may become loaded with non-protoplasmic enclosures, and skeletal or supporting tissues arise. It is also probable that the increasing density and aggregation of the colloid substratum may lead to an actual decrease in the rate of chemical reactions, and that the increase in density and thickness and the decrease in the permeability of membranes may retard the exchange through them. Thus and thus does ageing begin while the life is still young. "The decrease in rate of metabolism is a part of development itself, and not an accidental or incidental feature of life. The decrease in metabolic rate during development is in fact a necessary and inevitable consequence of the association of the chemical reactions which constitute metabolism with a colloid substratum produced by the reactions" (p. 184). But there is another side to all this, which has been for the most part overlooked because it is inconspicuous in higher forms. There are processes of reduction as contrasted with growth, of retrogressive as contrasted with progressive development. Accumulated substances and structures may be broken down, and the self-fettered metabolism increases in rate. There is a retrogression towards the embryonic condition, as is familiarly seen in the pupa of a fly. "Dynamically rejuvenescence consists in increase in rate of metabolism, and morphologically in the changes in the substratum which permit increase in rate." And this rejuvenescence is as essential a feature of life as senescence. Ageing has been too much regarded as "a rather mysterious process, quite different from anything else in the life cycle," but it is simply a conspicuous expression of what occurs in minor rhythms continually. Thus the period of "loading" of a gland-cell is a period of decreasing metabolic activity (of "senescence"), and the period of discharge one of increasing activity (of "rejuvenescence"), which makes possible a repetition of the cycle. So there are alternations of fatigue and recovery, of quiescence and activity, and "whether we call one cycle an age-cycle and another something else is of little importance, except as regards convenience." It is further suggested that there may be secular senescence and rejuvenescence in racial evolution. "The age-changes in the organism are merely one aspect of *Werden und Vergehen*, the becoming and passing away, which make up the history of the universe."

It is out of the question to express in a few lines more than an appreciation of a carefully executed piece of work of this magnitude. It is rich in suggestiveness and original ideas, and gives us a new view of the organism and its vital tides. Much depends on the soundness of the susceptibility method of determining the rate of metabolism, for a great deal of the evidence relies on this. We confess to a feeling that the superstructure of interpretation is too broad for the Planarian basis on which it mainly rests. Time is required for a consideration of the evidence given of rejuvenescence in the early stages of development in higher animals, and for weighing the author's reasons for rejecting Weismann's conception of the apartness of the germ-plasm. But it is a great satisfaction to meet with such a fine instance of resolute biological thinking, and we offer Prof. Child our congratulations.

(2) The author's main contribution to the problem of organic individuation is the demonstration of a distinct gradient in the rate of metabolic reactions along the chief axis of various axiate types. The apical or head region is primarily the region of highest rate of metabolism, and, in general, regions nearer to it have a higher rate than regions farther away. Moreover, in experimental

reproduction, "the apical or head region develops independently of other parts, but controls or dominates their development, and in general any level of the body dominates more posterior or lower levels and is dominated by more anterior or apical levels." The dominance depends primarily upon the rate of metabolism, and seems to operate by impulses, excitations, or changes transmitted in various ways from the dominant region to other parts of the body.

What Prof. Child seeks is a dynamic conception of the organism, and he maintains that "the individual is primarily a metabolic gradient in a specific protoplasm; the only primary difference between the dominant and other levels of the gradient is a difference of metabolic rate. At this time the products of metabolism at different levels of the gradient are not specifically different, but differ in quantity." But the differences in rate at different levels bring about, sooner or later, differences in constitution and character of the protoplasmic substratum. Here one stable substance and there another remains as a constituent of the colloid substratum. Thus "each level of the gradient develops a characteristic protoplasm, and the character of the protoplasm in turn modifies and alters the character of the reactions, and so specific, or what we call qualitative, differences arise, and different specific substances may be produced at different levels of the gradient." Then for the first time chemical or transportative correlation in the commonly accepted sense becomes possible. The individual is there before the orderly specificities of chemical correlation are present or possible. "The starting point in differentiation is in differences in metabolic rate." The organism is a dynamic reaction system—"a protoplasm of specific constitution with a corresponding metabolic specificity." Individuation is a relation of dominance and subordination of parts. Development is a realisation of the capacities or possibilities which are given in the physico-chemical constitution of the fundamental reaction system. We have said enough to indicate the trend of the author's exceedingly interesting theory, which is doubtless a good one to work with, though it seems to our prejudiced vision to leave half of the Prince of Denmark out of the play. For, colloid substratum and metabolic gradient notwithstanding, we must regard even Prof. Child's Planarians as psycho-physical beings, mind-bodies or body-minds as you will, but organisms as well as mechanisms through and through.

HYDRAULIC FORMULA RECONSTRUCTION.

Hydraulic Flow Reviewed. By A. A. Barnes. Pp. xi+158. (London: E. and F. N. Spon, Ltd., 1916.) Price 12*s*. 6*d*. net.

THE book is in two parts, the first of which deals with the flow of water in pipes and channels. The author had occasion to investigate certain conditions of flow in the Thirlmere aqueduct, which supplies water to Manchester, and, finding the variation in the coefficients of accepted formulæ unsatisfactory, he was led to review the whole subject of the laws of flow, with the result that he has devised a series of formulæ in which the coefficient is independent of variations in the size or gradient of the conduit. Taking the equations of five well-known experimentalists, which he styles "the more salient formulæ" on the subject, he shows that they are of the form $=Km^{\frac{1}{2}}i^{\frac{1}{2}}$. He then points out that the square root indices of m (the hydraulic mean depth) and of i (sine of slope) are incompatible with a constant value for the coefficient k, for a particular class of pipe or channel. In accordance with the precedent set by Hagen and followed by Thrupp and others, he recommends the adoption of the more general expression $v=Km^{\alpha}i^{\beta}$, and from the analysis of a considerable number of published data he is enabled to assign a series of values to K, α, and β which give consistent and satisfactory results when applied to a wide range of cases. The formulæ thus obtained are sixteen in number, of which we only quote the first as typical of the rest. For new asphalted cast-iron pipes the value is $v=174{\cdot}1m^{\cdot 769}i^{\cdot 529}$. The results are plotted in diagrammatic form for reference, and the advantages of using a system of logarithmic co-ordinates (which give straight-line diagrams) for this purpose are pointed out.

In the second part of the book, dealing with the measurement of water by means of triangular notches, rectangular weirs, and circular orifices, the author discards the basic expression in common use, and advocates the application of the general formula adopted in part i., which he casts in the form $v=Km^{\alpha}H^{\beta}$. For a right-angled V notch this becomes:—

$$v=2{\cdot}462m^{-\cdot 00703}H^{\cdot 48703}$$

whence $Q=2{\cdot}481H^{2\cdot 48}$.

It is interesting to note that this latter expression corresponds very closely with the results obtained quite recently by Messrs. Gourley and Crimp in researches made on the river Alwen. Their formula reads:—

$$Q=2{\cdot}48nH^{2\cdot 47}$$

(n is the tangent of half the included angle of the notch, and, therefore, is unity for a notch of 90°).

For weirs with end contractions Mr. Barnes has determined:—

$$v=3{\cdot}324m^{\cdot 11}H^{\cdot 38},$$

and for weirs without end contractions:—

$$v=3{\cdot}324m^{-\cdot 02}H^{\cdot 51},$$

while for circular orifices:—

$$v=4{\cdot}652m^{-\cdot 015}H^{\cdot 5}.$$

There are a large number of authenticated results incorporated in the volume, tabulated in support of these equations, as well as plates giving the results graphically. The author claims that his formulæ are proved correct by experiment for quantities as small as 0·0034 cubic foot per second, by means of orifices, and as large as 320 cubic feet per second, by means of weirs.

As a concise and comprehensive *résumé* of the results obtained from a wide range of experimental work, combined with a striking revision of their mathematical expression, the volume is a welcome and valuable addition to the literature on the subject. B. C.

SERUM REACTIONS AND BACTERIAL THERAPY.

Applied Immunology: The Practical Application of Sera and Bacterins Prophylactically, Diagnostically, and Therapeutically. By Prof. B. A. Thomas and Dr. R. H. Ivy. Pp. xv+359. (Philadelphia and London: J. B. Lippincott Co., 1915.) Price 16*s*. net.

THIS book gives an account of those "reactions" employed in the diagnosis of disease which are based upon alterations in the body-fluids resulting from the action of micro-organisms or from the introduction of foreign proteins, and of the treatment of morbid conditions with serums, bacterial vaccines, etc. These reactions and treatment may be classed under the term "immunology," since they are based upon processes which commonly result in the living body in a state of immunity or resistance to the material—micro-organism or protein—which produces them. This material is named the *antigen*, and the substances which are the outcome of its action are known as *anti-bodies*.

The opening chapter of the book deals with the subject of immunity, its kinds and mode of production, and with the history and development of immunology; the second and third chapters give an account of antigens and anti-bodies and of Ehrlich's side-chain theory. These subjects are treated simply and briefly, but fully enough for the object of the book, which the authors state has been "to crystallise and detail the practical phases of serum and bacterin applications in medicine, thereby enabling the student and general practitioner, with even a slight laboratory experience, to appreciate the significance of, and more competently apply the principles underlying, immunology." In chap. iv. anaphylaxis or hyper-susceptibility is described, but we miss any reference to Bordet's theory of its mode of production. The preparation and properties of the various antitoxins and anti-sera are then described, together with certain miscellaneous sera and extracts, and their use in treatment. While usually full enough, some sections appear to be too brief; thus, anti-tuberculosis sera are dismissed in four lines, and no mention is made of Spengler's I.K. serum.

The subject of agglutination and its use in diagnosis are next considered. Dilution of the serum by means of a Wright's pipette is described, but no mention is made of the "throttled" pipette which is so convenient for this kind of work, nor is the subject of "zones of no reaction" alluded to—an omission of some moment.

In chaps. x. and xi. the precipitin reaction and its application for the recognition of blood-stains, etc., and lysis or solvent action are described.

The important subject of complement fixation is next dealt with, and the employment of this reaction for the diagnosis of syphilis (the Wassermann reaction) naturally occupies the premier place. Full details are given of the method of carrying out this reaction, but we should have liked fuller information on the meaning of the phenomenon of fixation in the absence of antigen and on the reaction with cerebro-spinal fluid.

Miscellaneous biochemical reactions, including the Abderhalden reaction, have a few pages devoted to them; and the important subjects of the tuberculin and similar reactions and tuberculin therapy are next considered at some length, following on conventional lines.

The subjects of phagocytosis and recovery from bacterial infections are then dealt with, leading up naturally to a consideration of bacterial inoculations, the opsonic index, and vaccine therapy. This section is somewhat slipshod, for the authors have not clearly distinguished between *preventive* and *therapeutic* inoculations. Thus it is stated that "treatment" of bubonic plague with bacterial suspensions has been extensively practised, and that "therapeutic" inoculation greatly reduces the severity of attacks; in both cases *preventive* treatment or inoculation is really meant.

In an appendix the serum treatment of hæmorrhage, organotherapy, and chemotherapy with salvarsan, etc., are briefly but sufficiently considered.

The book is illustrated with a number of figures, charts, and plates, some of the last-named being coloured. We notice an error occurring throughout the chart illustrating the Wassermann reaction, the incubation temperature being stated to be 56° C. instead of 37° C.

The book, while capable of improvement in many directions, may be recommended as giving a useful survey, free from too much detail and technicalities, of the subject of immunology.

R. T. Hewlett.

SCHOOL MATHEMATICS.

(1) *Analytic Geometry.* By Prof. H. B. Phillips. Pp. vii+197. (New York: John Wiley and Sons, Inc.; London; Chapman and Hall, Ltd., 1915.) Price 6*s*. 6*d*. net.

(2) *Problems in the Calculus, with Formulas and Suggestions.* By Dr. D. B. Leib. Pp. xi+224. (Boston, Mass., and London: Ginn and Co., 1915.) Price 4*s*. 6*d*.

(3) *Mathematical Tables for Class-room Use.* By M. Merriman. Pp. 67. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 2*s*. 6*d*. net.

(4) *Rural Arithmetic.* By A. G. Ruston. Pp. xi+431. (London: University Tutorial Press, Ltd., 1916.) Price 3*s*. 6*d*.

(1) PROF. H. B. PHILLIPS believes that the differential calculus should be given to the student in college at the earliest possible moment, and that to accomplish this a short course in analytic geometry is essential. He

has therefore written this text to supply a course that will equip the student for work in calculus and engineering, without burdening him with a mass of detail useful only to the student of mathematics for its own sake. The result is a very attractive little book. The author has picked out the easy and fruitful bits of his subject without concerning himself greatly whether the topics chosen are conventionally elementary or advanced. He gives us a book very different from the stock "analytical conics," for the conic falls into its place among other curves, and is not studied under a microscope. For example, we have nothing about the equation of the tangent to a conic; presumably the author would take tangents after dy/dx. On the other hand, we have sections on periodic functions, empirical equations, parametric representation, co-ordinates in space, surfaces. The book is one that might very well be used with a class of intelligent non-specialists in their last two years at an English public school, at a stage when the function of mathematics is to broaden their outlook. It would serve equally well as an introductory course for a specialist.

The book is full of pleasing practical touches—*e.g.* "But on other problems, *notably in work with alternating currents,* an interpretation can be given to the process of extracting the square root of a negative number, and then such results are entirely real."

(2) Most English text-books on the calculus are fairly well provided with exercises, but anyone who wants more will find a good collection here. The sets on maxima and minima are especially practical. Students of foreign fashions in notation will note the absence of $\sin^{-1}$; arc sin is used instead. The hyperbolic functions have not found admission, which seems a pity. The sets of exercises are prefaced by brief directions and plain warnings; the directions however are, from an educational point of view, too much in the way of rules—*e.g.* "To find d^2y/dx^2 (when x and y are given as functions of t) use the somewhat cumbersome formula

$$\frac{d^2y}{dx^2}=\left(\frac{dx}{dt}\cdot\frac{d^2y}{dt^2}-\frac{dy}{dt}\cdot\frac{d^2x}{dt^2}\right)\Big/\left(\frac{dx}{dt}\right)^3,$$

etc." (p. 29). On p. 81 the precise meaning of "in general" is not clear in the sentence: "Expansion into series is, in general, useful in calculations only when the series is convergent."

(3) This book contains many more tables than are commonly used in British class-rooms—*e.g.* cubes and cube roots, tables of $n^{\frac{3}{2}}$, n^5, $n^{\frac{1}{5}}$, $n^{\frac{2}{5}}$, $n^{\frac{2}{3}}$, areas and circumferences of circles, volumes of spheres, circular segments, chords, etc., together with five pages of weights and measures (from which it appears that the American yard differs from the British yard, being defined as 3600/3937 metres). On the other hand, there is no full table of secs and cosecs. Sine and cosine share a table, as do tan and cot. The "arguments" are given to three significant figures, or for every ten minutes in the trigonometrical tables. There are no difference columns, and to obtain a fourth significant figure, or the intermediate degrees, it is necessary to interpolate. Some of the functions are given to four significant figures, some to five; the principle underlying the choice of four or five is not mentioned. The author has broken with the curious tradition (the origin of which we should like to know) that ten should be added to the log of a circular function.

For British schools this book will probably be considered to contain too much in one way and too little in another (*e.g.* difference columns). The type is too small for young eyes.

(4) This book contains chapters on household accounts, commercial arithmetic, business letters, soils, manures, crops, live-stock, foodstuffs, dairying, mensuration, levelling, brickwork and building construction, water supply, work and power, measurement in the field. The explanations of arithmetical processes are undistinguished and sometimes old-fashioned (*e.g.* inverting the multiplier in contracted multiplication). But we imagine that this is not the part of the book in which the author is most interested. The description of all practical matters concerning farms and farmers is well written, and the numerous examples have a most realistic and practical appearance. How much more interesting it must be to find the volume of a "mangel pie" than of a mere prism! C. G.

OUR BOOKSHELF.

Aids to Bacteriology. By C. G. Moor and William Partridge. Third edition. Pp. viii+278. (London: Baillière, Tindall and Cox, 1916.) Price 3*s*. 6*d*. net.

THIS well-known little book, now in its third edition, contains an extraordinary amount of information within a small compass, though necessarily in a condensed form; in fact, the whole range of subjects included under the term "Bacteriology" is covered by it. Migula's classification of the Bacteria now replaces that of Heuppe, and as regards bacterial mutability, the authors remark that this is largely of academic interest, and that in practice species tend to crop up fairly true to type. Antibodies, apparatus, culture media and methods of examination are surveyed, and all the principal pathogenic bacteria and protozoa are described. In addition, the moulds, yeasts, fermentation, and enzymes are dealt with as well as the bacteriology of water, milk and other foods, air, soil and sewage, and disinfection and disinfectants; little seems to have been missed and few errors occur. It is a pity that *B. perfringens* as a synonym for *B. Welchii* is not mentioned, for it is so commonly used now. Agricultural bacteriology has two or three pages devoted to it, including nitrogen fixation, nitrification and sterilisation of soil. The filterable viruses are dealt with, and some recent work on the meningococcus and other topics is referred to in a brief appendix. Altogether we may congratulate the authors upon having compiled an exceedingly comprehensive and useful little book.

Mind and Health Series. The Influence of Joy. By George Van Ness Dearborn. Pp. xviii + 223. (London: William Heinemann, 1916.) Price 5*s*. net.

PROF. PAVLOV of Petrograd has shown in famous experiments that digestion is affected favourably or unfavourably by emotional conditions, and his work has been followed by Cannon, Carlson, Crile, and others. The author of this volume has studied the influence of joy on blood pressure, and has devoted some attention to the psycho-biology of the emotions. His thesis is that joy is an important factor in the health of the body, and his illustrations refer to the influence of joy (1) in stimulating secretion, the movements of the food canal, and the process of absorption; (2) on the circulation; and (3) on the general integrative function of the nervous system.

The evidence given as to the influence of joy on secretion and blood pressure is more convincing than that under the third head. Much attention is given to the influence of emotion on the secretion of adrenalin and all that follows even a slight increase in the amount of that powerful substance.

The author writes with enthusiasm and occasionally with exuberance, but it is with good science that he confirms the good sense of the cheerful-minded in all ages, who have realised that "a merry heart is the life of the flesh." There is much salutary counsel in what Prof. Dearborn has to say regarding the cultivation of the will to be glad, and he has made a very useful contribution to psycho-biology.

Manual of Russian Commercial Correspondence. By Mark Sieff. Pp. xx + 232. (London: Kegan Paul, Trench and Co., Ltd., 1916.) Price 3*s*. 6*d*. net.

THIS is a welcome addition to the student's library. Admirably qualified for the task, the author has compiled a veritable *multum in parvo*, and the student who masters its contents will have little to apprehend when called upon to deal with Russian correspondence. A valuable feature is the section, modelled on the plan adopted by N. A. Blatov in his "Manual of Russian Commercial Correspondence," setting forth with admirable clearness the general plan on which letters on various subjects should be constructed. It constitutes a lesson in orderly arrangement and concise statement which might be profitably studied by correspondents in any language. Where so much is excellent it seems almost hypercritical to point out that the English phraseology is in places somewhat cumbersome and might with advantage be simplified, and also that here and there the English idiom is not quite correct. But these are minor blemishes which in no way detract from the utility of the work. As it is one thing to read print and a very different matter to decipher handwriting, we would suggest that it might be of assistance to students if a future edition contained a few facsimile specimens of actual Russian letters.

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.]*

Optical Deterioration of the Atmosphere in July and August, 1916.

DR. MAURER, director of the Swiss Federal Meteorological Institute, has forwarded to me a note on the optical deterioration of the atmosphere noticed in the Alps in the summer which has just passed. At his request I enclose a translation of his note, as the subject is likely to interest your readers.

NAPIER SHAW.

Meteorological Office, South Kensington, London, S.W., September 21.

Remarkable optical deterioration of the atmosphere became apparent in the Swiss Alps during the last ten days of July by the persistently abnormal magnitude and unusual intensity of the bright patch round the sun, to which the name aureole is sometimes assigned. Observations in previous years have established a well-defined minimum during the summer months, both in the diameter and the intensity of the solar aureole, but during the present year, from July 23 until the middle of August, the diameter generally attained 120° to 130°, and on August 25 even 140°, with relatively great intensity. Abnormal extension of the aureole was also observed after July 21 at high levels on the Alps, above 3000 metres, and a true brown Bishop's-ring was seen on August 3–4 on the high peaks of the Upper Engadine.

On August 6 twilight phenomena were very abnormal. The "purple light" was entirely absent; the westerly earth-shadow was very indefinite, and the eastern twilight-arch of the zodiacal light was similarly affected. The western sky, at first of a homogeneous pale yellow colour, showed a peculiar cirrus-like structure for some time after sunset. At first the stratification was strictly horizontal, but later on it appeared undulating, or in flaky form. It did not disappear until darkness set in. Similar phenomena were observed in 1883–4, 1902–3, and 1912, in connection with the much-discussed optical deterioration of the atmosphere in these years. After the end of July this remarkable cirrus-like layer could be seen best in the higher Alpine regions, but a bright "purple light" was not seen there either in July or August. The cause of the deterioration is for the time being still in doubt. Up to the present no reports of volcanic eruptions have come to hand from any part of the globe.

Zürich, September.

Science in Education.

IN reply to "F.R.S.; F.B.A." (NATURE, September 28, p. 69), may I express the hope that, whatever may be the custom in France, those who discuss the place of science in education, when they say science will mean science, and not "Egyptology, classical archæology, history, art, linguistics, Indics, Sinics, Hellenics, philology (Latin and Celtic), French language and literature, Italian, Spanish, English, German, law, and economics"? No one wants to deny that the study of man holds as large a place as the study of Nature. Man has never yet tired of studying himself, and needs little encouragement to continue doing so. But the progress of the modern world is due to the fact that an increasing number of minds have escaped the vicious circle of these introspective examinations and begun to study the realities of external Nature.

Mr. Carnegie in 1901 gave a million pounds to provide funds "for improving and extending the opportunities for scientific study and research in the Universities of Scotland, my native land," to quote from his trust deed. In the University of Aberdeen, of which I have the honour to be a member, out of 132,000*l.* allocated from this benefaction in the period of $15\frac{3}{4}$ years, a bare one-quarter has gone to science; 52,118*l.* has gone to endow one professorship in history and five lectureships in French, political economy, German, education, and constitutional law and history; 24,750*l.* has been assigned to provide new buildings for teaching arts subjects, a new examination hall, and an extension of the library; 26,750*l.* has gone, 15,750*l.* to maintenance of the library and 11,000*l.* for provisional assistance in teaching, science being represented in this to an indefinite extent. The remaining 28,382*l.* has gone to science, 15,750*l.* for the equipment of laboratories, and 12,632*l.* as an endowment for a lectureship in geology. With reference to the latter, the Geological Department, taking the figures for the year before the war, was entirely supported by the fees paid by the students, and geology got the interest of the 12,632*l.* in the same sense as the Postmaster-General gets the sovereign when you purchase a 20*s.* postal order. Personally I think calling science what is not science needs to be watched and checkmated.

Frederick Soddy.

University of Aberdeen, September 30.

AN IMPERIAL DEPARTMENT OF MINERAL PRODUCTION.

The presidents of the technical institutes most closely connected with the production and utilisation of our mineral resources have addressed to the Advisory Council for Scientific Research a memorandum advocating the establishment of a central Government Department, the duty of which should be to foster the development of the mineral resources of the British Empire. Whatever form such a department may take, the need for its creation is very obvious. In Great Britain no such department exists. The Geological Survey, under the Board of Education, records the existence of mineral deposits, but always from the point of view of the geologist, whose main interest lies in their mode of occurrence and not in their exploitation. The Inspectorate of Mines under the Home Office is concerned only with the due policing of mines from the point of view of safety; its ideal would be a state of affairs in which mining accidents were reduced to zero; and even though this were brought about by the cessation of all mining, the Inspectorate of Mines would have fulfilled the object for which it exists. The Board of Trade, the Imperial Institute, and many other departments of the Government take a more or less desultory interest in mineral production, but there is no one department the special duty of which it is to watch over the development and proper utilisation of our mineral resources.

What is needed is a Ministry of Production, or something equivalent thereto, which should have for its particular object the care of developing all the natural resources of the Empire. All natural products may be divided into three groups: they are produced by the cultivator, by the hunter or fisherman, or by the miner. Of all these the last-named needs the most careful attention, because minerals alone constitute a wasting asset; unlike the other products, they are not renewed, and, once exhausted, are gone for ever. The cultivation of a field on wrong principles will entail losses for a year or two, but these are quite remediable, and the application of proper methods will restore it to fruitfulness; but a mine worked on wrong principles is ruined for ever, and mineral not properly wrought is in the vast majority of cases lost irrecoverably.

It is this consideration that renders the need for a Ministry or Department devoted to the administration of our mineral resources so very urgent. In most Continental countries the minerals have remained the property of the State, and the State has therefore a direct pecuniary interest in seeing to their development as an integral part of the national revenue. In this country and in America the State has found it advantageous to relinquish the State ownership of minerals, it being held that the development of the national mineral resources is thus facilitated, and that such free development is of more benefit to the nation than the revenue which might be derived from its mineral concessions. As regards purely fiscal reasons, these two nations are accordingly not directly concerned in the development of their mineral wealth, but it by no means follows that they should treat the subject with indifference. In the United States there is a Department of Mines that takes a very active interest in encouraging the mineral output. In Canada there is a Department of Mines upon somewhat similar lines, which is doing excellent work, and under the fostering care of which the mineral output of Canada is making rapid advances.

There was a time when Great Britain stood at the head of all nations as a mineral producer, at any rate as regards a considerable number of important minerals and metals; that we have fallen far behind to-day is due no doubt in great measure to natural causes, but their effect has been and is being accelerated by the fact that it has been nobody's business to see to it that our mineral resources were worked to best advantage; whenever legislation has touched mining, it has been to hinder, not to help, mining operations, mainly because there was no great Department of State to look after our mineral interests. Wastefulness in the production and utilisation of our mineral resources has gone on and is going on unheeded and unchecked, mainly again for the same reason. The need for a State Department administered on sound economic lines, as free from political bias as our national methods admit of, is perhaps more urgent for the British Isles in the first instance, but together with this and above this, there should be an organisation for protecting the mineral industries of our whole world-wide Empire, for consolidating the resources of the Empire, and for rendering it impossible that in the future the control of any portion of the Empire's mineral production should ever pass into alien hands.

Henry Louis.

THE SURVEY LINK CONNECTING THE TRIANGULATIONS OF INDIA AND RUSSIA.[1]

At the meeting of the International Geodetic Association held in London in 1909 the way was cleared for the completion of a connecting link between Indian and Russian triangulations which would carry scientific measurement from Cape Comorin to Petrograd. This necessitated the extension of a geodetic series across some of the highest and most unapproachable of the snow-capped ranges in the northern Himalayan system. Between Gilgit and Salisbury Peak on the Nicolas (Russian spelling) range of the Pamirs there intervene about 100 miles of inconceivably wild and rugged mountain country distinguished

FIG. 1.—On the Russian East Station of Sarblock, 17,284 ft. From "Records of the Survey of India."

by groups of peaks running to altitudes of more than 20,000 ft. and seamed with a most amazing series of waterways containing the biggest glaciers in the world. Salisbury Peak, near the western end of the Pamir boundary between Russia and Afghanistan, looks southwards across the valley of the river Ab-i-Panja (flowing westward to the Oxus and skirting the southern foot of the Nicolas range) on to the great ridge of the Hindu Kush. From the Hindu Kush southward to the Gilgit river flow three great mountain streams, which afford the only possible approaches northward, *i.e.* the Yasin, the Ashkuman, and the Hunza.

[1] "Records of the Survey of India." Vol. vi., "Completion of the Link connecting the Triangulations of India and Russia, 1913." Prepared under the direction of Sir S. G. Burrard. (Dehra Dun, 1914.) Price 4 rupees or 6s.

Setting aside, for the present at any rate, any consideration of making this geodetic connection through Afghanistan or Persia (which, for political reasons chiefly, is out of the question), the choice of an approach to the Russian boundary in the Pamirs lay between these three most difficult routes. The line of the Hunza was eventually selected as leading more directly to a point on the Russian border close to the Chinese frontier, and involving no question of crossing the valley of the Ab-i-Panja, which, lying low between the Nicolas range and the Hindu Kush, is a narrow strip of Afghan territory. Between 1909 and 1911 a series of principal triangulation had been carried

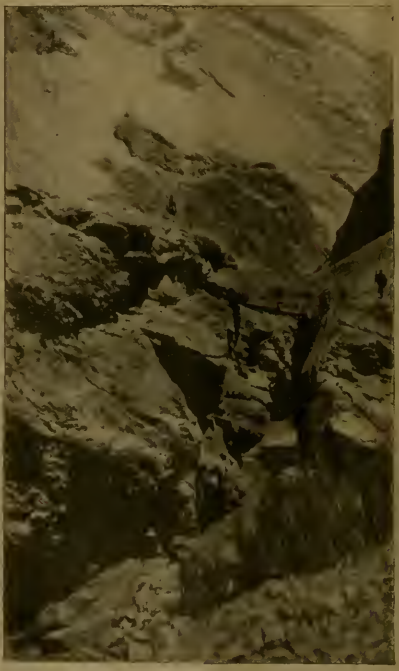

FIG. 2.—A log bridge over the Chapursân. From "Records of the Survey of India."

from Rawal Pindi to Gilgit, thus furnishing a first-class base from which to take off for this northern extension. At the other end of the line two trigonometrical stations had been fixed by the Russian surveyors at the eastern end of the Little Pamir, not far from the Beyik Pass, which offered the necessary points for final connection.

The report under review deals with the efforts of the Indian Survey officers to bridge this gap and reach commanding observation points in the barren and rugged *entourage* of the Hunza Valley, by means of which a geodetic series could be carried successfully to the Hindu Kush. Probably no scientific surveyors in the world have ever been faced with quite such a problem. The difficulties were not merely those of mountaineering and excessive altitude or of narrow valleys flanked by gigantic mountain walls. These regions are subject, *inter alia,* to storms of great violence and suddenness, and it was during one such storm that the camp of a native assistant was struck and his whole party practically put out of action. The roads, or mountain tracks, which lead to the passes of the Hindu Kush have often been described by travellers, and there is no indication in this report that they have improved of late years. Certainly no very great trouble was caused by the nature of the transport requisitioned. All sorts and conditions of men were impressed into service. The regular native staff of the Survey Department and the trained Gurkha assistants drawn from the frontier regiments were all trustworthy under any conditions of stress and difficulty, whilst the coolie carriers, who were chiefly recruited from the Baltis, were quite satisfactory. Lieut. Mason's appreciation of their services is pleasant reading, and speaks well for his tact and consideration in dealing with natives.

It was, on the whole, the technical difficulty of selecting sites for stations of observation, and the incessant demand for strenuous exertion in climbing mountains which possess absolutely no attraction beyond that of the grandest and most savage scenery in the world, which hindered the progress of the party; and it was the successful facing of these difficulties which rendered the completion of this series such a brilliant achievement among the great records of Indian triangulation.

The work in the Pamir highlands was laid out by Lieut. Bell, R.E., whose sudden death ere the work was completed was deeply felt by the whole party. The linking up of two magnificent systems of triangulation, such as those of India and Russia, which would give a continuous and unbroken geodetic system of earth measurement through sixty degrees of latitude, has ever been a most fascinating objective to the scientific geodesist in India, Russia, and England; but whether a narrow series such as this, with uneven sides and angles as factors in the successive figures, will fully satisfy the requirements of geodesy may be questionable. Some of the sides of the figures are very short, restricted by narrowness of the Hunza Valley, and the angles are far from fulfilling the condition of equality in arc. It is, therefore, not claimed for it by the Surveyor-General of India that it represents anything more than a "secondary" series, and it still remains for geodesists to say how far it has succeeded in fulfilling the high scientific requirements that were anticipated from its completion. Incidentally, however, it has been of the greatest practical use, for it has confirmed the values determined by the measurements of the Pamir Boundary Commission in 1895, and proved that the process then adopted of interpolation from distant and definite peaks (which were already fixed by the Indian triangulation on the Gilgit frontier), supported by a constant repetition of observed azimuths, was accurate to a degree which seems to have been unexpected by the present Survey Staff in India, although the coincidence in final values causes no

FIG. 3.—The distant Karakoram Range from Tomtek, h.s. 18,608 ft. From "Records of the Survey of India."

surprise to those who were concerned in that Commission work. Roughly, it may be said that the Commission values obtained in the course of a month or two by the method referred to are in excess of those now fixed by about two seconds of arc both in latitude and in longitude, a displacement which has no effect whatever on the validity of that international boundary which was then demarcated.

This is not unimportant, for it need be no longer a political secret that the adoption of the crest of the Nicolas range as the boundary in question depended on the fact that no part of it was north of the latitude of Lake Victoria. The Russians, by astronomical deduction, maintained that it did in fact bulge over that parallel, but the results of the Pamir triangulation, based on those mighty peaks which were visible from certain high altitudes overlooking the Hindu Kush, combined with astronomical determinations for latitude of the British surveyors, afforded too strong an argument to be refuted, and the range was adopted. It is therefore satisfactory to find (not that the matter was ever really in doubt) that the range is, so to speak, in its right place. These results do also suggest that more use might be made of the system of interpolation. The British officers who have been triangulating across the backbone of the Andine Cordillera in Peru have indeed made use of it, and that must have been just about the same time that Lieut. Mason's party was pushing its way through the Hunza defiles.

T. H. HOLDICH.

MR. BEDFORD MCNEILL.

IT is with regret that we announce the death on September 18, due to cerebral hæmorrhage, of Mr. Bedford McNeill, the well-known mining engineer, at fifty-five years of age. Apart from his high reputation as a mining engineer, Mr. McNeill's name was almost a household word in connection with the telegraphic code compiled by him, which was issued originally in 1893, and in an enlarged and revised form in 1908. This code is employed almost without exception by mining companies and engineers, to whose use it was specially dedicated, and other business men have found it extremely practical for cable communications.

As a mining engineer Mr. McNeill graduated at the Royal School of Mines in 1880, when the school was still in Jermyn Street; and his professional career as consulting engineer, which began in the office of the late Mr. John Darlington, took him into many parts of the world. He was a member of many learned societies, including the Institute of Chemistry, the Geological Society, of which he was also a Member of Council and Treasurer for some years, and the Iron and Steel Institute. In 1895 Mr. McNeill was elected a member of the Institution of Mining and Metallurgy, of which he soon afterwards became vice-president, and he occupied the presidential chair in 1913–14. His inaugural address in that capacity dealt with the present and future problems confronting the mining profession, particularly as regards the speculative nature of mining and its close association with capital. He pointed out that mining was likely to become more speculative in its character in the future, since, though there were still large areas not yet properly prospected, the engineer may ultimately be driven to working that class of mineral occurrence which presents no visible evidence whatever at surface, and the location and working of which will inevitably demand higher technical skill and involve greater risk of loss of capital than those deposits at present dealt with. During Mr. McNeill's term of office the Institution of Mining and Metallurgy acquired its freehold house at No. 1 Finsbury Circus, which was formally opened on January 13, 1914, by the Lord Mayor of London, and during his presidency also the first steps were taken for securing the Royal Charter which has since been granted to the institution. His connection with the Royal School of Mines was maintained throughout his career.

Mr. McNeill was buried at Hollington, West St. Leonards, on September 21. The following societies were officially represented at the funeral:—The Institution of Mining and Metallurgy, the Royal School of Mines Advisory Board, the Mining Committee of the Advisory Council for Scientific and Industrial Research, the Geological Society, the Royal School of Mines, the R.S.M. Old Students' Association, and the Mining and Metallurgical Club, of which he was vice-president, while floral tributes were sent by the Institute of Chemistry, the Iron and Steel Institute, etc. Mr. McNeill's death creates a gap in the mining and kindred professions that will be difficult to fill.

NOTES.

AN account of a new means of delineating internal organs *in vivo*, and the localisation of injuries to them, by an electrical method devised by James Shearer, M.D. (Washington, D.C.), at present a sergeant in the R.A.M.C., is given in the *British Medical Journal* for September 30. It is difficult to realise from the description the exact nature of the electrical installation used, but the principle is said to be to impose upon two alternating electric fields of equal strength at right angles the effect of a third field having its origin in the organ under examination. The patient lies on an insulated table, and near him are placed two screens of perforated zinc plate, one horizontal and the other vertical, connected to two separate batteries. A sheet of waxed paper is then put upon a cylinder which is set in rapid rotation, and a needle scribes upon this paper a tracing of the organ under examination, showing at the same time any lesions in it. Prints can afterwards be taken from the record by contact printing with photographic paper. Five illustrations are given in the *British Medical Journal* showing respectively pictures of the brain, kidney, cæcum and appendix, intestine, and liver of injured patients submitted to the process. The brain picture is as clear a delineation of the blood-vessels as is given in text-books of anatomy, but how it could possibly have been produced by a tapping needle upon a rapidly revolving cylinder cannot readily be conceived. Without further details to enable electro-physiologists to repeat Sergeant Shearer's work it is impossible to say more than that the results, if confirmed, represent a very remarkable discovery, which may be of immense advantage in delineating the soft internal structures of the body. So many inventions at first received with incredulity have turned out to be truly useful that we hesitate to speak of this present one as incredible. But with the imperfect details and explanation which are as yet forthcoming, we may be excused if we adopt the attitude of scientific expectancy. We trust it will not be long before the new method is examined by proper experts, and its scientific soundness properly investigated.

At 3 a.m. (Summer Time) on Sunday last, October 1, Greenwich Time again became the standard time of Great Britain. By an order issued by the Home Office, "the hour 2–3 a.m. Summer Time" was followed by "the hour 2–3 a.m. Greenwich Time." All railway clocks and clocks in post offices and Government establishments were put back one hour, and the Government requested the public to put back the time of all clocks and watches by one hour during the night of Saturday-Sunday, September 30-October 1. From October 1 onwards Greenwich Time will be used for all purposes instead of being limited to the needs of navigation, astronomy, and meteorology, as it has been since May 21. It is announced that the Home Secretary, while satisfied with the results of the Summer Time Act, has appointed a committee to consider the question in all its aspects. A Daylight Saving Bill will probably be reintroduced next year, but Mr. Samuel thinks that certain objections, coming chiefly from northern manufacturing districts, and a number of suggestions and recommendations should be inquired into first. The late experience has shown that the State need not hesitate to introduce any changes which are believed to be for the good of the community. In Nature of September 28 a correspondent suggested certain modifications of the customary use of a.m. and p.m., so as to avoid the designation of half an hour after midday by 12.30 p.m., while 11.30 p.m. occurs eleven hours later. Mr. C. T. Whitmell writes to say that he made the same suggestion in the *Yorkshire Post* of August 4, and remarks that "some definite agreement as to the way of representing the times between noon and 1 p.m. and between midnight and 1 a.m. is certainly desirable." The Home Secretary's committee might consider this matter, and also the question of designating hours from 0 to 24, so as to avoid the use of a.m. and p.m. altogether.

Mr. Benjamin Kidd, the author of important books and articles in which a system of social philosophy is developed from an original point of view, died on October 2, at fifty-eight years of age. His first work, "Social Evolution," is the best known, and when it was published in 1894 its originality and force were recognised immediately. The keynote of the work was the declaration that religion is not the enemy of science and enlightenment, but, on the contrary, through the ethical principles of its teaching, has been one of the most important agencies in social development, and is closely bound up with that portion of our nature to which all modern social advance is due, and by which the course of future progress will be decided. Mr. Kidd thus found the causes of the evolution of society and of modern civilisation, not in the growth of intellect and of science, but in the continuous action of religious beliefs. In 1898 was published his book, "The Control of the Tropics," which directed attention to the importance of the tropics in the development of civilisation; and in 1902 appeared his "Principles of Western Civilisation," which made "efficiency in the future" the determining quality of social development. This "projected efficiency," when "society, with all its interests in the present, is subordinated to its own future," was regarded as the secret of success and of progress, and its absence was the cause of stagnation. Mr. Kidd was also the author of other notable works. To the tenth edition of the "Encyclopædia Britannica" he contributed a prefatory article on "The Application of the Doctrine of Evolution to Sociological Theory," and for the eleventh edition he wrote the article on sociology. In 1908 he delivered the Herbert Spencer lecture at Oxford upon the subject of "Individualism and After."

A Skien newspaper announces the discovery in Telemark, Norway, of a rich mineral field covering several kilometres. Bismuth and silver have been found there, and it is said that there are traces of gold.

The Faraday Society will hold a general discussion on "Refractories" at its first autumn meeting, the date of which is provisionally fixed for Wednesday, November 8. The discussion will be presided over by Sir Robert Hadfield, president of the society, and the opening paper will be read by Dr. J. W. Mellor.

A lecture on "Stresses in Transparent Materials as Revealed by Polarised Light" will be delivered by Prof. E. G. Coker before the Optical Society on Thursday next, October 12, at the rooms of the Chemical Society, Burlington House, Piccadilly, W.

According to the *Times* a "meteorite (commonly known as a 'thunderbolt')" fell at Dinas Powis, near Cardiff, on the night of September 26–27, and did some damage. The cause of the damage was, however, not a meteorite, but a lightning-flash. There had been thunderstorms on or about the same day of the month in the previous May, June, and July, whilst it was on March 27 that the famous storm occurred.

Mr. Lloyd George's allusion to the absence of the nightingale from Wales has caused a long and sharp discussion in the local Press. It is authoritatively stated that during the last thirty years the nightingale has been steadily moving westward in the Principality. In East Glamorgan it is a regular visitor, but has also been reported from Carmarthen, and was heard as far west as Aberystwyth in 1911.

A wireless station has been established on Dickson Island, at the mouth of the Yenisei, by an expedition under the leadership of Dr. Kuchakov, for the purpose of sending meteorological telegrams to the physical observatory in Petrograd. The value of these telegrams will be felt chiefly in Siberia.

During the past summer a party of forty men, including five engineers, has been working the large coalfield on Bear Island, between Spitsbergen and Norway. The field has proved of greater extent than was anticipated, and the coal seams crop out on the north side of the island. A cargo has already been dispatched, and it is possible to continue the export throughout the year. The Norwegian Government proposes to establish wireless and meteorological stations there.

At Leonardsberg, four kilometres from Norrköping, Sweden, there have recently been discovered and cleaned from the surrounding earth a number of rock-carvings, both large and small. One of them shows a row of human figures, among others women with children, men bearing shields, horses, and two other quadrupeds with curious head ornaments. Another interesting rock-carving has been discovered in Biskopskulla parish in Upland. Six previous carvings were known from this district, but the present one is the representation of a ship of a type hitherto unknown there, since it is not merely outlined but carved on the rock in low relief. About one metre long, it represents one of the so-called dragon ships, and belongs to the oldest group of such monuments of the Bronze age, a conclusion confirmed by its height of 32·5 metres above sea-level.

THE Y.M.C.A. is organising a series of microscopic exhibitions in the military and naval camps for the interest of the men in their leisure hours. An organising committee consisting of fellows and members of the Royal Microscopical Society, Quekett Microscopical Club, and the Photomicrographic Society has been formed, and already many fixtures have been made for exhibitions to be held in the Y.M.C.A. huts in various centres throughout the metropolitan area and the home counties. The exhibitions generally take place in the late afternoons or the evenings, and ladies and gentlemen who can spare the time to give service with their microscopes are invited to communicate with the hon. sec., Microscopical Department, Y.M.C.A., Tottenham Court Road, W.

SIR WILLIAM ASCROFT, a pioneer advocate of technical education, died on September 29, in his eighty-fifth year. He was president of the council of the Harris Institute, Preston, for more than thirty years (resigning in 1912), one of the original members of the council, and one of the trustees. The *Preston Guardian* remarks:—"Sir Wm. Ascroft's zeal for education, and particularly technical education, made the Harris Institute not only an incalculable benefit to Preston, but also one of the most influential pioneers of technical education in this country, setting an example which has been followed in many other centres. It was in recognition of his great services in this connection that his name was included in the list of Royal birthday honours in 1908."

IN the *South African Journal of Science* for June the Rev. S. S. Dorman deals with the question of the ruins at Zimbabwe and other sites in Rhodesia from the point of view of native tradition. He rejects the views advanced by Bent, Peters, and Hall that these buildings were erected by Semites, or under Semitic influence, from 2000 B.C. to A.D. 900. He has recorded the evidence of two intelligent natives, who allege that the buildings are of comparatively recent age, and that they were probably abandoned under pressure from marauding tribes. The so-called "temple" is now said to be only the residence of the chief, and the writer states that the buildings at Zimbabwe have not an appearance of antiquity, and that from the amount of weathering they do not appear to be more than 500 years old. He also produces evidence to show that gold mining was carried on by the natives at sites where these ruins do not exist, and he sums up by saying:—"As a large part of the Semitic theory of the origin of Zimbabwe and its associated ruins rests upon the ignorance of the natives of rock mining and the excessive antiquity of the mines, the bottom is absolutely knocked out of it by these and similar facts."

IN spite of the elaborate survey of Irish stone monuments by Mr. W. C. Borlase in his "Dolmens of Ireland," much remains to be done in that island, where dolmens, stone circles, alignments, and pillar-stones (inscribed, uninscribed, holed, and marked) are singularly abundant. In the June issue of the Journal of the Royal Society of Antiquaries of Ireland Mr. J. P. Condon publishes the first portion of a survey of the rude stone monuments of the northern portion of Cork County, in which he records many examples hitherto undescribed, and not even marked on the maps of the Ordnance Survey. At Greenhill a new ogham stone, with a fragmentary inscription, has been recently discovered; the Island group of monuments in the parish of Rahan forms a remarkable collection, and the stone circle at Lissard, in the parish of Grenagh, is fairly complete. On the whole, in this communication as many as eighty-five examples are described. This large collection from a small area shows the great abundance of these monuments, and the need for a complete survey of the whole of Ireland before these valuable antiquities are destroyed.

WITH the conception of the cancer problem as essentially a biological problem English readers have been familiar for many years, and Prof. L. Loeb's summary of the present position in the September number of the *Scientific Monthly* will be generally accepted. In several matters of detail, however, it is doubtful if his formulation of the problems will be useful. The attempt to separate the internal and external factors, as, for example, heredity and chronic irritation, disregards the fundamental truth that the influence of chronic irritation in the causation of cancer can only be conceived as acting through modification of the intracellular mechanism. It is a pity that the article does not distinguish between hypothetical views and generally accepted truths. An example of this is the statement that cancer of the mamma in mice cannot develop in the absence of a rhythmical repeated stimulus from the ovaries, although Loeb himself claims to have proved that the diminution of spontaneous mammary cancer in mice by castration can only be obtained if it is performed before sexual maturity. The contrast between spontaneous and transplanted cancer and the nature of immunity to the latter are well brought out. The paper ends with an attempt to combine the parasitic hypothesis of cancer etiology with the purely biological conceptions of its nature, mainly on the assumption that the explanation of the proliferation of cancer is to be found in analogies with the plant tumours caused by the *Bact. tumefaciens* and the bird tumours discovered by Peyton Rous to be due to a filtrable virus.

THE September issue of the *Journal of the Board of Agriculture* contains a useful summary of the results of co-operative experiments carried out in the years 1911–13, under the auspices of the Union of German Experiment Stations, with the view of obtaining further evidence as to the validity of the so-called "citric solubility" as a measure of the fertilising value of basic slag. The question is one which has aroused much controversy in recent years in Germany and also in this country, and has acquired considerable practical importance through the official recognition of the conventional Wagner method of determination of "citric solubility" in the Fertilisers and Feeding Stuffs Acts and regulations made thereunder. With one exception the reports from the five experiment stations co-operating in the tests are unanimous in upholding the validity of the Wagner test and justify the unanimous resolution of the Union of German Experiment Stations that there are no grounds for departing from the customary methods of evaluation of basic slag. It may be added that similar, though less comprehensive, tests carried out during the past three years at various centres in this country, under the auspices of the Agricultural Education Association, have also given results which in the main bear out this conclusion.

THE revised edition of Special Leaflet No. 46, recently issued by the Board of Agriculture and Fisheries, bears testimony to the vigorous criticism sustained from practical agriculturists since the first issue by reason of the advocacy in the leaflet of the application of sulphate of ammonia to the wheat crop during the autumn months. In view of this criticism it has been thought desirable to embody in the new issue a reasoned justification of the recommendation. It is admitted that on the average of years, if a dressing not exceeding, say, $\frac{3}{4}$ cwt. sulphate of ammonia is to be used, spring dressing may be expected to pay better than autumn dressing. It is argued, however, that with wheat high in price much heavier dressings can be profitably applied, that these must in any case be given in two or more instalments, and that the best result may be expected from them if a portion be applied in the autumn and the balance in the spring. It is further urged that the common fear of loss of soluble salts by leaching throughout the winter is largely groundless in the case of sulphate of ammonia, since the ammonia is firmly retained by the soil and is only readily removed by water after conversion to the form of nitrate. Such nitrification being the outcome of bacterial activity, little change of ammonia is likely to take place at the low temperatures obtaining in the soil during the winter months.

THE attention of teachers of geography should be directed to the fine illustrations which are a feature of the *National Geographic Magazine*, published in Washington. The magazine is ostensibly a popular publication, and fulfils its object of increasing and diffusing geographical knowledge. The issue for August, 1916 (vol. xxx., No. 2), contains, among others, articles on Sardinia, Argentine and Chile, and San Domingo and Hayti. The chief feature of each article is the illustrations, many of which have considerable geographical value, and all of which are admirably reproduced. It is not easy to get illustrations of the negro republic of Hayti, and those in this magazine give a vivid impression of the island and its chief towns. The people of the countries concerned are well illustrated in all the articles.

ON the Monthly Meteorological Chart of the North Atlantic and Mediterranean for October there appears the usual inset map of "phenomenal drifts and heights" of North Atlantic ice. We notice in this map a record, which has appeared in many previous issues, of ice, presumably an iceberg, recorded near the island of Colonsay, off the Firth of Lorne, in the west of Scotland. It was sighted by fishermen in July, 1902. It is a little difficult to credit this remarkable occurrence, and if the fishermen were not mistaken the iceberg would surely have been seen by other observers, but the chart makes no mention of this. There are conditions of sea and weather in which ice can easily be imagined, and this suggests one of those cases. Unless the record is established beyond all doubt, it would be well to query this occurrence or to remove its indication from the chart.

WE learn from the *Geographical Journal* for September that the Arkhangel Society for the study of the Russian North is taking steps to obtain information as to the fate of the two Russian polar expeditions, of which there has been no news for several years. Rusanoff's expedition in the *Hercules* visited Spitsbergen in the summer of 1912, and was last heard of the same year in Novaya Zemlya, on its way through the Matochin Shar to the Kara Sea. Ice conditions were exceptionally severe in Arctic seas in 1912. The other expedition, in the *St. Anna*, passed through Yugor Strait in September, 1912, with the intention of making the north-east passage. It was afterwards learnt that the *St. Anna* was abandoned in April, 1914, in 83° N., 63° E. Several Russian search expeditions have failed to reveal any further news. The Arkhangel Society is raising a fund of 2500*l*. to be spent during the next three years in prizes for information throwing any light on the fate of the explorers. It is almost impossible that there can now be any survivors.

THE *Philippine Journal of Science* for January contains an interesting paper by G. W. Heise on the water supply of the city of Manila. The water is derived from the upper reaches of the Mariquina River, and the only physical purification it receives is storage in a reservoir for about three and a half days, which reduces the bacteriological count by about 90 per cent. The water is then treated with chloride of lime in doses varying from 0·5 to 0·75 part of available chlorine per million parts of water. This treatment appears to be still in a more or less experimental stage, and while, on the face of it, the sterilisation does not quite come up to expectations, some interesting results were obtained. Perhaps the most noteworthy of these is that the benefit derived from increasing the dose from 0·5 part of available chlorine per million to 0·625 part is very much greater than that derived by a further increase from the latter figure to 0·75 part. These results are chiefly judged by bacteriological counts made on the water before treatment and three-quarters of an hour after treatment. Possibly, if the results were judged on tests for *B. coli* done on various volumes of water (say 100 c.c., 10 c.c., 1 c.c., 0·1 c.c., etc.) instead of only on 2 c.c., and after longer contact (say three or four hours) of the water with the germicide, they would then wear a more favourable aspect, and at the same time give a truer estimate of the effect of the treatment.

UNDER the title "Mathematical Portraits and Pages" Messrs. Ginn and Co. have issued an attractive illustrated pamphlet of about twenty pages, drawn up by Prof. David Eugene Smith. The contents include reproductions of portraits of Newton, Isaac Barrow, John Wallis, Nicholas Saunderson, and Brook Taylor (of Taylor's theorem), also facsimiles of pages of "The Craft of Nombryng," Tonstall's "De Arte svppvtandi," Recorde's "Grovnd of Artes" and his "Whetstone of Witte," and the title-page of Digges and Son's "Stratioticos."

WHILE the late Captain Ferber was probably the first to consider lateral stability in applying the equations of rigid dynamics to the motions of aeroplanes, he unfortunately assumed that an aeroplane could be replaced by a system of three mutually orthogonal plane surface-elements, and it is greatly to be feared that the accident in which he lost his life may have arisen through the consequent misunderstanding of the problem. In the *Tôhoku Mathematical Journal*, ix., 4, Mr. Selig Brodetsky has now taken up the question as to how far it is possible, even on the simple "sine-law" hypothesis, to replace an aeroplane by three or more equivalent surfaces in three planes at right angles. The investigation leads to some exceedingly heavy algebra, which Mr. Brodetsky may claim to have worked out to the bitter end, with, briefly speaking, the following results:—(1) Except in the case of small divergences from a state of steady motion no such representation is possible; (2) in the case of small oscillations three planes are insufficient, but it is possible to represent the system by six surface-elements, namely, two in each of the three coordinate planes.

WHILE the claims of Napier as the discoverer of logarithms have received ample recognition in connection with the tercentenary celebration in 1914, it is interesting to notice that a system of logarithmic tables was invented and drawn up almost contemporaneously with Napier's work by Jost Bürgi, a Swiss. A brief note dealing with Bürgi's work is contributed to the *Mitteilungen der naturforschenden Gesellschaft in Bern* for 1914 (p. 318) by Dr. A. Bohren. Bürgi was born at Lichtenstein, in Toggenburg, about the year 1552, but of his early life little is known. He was originally a clockmaker by trade, but developed a talent for astronomical work, and, under the patronage at first of the Landgraf Wilhelm of Hesse, and later of Rudolf II. of Bohemia, he not only invented new astronomical instruments, but greatly assisted Kepler with his observations. His treatise on logarithmic methods described under the title "Arithmetical and Geometrical Progression-Tables" first saw the light in 1620, but it is certain that the tables were calculated and used by him long before that date, and their publication had been delayed by the war in Bohemia. Probably for the same reason the instructions which were to accompany the tables were never published, and in consequence they failed to come into general use. Both Bürgi and Napier built up their tables by forming successive positive integral powers of a number differing from unity by a very small decimal, but Bürgi's tables are based on the relations $x=10n$, and $y=10^8(1{\cdot}0001)^n$, while Napier calculated his logarithms from the successive powers of $1-10^{-7}$. It would thus appear probable that Bürgi was the first to use a base greater than unity, and so to obtain a scale more suitable for use with integral numbers. Whether Napier was acquainted with Bürgi's work is considered doubtful. Possibly Napier may have got the idea from Bürgi, and his choice of a system the base of which is less than unity may have been intended as an improvement to facilitate the use of the tables in trigonometry.

Circular No. 58 of the Bureau of Standards contains much valuable information as to the properties of invar and related nickel steels. Invar is a nickel steel containing about 36 per cent. of nickel, together with small amounts of carbon and manganese, and metallurgically negligible amounts of sulphur, phosphorus, and other elements. It melts sharply at about 1425° C. Above 200° C. to its melting point it may be considered to consist of a homogeneous solid solution of the above elements. Below 200° C., and at a temperature dependent on its history and exact composition, it undergoes a reversible transformation of such a nature that for any sample the transformation may be incomplete. This condition of thermochemical instability gives rise to both slowly and quickly changing values of its physical properties—changes which are particularly manifested in the expansion. It can be rolled, forged, turned, filed, and drawn into wires, and it takes a beautiful polish, giving an excellent surface on which fine lines may be ruled. It will withstand without spotting the corrosive action of water, even when immersed for several days. Its electrical resistivity is about eight times that of pure iron, and its temperature-coefficient of electrical resistance about 0·0012 per degree Centigrade. It is ferromagnetic, but becomes paramagnetic in the neighbourhood of 165° C. The mean coefficient of linear expansion between 0° and 40° C. is for ordinary invar of the order of one millionth, and samples have been prepared with even small negative coefficients; the amounts of carbon and manganese appear to exercise considerable influence on the expansion. Above 200° C. its expansion is nearly the same as that of ordinary Bessemer steel. It is subject to changes in length due to "after effects" following cooling from a high temperature, and even following slight alterations in temperature. A mathematical formula, $\Delta h/h = -0{\cdot}00325 \cdot 10^{-6}t^2$, holds for temperatures between 0° and 100° C.

The results of the measurements of the rate of vaporisation of platinum vessels raised to high temperatures which have been made at the U.S. Bureau of Standards by Messrs. Burgess and Waltenberg are given in Scientific Paper No. 280, recently issued by the bureau. At temperatures below 900° C. there is no appreciable vaporisation, whatever be the composition of the platinum alloy of which the vessel is made. At 1000° C., however, the loss from 100 sq. cm. of a vessel of pure platinum is 0·08, and at 1200° C. 0·81 milligram per hour. For an alloy containing 1 per cent. iridium the corresponding rates are at 1000° C. 0·30, and at 1200° C. 1·2 milligrams per hour. For a 2·5 per cent. iridium alloy they are at 1000° C. 0·57, and at 1200° C. 2·5 milligrams per hour. Rhodium alloys, on the contrary, vaporise at lower rates. For an 8 per cent. rhodium alloy the rates of loss are at 1000° C. 0·07, and at 1200° C. 0·54 milligram per hour.

Since the appearance three years ago of the last edition of Prof. G. Lunge's "The Manufacture of Sulphuric Acid and Alkali," vol. i., many additions to the subjects treated of have been made. To deal with the new developments, Prof. Lunge has prepared a supplementary volume, which Messrs. Gurney and Jackson announce for publication this autumn.

Mr. F. Edwards, of High Street, Marylebone, announces for early publication "The Fauna and Ethnology of New Guinea," being the official records of the collections formed by the British Ornithologists' Union Expedition, 1909–11, and the Wollaston Expedition, 1912–13, in Dutch New Guinea. The work will be in two volumes, and the edition limited to 150 copies.

OUR ASTRONOMICAL COLUMN.

The Astronomical Compass.—The utilisation of the heavenly bodies as a means of determining direction has attracted considerable attention since the outbreak of war, and various attempts to simplify the problem for general use have been made. Simplified azimuth tables, in conjunction with maps of the stars, have mostly been employed, but it is evident that such tables may be replaced by graphical projections of the circles of the celestial sphere. Under the title of the "Rev. William Hall's Visible Astronomical Compass," an arrangement for the direct solution of the chief problems depending upon the diurnal motion of the heavens has been published by Mr. J. D. Potter, 145 Minories, E.C. (price 1s. net, post free). A circle 6 in. in diameter, on a card 10 in. × 8 in., contains a stereographic projection on the plane of the horizon, for latitude 50° N., showing the circles of each even degree of declination, and hour circles at intervals of ten minutes. Circles of azimuth and altitude are not drawn, but the outer edge of the horizon circle is graduated for true bearings, and altitudes may be read off on a scale provided, after measurement with dividers along a travelling thread fixed at the zenith point. Given the time, or an approximate measurement of altitude, the bearing of any object is, of course, readily determined, and the "compass" can then be adjusted so as to show true directions. No new principle is involved, but the arrangement provides a stereographic projection in a convenient form, and the necessary instructions for its use are given. It should be understood, however, that a star map and an almanac are also requisite, and that some means of measuring altitudes would greatly extend the usefulness of the projection.

Effect of Haze on Solar Rotation Measures.—The extensive determinations of the sun's rotation which have been made by the spectroscopic method have shown remarkable variations, even among results obtained at the same observatory at different times. Thus the values for the equatorial velocity range from 1·86 to 2·11 km. per sec., and observers have not agreed as to the inequality of the values obtained from different lines at the same time. Again, while some observers have found values of the rate of rotation progressively increasing with the wave-length, many other observations have not shown this effect. A valuable contribution towards tracing the source of such discordances has been made by R. E. De Lury, of the Dominion Observatory, Ottawa, in a careful investigation of the effects of haze on the spectroscopic measurements (Journ. R.A.S. Canada, vol. x., p. 345). The effect of terrestrial atmospheric haze is obviously to superpose a weakened solar spectrum, coming mainly from the centre of the sun's disc and showing no displacements at all, upon the limb spectra. The measured displacements of the blended lines at the limb would then be too small, and would vary from line to line, according to the character of the line at the limb as compared with the centre. Correction for the haze effect can be made by correlating accurate determinations of the relative strengths of haze and limb spectrum with displacements of groups of lines of different intensities. Further investigations may be necessary, but Mr. De Lury appears to be already convinced that variations hitherto ascribed to the sun are mainly due to variations in haze.

The Masses of Visual Binary Stars.—Mr. R. T. A. Innes has been led to some remarkable conclusions by a discussion of data relating to binary stars (*South African Journ. Sci.*, vol. xii., p. 453). All close pairs of stars, with few exceptions, are apparently to be regarded as binaries, whether they show relative motion or not. On the assumption that a binary has the same brightness as the sun, Mr. Innes calculates its distance from the apparent magnitude, and thence the mass, if the period be known. When no orbit has been computed, he proceeds in a similar manner, and calculates the annual angular motion at the distance of the companion which would be produced if the primary had the same mass as the sun. The calculated motion is mostly much in excess of that observed, and Mr. Innes concludes that very few double stars have a mass, or "gravitative power," as he prefers to call it, equal to that of the sun. He has been led to suppose that gravitative power is small in stars of types B and A, moderate in F, and large in G and K stars; in types Oe and M it appears to be absent altogether. The A type is considered to be poorly represented among binaries, because stars of this class have but little effective gravitative power, notwithstanding their great brilliancy. There appears to be a limiting distance below which double stars cannot exist, and for solar-type stars this is apparently about five times the earth's distance from the sun. It is suggested that light-pressure may partly or wholly neutralise gravitative power in stars of small density and great luminosity.

MUTATION AND EVOLUTION.

PROF. ARTHUR DENDY'S presidential address, delivered in February last, before the members of the Quekett Microscopical Club appears in the journal of the club for April, and will probably be much discussed, inasmuch as it is devoted to an analysis of the relation of mutation to the evolution theory, the arguments being based on data drawn from the sponges. The phenomena of mutation, it is contended, is more a chemico-physical than a biological phenomenon. Mutations, such as are observable in sponge spicules, in his opinion, strongly suggest the existence of definite factors in the germ plasm. The factorial hypothesis, he considers, is further supported by evidence which is accumulating as to the general course of evolution followed by the Tetraxonida. On the whole this evolution seems to have been progressive, accompanied by increasing complexity of structure, manifested especially in the skeleton. Along certain lines of descent, however, it appears that the culminating point has been passed, and regressive evolution is taking place, resulting in simplification of structure, by the dropping out of certain types of spicule. This loss cannot be regarded as an adaptive modification, nor can it be explained as due to mechanical necessities. Prof. Dendy concludes, therefore, that it is due to some change in the germ-plasm, affecting the power of the sponge to produce the particular spicules in question.

How can we reconcile these facts, it is asked, with the belief that evolution has taken place, in the main, by slow, successive modifications, rather than by sudden mutations? The conception of factors is intimately bound up with that of mutations, and the existence of the one would seem to imply the occurrence of the other.

As to which set of characters is to be regarded as the more important from the point of view of the student of progressive evolution Prof. Dendy holds there can be little doubt, but how far the division into adaptive and non-adaptive corresponds to the distinction between fluctuating variation and mutation is a different question. Certainly the chances are greatly against a mutation, when it first appears, having any adaptive significance. The evidence seems to him to show that the slow, successive variations of the Darwinian theory have had far more to do with the evolution of sponges than the process of mutation, and are mainly responsible, under the guidance of natural selection, for adaptive modifications.

It is not easy to follow Prof. Dendy in his attempt to discriminate between, and apportion the value of, adaptive and non-adaptive characters. It would seem, however, that he would regard the former as directly affecting viability, in proportion to their responsiveness to the demands of natural selection. They are characters which are of necessity immediately and continuously functional. The latter seem to be regarded as accretions or fortuitous variations, tolerated until they acquire survival value—that is to say, until they come under the sway of natural selection. If this is so, then all non-adaptive characters are potentially adaptive. They afford the basis for further evolutionary phases, or, in other words, the material which will determine the trend of future development and the fate of the organism for good or ill.

W. P. P.

SOME PROBLEMS IN EUGENICS.

STUDENTS of human heredity from the sociological point of view are indebted to the American Eugenics Record Office (Long Island, N.Y.). Its last-issued Bulletin (No. 15) contains the study of a family indicated by the pseudonym of "Dack," showing markedly a "hereditary lack of emotional control." The author of the bulletin is Mrs. A. W. Finlayson, and Prof. C. B. Davenport contributes a preface in which he emphasises the importance of such "eugenics field-work." Mrs. Finlayson has collected data with regard to 150 descendants of the pair of "Dacks" who emigrated from Ireland to Pennsylvania in 1815, three generations being passed under review. Forty individuals are not recorded to have shown anti-social traits, but the remainder all failed in self-control, many being dishonest, and tending to alcoholism, or to profligacy, forty-one of these being "obviously a burden to society." These objectionable features were most pronounced in the case of offspring of a marriage of first cousins; Prof. Davenport's conclusion that violence of temper is a "dominant" character is confirmed, as in this family it was not found to "skip a generation." Most thoughtful readers of the bulletin will agree with the suggestion at the end of the preface that "unless society steps in and trains the trainable and segregates the uncontrollable, things will go from bad to worse."

Human endowments of a more pleasing kind are discussed by Dr. H. Drinkwater in a paper entitled "Inheritance of Artistic and Musical Ability," published in the last number of the *Journal of Genetics* (v., No. 4). He gives pedigrees—extending in some cases over four generations—of several families of artists and musicians, which indicate that where both parents are talented all the children inherit the talent, while a non-artistic or non-musical pair never have talented offspring. Hence he infers that artistic or musical ability is a recessive Mendelian character. When only one parent is musical, the number of children showing the recessive character may be more than the 50 per cent. required by the theory, but the records are too few for this to be regarded as a fatal difficulty to Dr. Drinkwater's interpretation. It will, however, be surprising if further research confirms the view that the complex nervous specialisation which must be supposed to accompany marked artistic or musical ability is determined by a simple genetic factor comparable with that which settles the colour of the eyes.

To the Journal of the Royal Statistical Society (vol. lxxix., part 2) Major Leonard Darwin contributes a paper on the inquiries needed after the war in connection with eugenics. He dwells on the selection of the best men generally for the fighting-line, shows that a higher death-rate may be expected to affect the more daring and self-sacrificing, and points out the meaning for the nation's future of the abnormally heavy losses among officers. His plea for a full investigation of the problem and of possible remedial measures may meet with a disappointing response, but nobody can read his paper and the report of the subsequent discussion—especially after studying the American bulletin summarised above—without realising the "reversed selective action" of the present world-conflict, and perceiving how absolutely opposed to the biological principles enunciated by Major Darwin's great father are those modern "people that delight in war."

G. H. C.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION C.

GEOLOGY.

OPENING ADDRESS (ABRIDGED) BY PROF. W. S. BOULTON, D.Sc., F.G.S., PRESIDENT OF THE SECTION.

IF we attempt to compare the growth of applied geology in Britain with that, say, in the United States of America, or even in our great self-governing Dominions, or to appraise the knowledge of, and respect for, the facts and principles of geology as directly applicable to industry in these countries and in our own, or to compare the respective literatures on the subject, I think we shall have to confess that we have lagged far behind the position we ought by right of tradition and opportunities now to occupy. The vast natural resources of the countries I have named have doubtless stimulated a corresponding effort in their profitable development. But making due allowance for the fact that Britain is industrially mature as compared with these youthful communities, we cannot doubt that in this special branch of geology, however splendid our advances in others, we have been outstripped by our kinsmen abroad.

To attempt an explanation of this comparative failure to apply effectively the resources of geology to practical affairs would demand a critical analysis of the whole position of science in relation to industry and education which is being so vigorously debated by public men to-day. It is unquestionably due, in no small measure, to our ignorance and neglect of, and consequent indifference to, science in general, more especially on the part of our governing classes. This war, with all its material waste and mental anguish, may bring at least some compensation if it finally rouses us from complacence and teaches us to utilise more fully the highly trained and specialised intelligence of the nation.

Here I digress for a moment to lay stress upon a great and needless loss of valuable and detailed knowledge of our Coal Measure geology. It is well known that the Home Office Regulations demand that plans of workings in the different seams at a colliery shall be made and maintained by the colliery officials; and that on the abandonment of the mine copies of such plans shall be kept at the Mines Department of the Home Office for future reference. For ten years, however, they are regarded as confidential. Such information is recorded primarily with a view to the prevention of accidents due to inrushes of water and accumulations of gas.

Unfortunately, as mining men can testify, the plans are often woefully incomplete, inaccurate, and positively misleading as regards such features as faults, rolls, wash-outs, and so forth, and this is notoriously so along the margin of the plans where workings have been abandoned. Cases have been brought to my notice where plans of old workings have been consulted when adjacent ground was about to be explored, and afterwards the plans have proved to be grossly inaccurate, with the consequent risk of serious economic waste. I believe this unfortunate state of things is partly the effect of the complete official severance of the Geological Survey and the Mines Department of the Home Office. When the Geological Survey was first established, and for many years afterwards, a Mining Record Office for the collection and registration of all plans relating to mining operations was attached to it; but afterwards the Mining Record Office was transferred to the Home Office.

I would suggest that it ought to be made possible for all mining plans to be periodically inspected by Government officials with geological knowledge, not merely after the plans are deposited in a Government office, but during the working of the mine; so that, if desirable or necessary, the geological facts indicated by the mine-surveyor on the plan can be tested and verified. If accurate and properly attested plans of old workings were always available, the opening up of new ground would be greatly facilitated and much waste of time and money would be avoided.

Need for Systematic Survey by Deep Borings.

When we turn our attention to the possible extension of the Coal Measures under the newer strata of South-Central England, the geological data at our disposal are lamentably and surprisingly few. Notwithstanding our eagerness to unravel the difficulties, and so to open up new fields for mining activity, very little positive progress has been made in the last twenty years. Of late a few deep borings have been sunk; one near High Wycombe, after piercing the Mesozoic cover, ended in Ludlow rocks; another at Batsford, in Gloucestershire, fifteen miles north of the well-known Burford boring, struck what are regarded as Upper Coal Measures, also resting on Silurian rocks.

At the present time it seems specially fitting to direct attention once again to our haphazard method of grappling with this great economic question. Are we to go on indefinitely pursuing what is almost "wild-cat" boring, to use the petroleum miner's expressive slang? Or shall we boldly face the fact that systematic exploration is demanded; and that this pioneer work is a national obligation, the expense of which should be a national charge?

At a meeting of the Organising Committee of Section C a recommendation was forwarded to the council in the following terms:—

"The council of the British Association for the Advancement of Science recommends that the site, depth, and diameter of every borehole in the British Isles exceeding 500 ft. in depth be compulsorily notified and registered in a Government office. That all such boreholes be open to Government inspection during their progress. That copies of the journals and other information relating to the strata penetrated by the boring be filed in a Government office under the same restrictions as those relating to plans of abandoned mines."

I would go further and urge that the Government should undertake the sinking of deep borings at selected points. This is no new idea. In his presidential address to the Geological Society of London in 1912 Prof. Watts pleaded most forcibly the vital importance of a State-aided underground survey of the area to which I have referred. The work is too vast for individual effort, or even for a private company to undertake. It is not suggested that deep borings should be sunk with the express purpose of finding coal. What is wanted is a systematic survey by borings at such spots as are likely to throw light upon the structural framework of the Palæozoic floor and the thickness of its cover.

Of course, there are difficulties in the way of such a scheme. There is the expense. But in view of the enormous economic possibilities of the work, and remembering that it is now possible to sink a boring to a depth of, say, 1200 ft., and to bring up 18-in. cores at a cost less than 2000*l*., it cannot be reasonably argued that the expense is beyond the nation's power to bear. A levy of a farthing a ton on the coal output of the United Kingdom for a single year would yield something like 300,000*l*., a capital sum that would provide in perpetuity an additional yearly grant to the Geological Survey of 15,000*l*., which would suffice not only to carry on this work, but would enable the Survey to extend its functions in the other directions I have indicated.

As to legal obstacles and vested mineral rights, I wish to say nothing except that if the country could be convinced that this work is urgently needed on national grounds, all scruples and doubts, so agitating to the official mind, would speedily vanish.

For many years I lived near our great exporting centres of the finest steam coal in the world, and as I watched the steady and incessant streams of coal-waggons, year in, year out, coming down from the hills, I was constantly reminded that we are rapidly draining the country of its industrial life-blood. Is it an extravagant demand to ask that an infinitesimal fraction of this irreplaceable Nature-made wealth should be set aside to provide the means for the discovery and development in our islands of new mineral fields?

Chemical and Microscopical Investigation of Coal Seams.

The recovery of by-products in the coking of coal, which up to the beginning of the war was almost exclusively undertaken by the Germans, is likely in the future to become an important British industry. This will ultimately demand a thorough knowledge of the microscopic and chemical structure of all the important coking seams in our coalfields.

Remembering how varied both in microscopical structure and chemical composition the individual laminæ of many of the thick coal-seams are, it will readily appear how important such a detailed investigation may become, having regard to the great variety of these by-products and their industrial application. Moreover, thin seams, hitherto discarded, may pay to be worked, as may also an enormous amount of small coal, estimated at from 10 to 20 per cent. of the total output, which up to the present has been wasted.

Geology of Petroleum.

It has been frequently remarked that in order to account for the vast accumulation of coal in the Carboniferous strata, it is necessary to postulate a special coincidence over great areas of the northern hemisphere of favourable conditions of plant growth, climate, sedimentation, and crustal subsidence, conditions which, although they obtained at other geological periods over relatively small areas, were never repeated on so vast a scale. Having regard to the estimates of coal deposits in Cretaceous and Tertiary strata, published in our first international Coal Census, the "Report on the Coal Resources of the World,"[1] it would appear that we might reasonably link the Cretaceo-Tertiary period with the Carboniferous in respect of these peculiar and widely prevalent coal-making conditions. For I find that of the actual and probable reserves of coal in the world, according to our present state of knowledge, about $4\frac{1}{2}$ million million tons of bituminous and anthracite coal exist, the vast bulk of which is of Carboniferous age; while there are about 3 million million tons of lignites and sub-bituminous coals, mostly of Cretaceous and Tertiary age.

When we look to the geological distribution of petroleum, we note that it is to be found in rocks of practically every age in more or less quantity, but that it occurs *par excellence*, and on a great commercial scale, in rocks of two geological periods (to a smaller extent in a third); and it is significant that these two periods are the great coal-making periods in geological history—the Carboniferous and the Cretaceo-Tertiary. It would take me beyond my present purpose to explore the avenues of thought and speculation opened up by this parallel. I will only remark that it seems to afford some support for the view that coal and petroleum are genetically as well as chemically related. While the terrestrial vegetation of the two periods was accumulating under specially favourable physiographical conditions, ultimately to be mineralised into seams of coal, the stores of petroleum believed to be indigenous to strata of the same periods were probably derived from the natural distillation of the plankton which must have flourished, too, on an enormous scale in the shallow, muddy waters adjacent to this luxuriant land growth. The phytoplankton, including such families as the Diatomaceæ and Peridiniæ, may well have played the chief *rôle* in this petroleum formation, while affording unlimited sustenance to the small and lowly animal organisms, like Entomostraca, the fatty distillates of which doubtless contributed to the stores of oil. It is possible, then,

[1] Report on "The Coal Resources of the World" for the Twelfth Intern Geol. Congress, 1913.

that a prodigious development of a new and vigorous flora during both periods—the spore-bearing flora, in the main, of the Carboniferous, and the seed-bearing flora of the Cretaceo-Tertiary period—was the chief contributory factor in the making of the world's vast store of solid and liquid fuel. It contributed directly by supplying the vegetable matter for the coal, and indirectly by stimulating the development of a prolific plankton, from which the oil has been distilled.

The world's production of petroleum has trebled itself within the last fifteen years. In 1914 the United States of America produced 66·36 per cent., and North and South America together nearly three-fourths of the world's total yield; while the British Empire (including Egypt) produced only a little more than 2 per cent. In the near future Canada is likely to take its place as a great oil- and gas-producing country, for large areas in the Middle-West show promising indications of a greatly increased yield. But Mexico is undoubtedly the country of greatest potential output. Its Cretaceous and Tertiary strata along the Gulf Coastal Plain are so rich that it has been stated recently on high authority that "a dozen wells in Mexico, if opened to their full capacity, could almost double the daily output of the world."[2]

As is well known, natural supplies of petroleum are not found in the British Isles on a commercial scale; but for many years oil and other valuable products have been obtained from the destructive distillation of the Oil Shales of the Lothians. If Mr. Cunningham Craig is right in his views recently expressed,[3] these shales, or, rather, their associated freestones, have been nearer to being true petroliferous rocks than we thought; for he believes that the small yellow bodies, the so-called "spores" in the kerogen shales, are really small masses of inspissated petroleum, adsorbed from the porous and once petroliferous sandstones with which the shales are interstratified.

If recent experiments on peat fulfil the promise they undoubtedly show, we shall have to take careful stock of the peat-bogs in these islands. It is well known that peat fuel has been manufactured in Europe for many years. But my attention has been called to a process for the extraction of fuel-oil from peat which has been tried experimentally in London, and is now about to be launched on a commercial scale, utilising our own peat deposits, like those of Lanarkshire and Yorkshire.

The peat is submitted to low-temperature distillation at ordinary pressure, or at a slight negative pressure, the highest temperature reached being about 600° C. From a ton of Lanarkshire peat, after the moisture is reduced to 25 per cent., 40 gallons of crude oil, 18 to 20 lb. of ammonium sulphate, about the same quantity of paraffin wax, 30 to 33 per cent. of coke, and 5000 to 6000 cubic ft. of combustible gas are obtained. The coke is said to be of very good quality. By the same process it is hoped to get satisfactory results from the lignites of Bovey Tracey.

Considering the rapid development of oil as fuel, and its supreme industrial importance in many other ways, it is remarkable that British geologists should have given such little attention to the *origin and occurrence of petroleum*. Among American geologists a lively interest in this subject has been aroused and a voluminous technical literature is already published. And yet the fact remains that we are still in a cloud of uncertainty as to this vital question, upon the solution of which depends whether the prospector of the future is to work by hazard or on scientific and reasoned lines.

Mr. Murray Stuart, now of the Indian Geological Survey, offered in 1910[4] a simple explanation of the occurrence of petroleum, based upon his own observations in Burma, a research which seems to have attracted far more attention in America than in this country. He showed that the oil of the streams and swamps in Burma is carried down to the bottom of the water in small globules by adhering tiny particles of mud. Thus there is formed a deposit of mud containing globules of oil and saturated with water. If afterwards this deposit is covered by a bed of sand, the oil and part of the water, as the pressure of overlying sediment increases, are squeezed into the sand, so that by a repetition of the process a petroliferous series of clays and sands may be accumulated. In examining lately a large quantity of the well-known "landscape marble" from the Rhætic of Bristol, I obtained from it small but appreciable amounts of petroleum; and towards the end of my investigation I was pleased to discover that I was in thorough agreement as to the origin of this curious landscape structure with Mr. Beeby Thompson, whose research was published more than twenty years ago.[5] In these thin deposits of hydrocarbons among laminated silts, with their striking tree-like growths and hummocky surfaces, may we not have, in miniature, an illustration of the deposition and partial migration of petroleum which occurs on so vast a scale in the oilfields of the world?

It is not suggested that all petroleum deposits have had such an origin. I am convinced, however, that in all geological ages such sedimentary accumulations have occurred; and that, except where the conditions of cover have been favourable for its imprisonment, the oil is, and has been throughout geological time, incessantly escaping at the surface. Thus we may conceive the earth as continuously sweating out these stores of oil, either in the liquid or gaseous form, especially where rocks are being folded and rapidly denuded.

It is sometimes asked whether the adoption of mineral oil as a power-producer is likely to supplant coal, and thereby seriously reduce the output of that mineral. The world's yield of petroleum will doubtless go on increasing at a very great rate; but from the experience gained in some of the fields in the United States and eastern Canada, it seems unlikely that this increase can continue for a very long period. Practically complete exhaustion of the world's supply is to be looked for within 100 years, says one authority.[6] Even if the output rose to ten times the present yield, it would represent only about half the present world output of coal, and it is practically certain that so high a yield of oil could not be maintained for many years. Owing to the almost certain rapid increase in the output of coal, estimates made by the same authority indicate that the total production of petroleum could never reduce the world's output of coal by more than about 6½ per cent.[7]

For us, and probably for those of the next generation, the geology of petroleum will continue to be of immense practical importance; but coal will doubtless remain our great ultimate source of power.

An obligation rests upon us to see that the oil resources of the British Empire and of territories within our influence are explored, if possible by British geologists, with all the special knowledge that can be brought to bear; and I am glad to think that the University of Birmingham and the Imperial College of Science and Technology, London, with this end in view, are doing pioneer work in giving a systematic and specialised training to our young petroleum technologists.

2 Ralph Arnold, "Conservation of the Oil and Gas Resources of the Americas," *Econ. Geol.*, vol. xi., No. 3, 1916, p. 222.

3 Institution of Petroleum Technologists, April, 1916.

4 "Rec. Geol. Surv. India," vol. xl., 1910, pp. 320–33: "The Sedimentary Deposition of Oil."

5 Q.J.G.S., 1894, pp. 393–410.

6 H. S. Jevons, "British Coal Trade," 1915, p. 710.

7 *Ibid.*, p. 716.

Organisation of Expert Knowledge.

We are reminded by the report of a Royal Commission—that on Coast Erosion in 1911—that systematic observations and the collation and organisation of geological and engineering knowledge are urgently needed in connection with the protection of our coasts and the reclamation of new lands. For it will be remembered that the Commission found that during the last thirty-five years the gain of land, as shown by Ordnance Survey maps, has been more than seven times the loss by erosion.

Here, again, the British Association may reflect with pride that it paved the way for this national inquiry. For many years its Committee on Coast Erosion gathered and collated evidence on erosion, and induced the Admiralty to instruct the coastguard to observe and report upon changes that take place from time to time.

After recommending "that the Board of Trade should be constituted the Central Sea-Defence Authority for the United Kingdom for the purpose of the administration of the coast-line in the interest of sea defence," the Commissioners go on to urge that "that Department should have the assistance of scientific experts to collate information and to secure systematic observations with regard to questions such as the changes taking place below the level of low water, the travel of materials in deep water, the movements of outlying sandbanks, etc., which are continually happening on the coasts of the kingdom, and with regard to which the information at present is scanty and vague."[8]

In economic geology, as in the case of other applied sciences, we must rely in the future less upon chance individual effort and initiative. We must concentrate, centralise, and organise; and at every stage we shall need expert control and advice as regards those larger scientific issues of national importance which have a direct practical bearing.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The annual report of the Department of Coal, Gas, and Fuel Industries, of which Prof. J. W. Cobb occupies the chair as Livesey professor, has just been issued by the University. It begins with a reference to the number of students who have entered the Army or are connected with the war work of the department, and also to the election of candidates to the recently founded Corbet-Woodall scholarship and Arthur Walker exhibition. Courses of lectures, which have been given in the past by specialists connected with the gas and fuel industries, have had to be restricted owing to the demands made by the war upon the lecturers. The research work of the department during the year includes two important publications. The Ventilation Research Committee, representing the Institution of Gas Engineers, has issued its third report. The work has been carried out, as before, by Mr. W. Harrison, who has made a careful and interesting study of causes of down-draughts, the effect of ventilating burners, etc. The second research, by Prof. Cobb and Mr. H. Hollings, on "Thermal Phenomena in Carbonisation," was read before the Institution of Gas Engineers in June last. The other work of the department has been mainly on behalf of the Ministry of Munitions and the Royal Society War Committee.

THE chemical courses of the Finsbury Technical College, which commenced on Tuesday, October 3, are undergoing modification and extension in order to cope with the increased demand for chemists trained to take up industrial posts. Commencing at first with a two-year curriculum, the courses have in recent years been extended over a period of three years, and in many instances students have, with profit to themselves, continued their advanced studies into a fourth year and even longer. If the renascence of British chemical industry is to be fruitful, there will not only be a demand for more chemists, but it will be essential that these newcomers should be better trained than their predecessors. The Executive Committee of the City and Guilds of London Institute has placed at the disposal of the chemical department of the Finsbury college a new suite of rooms, to be fitted as advanced laboratories of applied chemistry. The work of adaptation is in full progress, and the laboratories will be sufficiently ready for advanced students early in the new year. The installation of technical appliances is being extended, partly by purchase and partly by construction in the chemical department. Factory methods of conducting filtration, evaporation, distillation, desiccation, heating under pressure, and other generalised processes will be studied, and the possession of this plant and apparatus will render possible the execution of industrial researches in many branches of inorganic and organic chemistry, as, for example, the extraction of metals, preparation of alloys, cements, glazes, porcelains, glass, enamels, pigments, synthetic dyes, artificial perfumes, and pharmaceutical products. One gratifying feature of this development is the fact that the effort to develop along industrial lines is so far appreciated by certain firms that they have assisted by gifts of plant and chemicals.

IN a pamphlet of thirty-six pages, entitled "Scientific Method in Schools" (Cambridge University Press, price 1s.) Mr. W. H. S. Jones, senior classical master at the Perse School, has put forward some well-timed suggestions upon a subject now universally admitted to be of first-rate importance. Starting from the assumptions (1) that all subjects, in different ways and to different degrees, can be made to give a training in scientific method, and (2) that the scientific training even of the future researcher in physics or chemistry will be more effective if it is not confined to his special subject, but rests on a broad foundation, he puts forward the thesis that "whatever subjects are included in the curriculum, each one should contribute its quota to a comprehensive scheme of scientific method." He does not demand a strict "heuristic" treatment of every subject, but maintains that in lessons occurring regularly "once a week or once a fortnight in each subject," the pupil should be confronted with problems to be attacked by strict application of the methods of deduction and induction—particularly the latter—and should be taught to be constantly conscious of the necessity of working according to fixed laws. Mr. Jones introduces his proposals by quotations from Cicero and Charles Lamb, but does not show whether he is aware how entirely they are congruent with the results of the best relevant psychological researches of the present day. Be that as it may, the practical teacher will be more directly interested in the eleven detailed examples, drawn from courses in languages, history, geography, biology, and mechanics, which the author gives in illustration of his thesis. Of these, some represent the joint work of master and class, some the unaided work of schoolboys or undergraduates. It would be unreasonable to expect them to be proof against criticism (indeed, Mr. Jones disclaims any intention of offering them as models), but all will be found interesting and instructive as exemplifying a method of procedure of the general soundness and importance of which there can be no doubt.

[8] Royal Commission on Coast Erosion, etc., 1911. Third (and Final) Report, pp. 160–61.

On Monday, October 2, her Majesty the Queen opened the extension of the science laboratories of the London Royal Free Hospital School of Medicine for Women. The ceremony took place in the anatomical department, where more than 600 guests were accommodated. The Queen was addressed by the dean of the school, Miss Aldrich Blake, M.D., who gave a brief account of the school, comparing its position in 1874, when it was founded by Dr. Sophia Jex-Blake, with a total of fourteen students, and its present condition, with splendidly equipped laboratories and more than 400 students; by Dr. Winifred Cullis (lecturer in physiology), who thanked the Queen for the interest she had shown in the work and education of medical women, and all those who by their help had made it possible to carry out this much-needed extension; and by the chairman of the council, who, having handed to the Queen a key presented by the architects, asked her to open the extension. After the Queen had declared it open, her Majesty made a tour of the new laboratories. The extension which has now been carried out was planned and arranged for before the war, owing to the steadily increasing annual entry of students. When war broke out it was for a time uncertain whether the extension should be proceeded with, but the number of students entering the school in 1914 was so great that there was no alternative. Consequently an appeal for 30,000*l.* was issued, the appeal was generously responded to, and within seventeen months the whole sum was obtained. On the top floor the whole extension is given to the anatomical department, which now has one of the finest dissecting rooms in the country (an excellently lighted room, 140 ft. in length), private rooms, demonstration room, preparation rooms, and mortuary. The next floor is given to the physiological department, and the extension provides an advanced laboratory, demonstration theatre, dark-room, storeroom, and private and research rooms. In the floor below is an extension of the chemical department, adding to it an organic laboratory, balance room, and private and research rooms; on this floor is found also a students' union room. Below this is the extension of the physics laboratory, including lecture room, dark-rooms, and research room, and also some laboratories for pathological research.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, September 18.—M. Camille Jordan in the chair.—A. **Lacroix**: The riebeckite syenites of Alter Pedroso (Portugal), their mesocrate forms (lusitanites), and their transformation into leptynites and into gneiss.—E. **Picard**: Certain subgroups of the hyperfuchsian groups, corresponding with certain ternary quadratic forms.—E. **Esclangon**: Doppler's principle and the whistling of projectiles.—H. **Bordier**: The action of the X-rays upon iodine and iodide of starch in aqueous solution. The solutions are decolorised, a few minutes' exposure to the X-rays giving the same effect as several hours' exposure to ultra-violet light.—M. **Mauger**: The minettes of Jersey.—Ph. **Flajolet**: The perturbations of the magnetic declination at Lyons (Saint-Genis-Laval) during the first quarter of 1916.

BOOKS RECEIVED.

Science from an Easy Chair. By Sir Ray Lankester. Pp. xii+292. (London: Methuen and Co., Ltd.) 1*s.* net.

Doctors at War. By J. W. Barlow. Pp. 144. (London: D. Nutt.) 2*s.* 6*d.* net.

Evolution by Means of Hybridization. By J. P. Lotsy. Pp. viii+166. (The Hague: M. Nijhoff.) 6*s.* net.

History of Manufactures in the United States, 1607–1860. By V. S. Clark. Pp. xii+675. (Washington: Carnegie Institution.)

The Classics of International Law:—

Le Droit des Gens. By E. de Vattel. 3 vols. (1) Photographic Reproduction of Books I. and II. of the First Edition (1758), with Introduction by Albert de Lapradelle. Pp. 600. (2) Photographic Reproduction of Books III. and IV. of the First Edition (1758). Pp. 375. (3) Translation of Edition of 1758 (by Charles G. Fenwick), with translation (by G. D. Gregory) of Introduction by A. de Lapradelle. Pp. 486. (Washington: Carnegie Institution.) 8 dollars.

De Jure Naturæ et Gentium Dissertationes. By S. Rachel. 2 vols. (1) Reproduction of Edition of 1676, Introduction by L. von Bar, and List of Errata. Pp. 361. (2) Translation of the Text, by J. P. Bate, with Index of Authors Cited. Pp. 255. (Washington: Carnegie Institution.) 4 dollars.

British Rainfall, 1915. By H. R. Mill and C. Salter. Pp. 288. (London: E. Stanford, Ltd.) 10*s.*

Illustrations of the British Flora. By W. H. Fitch and W. G. Smith. Fourth, revised, edition. Pp. xvi+338. (London: L. Reeve and Co., Ltd.) 9*s.* net.

Results of Meteorological Observations in the Five Years 1911–15; also of Underground Temperatures in the Twelve Years 1898–1910, made at the Radcliffe Observatory, Oxford. Vol. li. Pp. xv+215. (Oxford: H. Milford.)

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BRITISH FORESTRY.

British Forestry: Its Present Position and Outlook after the War. By E. P. Stebbing. Pp. xxv + 257. (London: John Murray, 1916.) Price 6*s*. net.

THIS book, by the Lecturer in Forestry at Edinburgh University, is a study of the various problems which are involved in making provision for adequate supplies of timber after the war. In time of peace we were dependent on foreign countries for the great bulk of the timber, paper pulp, and other forest products which we consumed, the annual import into the United Kingdom being valued at no less than 43,000,000*l*. in 1913. During the war, owing to cessation of exports from the Baltic and lack of shipping generally, our supplies of timber have been much curtailed, although our need is now greater than ever. The trenches, railways, and other military works at the front have used up vast quantities of timber; while our collieries and mines have not abated their demand for pitwood. We have been forced to draw largely on our own woodlands, which are rapidly being felled under the auspices of the Home-grown Timber Committee, appointed by Government some months ago. The preservation and restoration of the existing woodland area call for immediate consideration.

Mr. Stebbing's remedy, which is developed in some fifty pages, is a national planting scheme to be taken in hand immediately. The recommendations of the various Government Committees and Commissions on Forestry since 1887 are shown to have had little effect. With regard to the existing woodland area, Mr. Stebbing demands that "all woods purchased and felled by Government at the present high rates should be at once replanted by the owner, as a condition of the contract." His planting scheme includes, in addition to the renovation of the woods that are now being denuded, the planting of 5,000,000 acres of wasteland, the whole to be carried out in thirty-two years, roughly equivalent to the taking in hand yearly of about 200,000 acres. A planting plan should be drawn up, county by county, under which the felled-over areas, the woods consisting mainly of useless scrub, and the most accessible of the wastelands would be selected and the order of planting laid down. The land might be acquired in many cases by lease or purchase. In other cases the Government, going into partnership with the landowner, might provide the money for planting and fencing up to a prescribed sum per acre. Compulsory powers to purchase wasteland, and enforced management of privately owned woods, according to plans approved by a State Forestry Board, though necessary if great progress in forestry is aimed at, are not distinctly advocated in this book.

The question of labour is discussed at length, two chapters being devoted to the employment of women, whose services might be useful in forest nurseries. At the end of the war partially disabled soldiers and sailors will be available, as well as a large number of ordinary labourers. The work could be commenced immediately by utilising the expert woodmen from among our prisoners; and thousands of acres of our denuded woods could be replanted during the coming winter.

Mr. Stebbing has made a special study of the timber trade and forests of Russia, Finland, and Siberia, and devotes a hundred pages to this subject. The immense supplies of timber available in this vast territory are of great importance to the Allies, in view of the reconstruction necessary at the end of the war in the devastated districts of Belgium, France, Serbia, and Poland. Mr. Stebbing urges the British Government to lease large areas in the Crown forests of Russia, which we could work in the period following the war, and thus obtain what timber we require at a reasonable cost. This measure would seem to be of doubtful utility, as it is probable that all the accessible forests (those near rivers where timber can be felled profitably) are already taken up.

CHEMICAL WATER PURIFICATION.

Water-Purification Plants and their Operation. By M. F. Stein. Pp. viii + 258. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 10*s*. 6*d*. net.

THIS volume is another addition to the already large number of books on water purification coming from the United States; and while, perhaps, the subject is not treated in quite such a scientific manner as in some of the others, there is a quantity of concise information useful to one who is in charge of a modern water-purification plant, and particularly of one where chemicals are used.

To anyone acquainted with methods of water purification as usually practised in this country the book will show vividly the wide differences existing not merely between the problems that present themselves to water undertakers in Britain and America, but still more their different methods of dealing with them. In this country slow sand filtration, usually preceded by more or less lengthy storage, is the general rule, while in America the usual methods appear to be rapid mechanical filtration after the addition of chemicals for coagulating, sterilising, or softening purposes. This is probably due to the fact that to a large extent the water used in the United States is derived from the great rivers and lakes, and is often very turbid and sometimes highly polluted, whilst over here many of the large towns obtain their supplies from upland gathering grounds, where the water is impounded in large lakes or reservoirs away from any chance of serious pollution, and only a comparatively few towns are supplied from polluted rivers. Another reason may be that in this country there is still a popular prejudice against the chemical treatment of a drinking water which is probably not nearly so marked in America.

As is usual with works on water purification, the book opens with a chapter dealing with the sources of supply and impurities likely to be found in water from different sources. The next chapter, and by far the longest, deals with types of purification plants, and describes in some detail the works of several large American cities, which may be taken as typical of the others.

Chapters follow on physical and chemical tests, bacterial tests, and the interpretation of these tests. In these chapters the author goes into very minute detail on the methods of carrying out these tests. It is worthy of note that no mention is made of chemical tests for organic impurities, the author confining his attention to tests for such substances as affect the dose of chemicals to be added—*e.g.* alkalinity and CO_2—and the estimation of any excess of the chemicals added. This is certainly at variance with the usual practice of English water analysts. Another point is the method suggested for the detection of *B. coli* in water, which is quite different from that usually adopted in this country, and scarcely seems to be capable of being used with any great degree of certainty, depending as it does on the relative proportions of CO_2 and hydrogen formed by the fermentation of dextrose broth. One cannot but feel that it is not altogether desirable that persons other than qualified chemists and bacteriologists should be entrusted with the carrying out of these tests on water, especially when, as in this case, the descriptions are given by an engineer.

The best part of the book is what follows in chapters dealing with coagulation and sterilisation, water softening, and sedimentation. These subjects are clearly and fully treated, and the chapters contain a host of valuable information.

The last chapter consists of notes on filtration and general operation. Next follow some very ingenious charts for computing the results of analyses and the amounts of chemicals required according to the analysis of the water. These charts, however, are on rather too small a scale to be of much practical use. The work concludes with appendices dealing with the analysis of coagulants, standard solutions, specifications for coagulants, and one or two useful tables.

The book is decidedly limited in its scope, and deals with only a few of the modern methods of purification, and, indeed, entirely omits to mention several important processes introduced in this country during the last decade. For example, no mention is made of either Houston's Excess Lime method of sterilisation and softening or the use of such substances as Permutit.

The volume is clearly printed and profusely illustrated with diagrams and photographs.

DENISON B. BYLES.

THEORY AND EXPERIMENT.

A Text-Book of Practical Physics. By Dr. H. S. Allen and H. Moore. Pp. xv+622. (London: Macmillan and Co., Ltd., 1916.) Price 8*s*. 6*d*. net.

THE distrust which the "practical man" feels for science is well known, and it must be confessed that he is by no means alone to blame for his attitude in the matter. The fault lies to some extent with the teacher of science, who too often lays undue stress on the theory, and, if an experiment which is supposed to illustrate the theory does so but indifferently, the student is apt to get the impression that theory and fact are somewhat distantly related. For example, a student who, having been rashly told that Atwood's machine is used for measuring "g," finds by careful experiment that the value obtained differs more or less widely from that given in text-books, generally concludes that the experiment is "wrong." He rarely has sufficient confidence in his work to know that the experiment cannot be wrong, and that it is the theory which is at fault. Of course, the trouble lies in an insufficient realisation of the assumptions made in the theory. If the experiment does not agree with theory, the student should be taught to find the cause of the discrepancy and to estimate the degree of concordance which the limitations of the theory and the accuracy of his measurements may lead him to expect. It is of the utmost importance that such discrepancies should not be passed over; and in a book like that before us, in which theory and experiment are brought together, the valuable introductory note on the accuracy of observations might with advantage have been amplified.

The course covered is a very complete one (up to about Pass B.Sc. standard), and we are glad to see that a fair share of attention has been devoted to mechanics. The electrical section, also, is very full, and has a valuable chapter of notes on electrical apparatus. An appendix contains mathematical tables and an assortment of useful data which are constantly being required in a physics laboratory. The book is convenient in size, well arranged, well illustrated, and well produced, and there are remarkably few misprints.

Each experiment is preceded by a brief theoretical account of the principles involved, which should enable the student to acquire an intelligent appreciation of the experiment to be performed; but in some cases scarcely sufficient attention is directed to the possible experimental errors.

There are occasionally statements which might prove misleading. We cannot, for example, agree that "the truth of Archimedes' principle can be demonstrated readily by purely theoretical methods." Such a statement tends to conceal the purely experimental foundation of the principle.

In the optical section "pin methods" receive perhaps more attention than they deserve, and in some cases they might with advantage be replaced by the more accurate and quicker "line methods." We should also like to have seen a description of the standard Pentane lamp instead of the vague statement that "some other standardised source [than the standard candle], such as a Pentane lamp, is used," without any indication of the way in which such standardisation is effected. We are glad to note, however, that Swan is given due credit for the prism-photometer, the origin of which is usually concealed so effectively under the name Lummer-Brodhun.

In dealing with methods of measuring the coefficient of linear expansion of a solid, the authors are scarcely fair to the optical lever, which is described as "not at all accurate": we should say that much depends upon the experimenter! The attention of the student might also have been directed to the fact that all these methods give only the difference between the expansions of two bodies, one of which is supposed not to expand. On p. 336, in the experiment on expansion of air at constant pressure, mention should have been made of the error due to the saturated water vapour in the flask. The experiment given on p. 357 to illustrate Newton's law of cooling will fail to do so unless the top of the calorimeter is closed; and the statement on p. 383 that "if the air is cooled down *locally* to this temperature [the dew-point] dew will be deposited on any flat surface exposed to this cooled air," requires modification.

In the section on magnetism we are sorry to see the statement (p. 393) that "a magnet of any shape usually behaves as though forces of attraction or repulsion originated from two definite points in its substance, which may be termed its poles." Careful experiment soon convinces an intelligent student that a point pole is a fiction. Again, on p. 426, it would be well to point out that the tacit assumption that the moments of the two magnets are unaltered by their mutual action when in close proximity is not justified by experiment.

In reference to the determination of the efficiency of an electric lamp, attention is rightly directed to the fact that this should be expressed as candle-power per watt, and not watts per candle-power.

The book as a whole is a valuable addition to the list of text-books on practical physics, and the authors show an intimate acquaintance with the difficulties of both students and teachers which should make it very acceptable to both.

G. A. S.

SYSTEMATIC ZOOLOGY.

(1) *The Fauna of British India, including Ceylon and Burma. Rhynchota*: vol. vi. *Homoptera: Appendix*. By W. L. Distant. Pp. viii+248. (London: Taylor and Francis, 1916.) Price 10*s*.

(2) *Catalogue of the Ungulate Mammals in the British Museum (Natural History)*. Vol v.: *Perissodactyla (Horses, Tapirs, Rhinoceroses), Hyracoidea (Hyraxes), Proboscidea (Elephants)*. By the late Richard Lydekker. Pp. xlv+207. (London: Printed by Order of the Trustees of the British Museum. Sold by Longmans and Co., 1916.) Price 7*s*. 6*d*.

(1) MR. DISTANT'S Appendix to the account of the British Indian Homoptera in the admirable "Fauna" has plenty to chronicle in the shape of novelties. In the Cicadas, so striking a group in the warm regions of the earth, he has to record as many as twenty-three new species since he dealt with the family in vol. iii.; and naturally among those families which make less noise in the world the proportion of novelties is greater, even the little Jassidæ claiming thirty-two new forms, and the Cercopidæ, familiar to us in the person of the "cuckoo-spit" insect, as many as fifty, a number more than trebled by the Fulgoridæ, most of which are not large and conspicuous like the celebrated "lantern-flies" which popularly typify the family. The Membracidæ have more than sixty new forms described, which fully bear out the family reputation for eccentricity in thoracic appendages. Among the new forms described there is a large proportion of new genera, which are fully characterised, so that it is not surprising that the present volume is a fair-sized one; it is well illustrated, having 177 figures.

(2) In addition to the Perissodactyles, Elephants, and Hyraxes, this concluding volume of the British Museum Ungulates contains an appendix to the Bovidæ, the general systematic index, and the index to the whole work. It has naturally suffered by the death of its author before he could revise, or indeed even complete, it; thus the lists of specimens in the museum do not go beyond the Horses and Tapirs, though in the remaining families the synonymy and localities are given. We are told that it has not been thought advisable to complete the volume on the full original plan, partly for lack of a competent author and partly for fear of detriment to science resulting from a mixed responsibility. It seems a great pity, however, that descriptions were not added throughout, as the responsibility difficulty could surely have been got over by bracketing and initialling them; while it does not conduce to the credit of science to issue a work dealing with such important and generally interesting animals with its last volume disfigured and rendered half useless by their general absence. Some can be found in the accounts of the Hyraxes and of the Bovines in the Appendix; in the case of the one equine described, *Equus quagga cuninghamei*, the description is made misleading by the figure being incorrect, since it is said to have the mane well developed, while the animal figured has scarcely any. This is one of the "Burchell's Zebra" sub-species, all of which, we think reasonably, are treated as forms of the Quagga, the typical race of which is extinct; but the Kiang, Chigetai, and Onager are given full specific rank. There are thirty-one illustrations in all, exclusive of an excellent portrait of Lydekker which forms the frontispiece.

F. F.

OUR BOOKSHELF.

An Introductory Course of Continuous-current Engineering. By Dr. Alfred Hay. Pp. xii+360. Second edition, revised. (London: Constable & Co., Ltd., 1916.) Price 6*s.* 6*d.* net.

Like all Dr. Hay's books, the present work will well repay the elementary student for the time spent on its study. It first treats of the elementary laws of electromagnetics, then proceeds to deal with instruments, machines, secondary cells, electric lamps, switchgear, and conductors. In places it lacks depth, whilst such things as definitions, fundamental ideas, and the distinction between E.M.F. and P.D. are not quite so clear as they might be.

The chapter on armature windings could be improved. The statements made regarding wave-windings have the ordinary two-circuit four-pole winding in view, and one at least of them is not even universally true for this. It is a mistake to hide from the student that many other wave-windings are possible, especially as some of them have practical advantages which will lead to their more extended use in future.

The chapter on storage cells ought to have at least one illustration showing a complete cell or battery, and the diagrams showing the construction of the plates might have been of a more modern type. The really useful primary cells should surely have found a place in "Continuous-current Engineering."

The chapter on switchgear is to be especially commended, as it gives much more information than is usually found in a small general text-book.

Although we have criticised several details, we are pleased with the book on the whole, and can recommend it to those requiring an elementary book on the subject. David Robertson.

My Yoruba Alphabet. By R. E. Dennett. Pp. xi+45. (London: Macmillan and Co., Ltd., 1916.) Price 1*s.* 6*d.* net.

Those who have been accustomed to depend upon the classical work of Col. Ellis on the Yoruba people may be surprised at Mr. Dennett's speculations. Ellis, a careful, competent writer, tells us that they worship a pantheon of nature deities, like Olorun, the sky-god, and phallic gods of fertility, like Elegba, to whom human sacrifices in a brutal form were, or are, offered. Of their higher spirituality he gives little or no evidence. Mr. Dennett, a competent philologist, starting from his own "firm conviction that all the works of the Great Creator of the Universe . . . conform to one definite universal order, and that the spirit, or inner consciousness of man, moves in conformity to this universal order so long as that consciousness works in obedience to the dictates of its Great Author," finds beliefs of a similar type among the Yorubas, who "are by nature deeply religious." Their alphabet, as interpreted by him, expresses eight "Elemental Factors," such as Authority, Morality, Potentiality, and so on. He claims that the summary of his results "should establish decisively and conclusively the systematic conformity of the construction of Yoruba words—especially the Yoruba primitive verbs—with the eight elemental factors of the Great Universal Order." Whether the hypothesis meet with acceptance or not, Mr. Dennett's book will be useful to students of the Yoruba speech, and, in particular, the system of transliteration now proposed deserves careful consideration.

Bacon's War Maps. Europe, embracing all the Countries Involved. (London: G. W. Bacon and Co., Ltd., n.d.) Price 6*d.* net.

This folding war-map includes the greater part of Europe and is on a scale of 1 : 4,000,000. It is politically coloured, fairly clear, and has a large number of names, but the only attempts to show relief is by a few stray caterpillar heights. In elevated areas like the Alps and the Carpathians these serve some purpose on a small-scale map like this, but in a lower region, such as the Allies' western front, the few heights that are shown are more misleading than useful. In the Balkans the map fails to reveal the significance of the Vardar valley. Nor is there any attempt to show marsh lands, the military importance of which has been demonstrated on more than one front. In the matter of names there is some scope for criticism. Halicz is not marked and Gorizia appears in the unusual form of Gorz. The map leaves scope for many improvements, which might have been carried out at the expense of the somewhat glaring political colouring if cost was a first consideration.

LETTERS TO THE EDITOR.

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

Science in Education.

Permit me to suggest that the science of man is scarcely "a vicious circle of introspective examinations," but is itself "one of the realities of external Nature," to use Prof. Soddy's definitions (Nature, October 5, p. 90). The science of man, as a biological phenomenon that changes the aspect of the inanimate world and interferes with most branches of living matter—as an organism the groups of which have a definite life-history of growth and decay of ability, sometimes called cycles of civilisation—or producing collective average mentality, which results in rapid expansion of ability combined with great destructiveness—in all these ways the science of man appears to stand, like geology or astronomy, apart from all introspection. The purely scientific study by comparison of these phenomena in mass-action, apart from individual movement, is as scientific as the study of mass-action of matter, physical and chemical, apart from tracing the movement of single atoms. The understanding of this seems to be academically needed if we are to escape from British narrowness, and see the world whole. F.R.S.; F.B.A.

Pre-Boulder Clay Man.

It will no doubt be remembered that at the time of the discovery in 1911 of a human skeleton in a sand pit in the occupation of Messrs. A. Bolton and Co., Ltd. (late Bolton and Laughlin), of Henley Road, Ipswich, it was held by some geologists and by myself that the remains occurred beneath an undisturbed stratum of weathered chalky boulder clay. Since this discovery I have been enabled to investigate extensively the small valley adjoining the sand pit in which the human skeleton was found, and to conduct excavations in the immediate vicinity of the spot where the bones occurred.

These investigations have shown that at about the level at which the skeleton rested the scanty remains of a "floor" are present, and that the few associated flint implements appear to be the same as others found on an old occupation-level in the adjacent valley. This occupation-level is in all probability referable to the early Aurignac period, and it appears that the person whose remains were discovered was buried in this old land surface. The material which has since covered the ancient "floor" may be regarded as a sludge, formed largely of re-made boulder clay, and its deposition was probably associated with a period of low temperature occurring in post-chalky boulder clay times.

It appears, then, that the human skeleton found is referable to a late Palæolithic epoch, and cannot claim a pre-chalky boulder clay antiquity. I wish to take this opportunity to state that those who opposed my contention as to the great age of these remains were in the right, while the views held by me regarding them have been shown to be erroneous.

J. Reid Moir.

12 St. Edmund's Road, Ipswich.

Variable Stars.

There are good reasons for believing that when a molten sun has sufficiently cooled down to allow of the formation of a solid surface, the solid surface rapidly cools. We may, therefore, regard a cooling sun as passing through three stages: (1) a stage in which the light emitted is very intense and regular; (2) a stage in which the surface from time to time solidifies and breaks up again; in this condition the emission of light would be very variable; (3) a stage in which the crust had become so firm as to be practically permanent, little, if any, light being emitted.

The conditions obtaining during the second stage are supposed to be of comparatively short duration.

May not some of the irregularly variable stars be in stage 2? If such were the case we should only expect a small proportion of the stars to show this variability; for there would be only a small proportion of them in stage 2.

R. M. Deeley.

Abbeyfield, Salisbury Avenue, Harpenden, October 2.

[This question is dealt with in the Hill Observatory Bulletin, vol. i., No. 2, p. 4.—Editor, Nature.]

Scarcity of Wasps.

It would be interesting to know whether the scarcity of wasps which is so marked in this district is general. I have seen only one wasp here this season. I am informed that sixty-seven queens were destroyed in one week this spring on the Earl of Crewe's estate, but this cannot fully account for the absence of wasps. Also, while at Bordon (Hants.) for three weeks in August I saw only one wasp.

Are there general causes to account for the scarcity, such as the cold spring, or disease, or is there a cycle of fecundity and scarcity? Possibly some readers of Nature have observed and remarked the absence of wasps this season in other parts of the country, and may be able to forecast the probable effect on insect pests next summer.

H. V. Davis.

"Noddfa," Wistaston, Crewe, October 3.

CAPT. KEITH LUCAS, F.R.S.

On Thursday last, October 5, Capt. Keith Lucas lost his life in a flying accident. In his short span of life—he was but thirty-seven—he had become the leading authority on the phenomena of excitation in nerve and muscle. He had gone through several phases. Coming up from Rugby, he obtained a minor scholarship in classics at Trinity College, Cambridge, and entered the college in 1897. He passed to natural science studies, and took a first class in the Natural Sciences Tripos. Soon after this he made a bathymetrical survey of a New Zealand lake. He then began research in physiology, was elected a fellow of Trinity in 1904, and a little later was appointed lecturer of the college and demonstrator of physiology in the University. The line of research he had chosen led to the development of his inherited faculty of mechanical design, and each additional step of his work was marked by the invention of a new instrument or by some striking improvement in instrumental methods necessary for the successful investigation of the problem. His exceptional mechanical ability found further scope when he became one of the scientific directors of the Cambridge Instrument Company.

On the outbreak of war he gave up work at Cambridge and undertook research at the Royal Aircraft Factory. His success in modifying the magnetic compass for use in the peculiar conditions of aircraft flight has been specially noted in the recently published report of the Advisory Committee for Aeronautics. The committee pointed out how greatly flyers are indebted to Dr. Lucas. His subsequent investigations afford an instance of his thoroughness and devotion to the work in hand. He acquired, as an accessory matter, a personal knowledge of the conditions of flight, and obtained a pilot's certificate. It was while engaged in this investigation that the accident happened which cost him his life.

Much as Keith Lucas had achieved in physiology, it is certain that, had he lived, he would have done much more. He conceived early the whole scheme of investigation necessary to settle his particular problem, and he followed it up step by step with unsurpassed logical method. So far as it can be said in science that the determination of a special problem depends on one man, it can be said of Keith Lucas. His friends loved the quiet and unassuming manner which carried so much strength of character.

J. N. Langley.

SIR AUREL STEIN'S THIRD JOURNEY IN CENTRAL ASIA.

SIR AUREL STEIN publishes, in the August and September issues of the *Geographical Journal*, an account of his third journey in Central Asia.

Starting from Srinagar, in Kashmir, in July, 1913, the first point of interest reached was the Darel Valley, where, at his new capital, Gumarekot, Raja Pakhtun-wali, son of Mir Wali, the murderer of Hayward the explorer, has succeeded in building up a new kingdom, the last, perhaps, which India has seen founded on the old adventurous lines. The fine glacier scenery of this region is illustrated by the view of the Chillinji Glacier (Fig. 1). In this valley of Darel the explorer succeeded in identifying, at Poguch, the site of an ancient Buddhist monastery which the Chinese pilgrims specially mention on account of its miracle-working colossal image of Maitreya Buddha in wood. As an illustration of the continuity of Oriental cults, the site is now occupied and the healing business taken over by the tomb of Shaha-Khel Baba, a Mohammedan saint, who has inherited the miraculous powers of his Buddhist predecessors. Thence over very difficult ground the traveller pushed on through the Yasin Valley to the Darkof Pass, the scene of the remarkable exploit by which a Chinese force, dispatched in A.D. 747 from Kashgar against the Tibetans, succeeded in effecting an entry into Yasin and Gilgit.

FIG. 1. Lower portion of Chillinji Glacier, seen from west across Ashkuman River. From the *Geographical Journal*.

By the beginning of September the party reached the main head of the Hunza Valley, and marched thence to Tashkurghan and Kashgar, where, as usual, Sir G. Macartney, the British Consul-General, supplied liberal aid to the expedition. Since Sir Aurel Stein's last visit, owing to the Chinese revolution of 1911, the political situation had changed for the worse. Mandarins had been assassinated, and local revolts had resulted in a general weakening of Chinese authority. From Kashgar the goal was the region round the dried-up Lop-nor, in the extreme east of the Tarim Basin. Beyond Mural-Bashi, Stein reached the most forbidding region he had hitherto encountered in Taklamakan, and after meeting great difficulties he returned to his old station, Khotan. In this region many interesting discoveries were made. He succeeded in fixing the site of Hsuan-tsang's Pi-mo, the Pein of Marco Polo, at a Buddhist shrine near Domoku, and a large number of tablets inscribed in the Kharoshthi character, and dating from the first century of our era, was found.

Passing Charchan on New Year's Eve, 1914, he found that a band of so-called "gamblers," or vagrant outlaws, had overthrown Chinese authority. At Miran paintings of great interest, almost Hellenistic in style, were unearthed. Later on the ancient Chinese road into the Tarim Basin was identified, and further finds of decorated silk fabrics will contribute to the solution of the problem of origin in the designs discovered in an earlier journey near Tun-huang, usually attributed to Persian art of the Sassanian period. Equally interesting were the desiccated corpses of the old chief and his family, with their well-preserved arms and dresses. The illustration (Fig. 2) of an ancient fort near Lou-Lan gives a good idea of the sites which came under investigation.

The first portion of the narrative leaves the explorer on the western portion of the fortified Chinese line which was first examined in 1907. The fact that he could, after seven years' absence, identify his own footsteps and the footprints of his dog shows the permanence of records of travel in these desert wastes.

The second chapter of the story finds the traveller starting early in 1915 to examine the deserts which fringe on the south and east the great barren hill region usually designated the Pei-shan Gobi. The site known as that of "The

FIG. 2.—Interior of Ancient Fort with wind-breached portion o. Rampart, south-west of Lou-Lan site. From the *Geographical Journal.*

Thousand Buddhas," from which a large mass of material was collected in an earlier tour, in spite of an ill-considered seizure of manuscripts by the Chinese Government, was found capable of providing large additional hoards; while the survey of the ruins of Khara-Khoto established the identity of the site with Marco Polo's "city of Etzina." At the north foot of the T'ien-shan range he traced the original route through which all the historical migrations westward — Indo-Scythians, Huns, and Turks — must have passed. In May, 1915, the traveller returned to Kashgar, and it might have been supposed that the wayworn party would have been satisfied to return and convey the important collections of new material to India. But the indefatigable leader determined to take the opportunity of crossing the Pamirs to study the historical geography of that region. Here one of the most remarkable features of the landscape was the splendid glacier peaks of Muz-tagh, seen from the watershed, about 11,000 ft. high, on the Tars-agar Pass (Fig. 3). It is satisfactory to record that Sir Aurel Stein speaks in high terms of the results of the Russian Topographical Survey of the Pamirs, which had been in progress for some years before the outbreak of the war. At last his desire to visit Lake Victoria or Zor-Kol was satisfied, and thence he passed through Wakhan to Samarkand, and thence into Seistan, where, at Koh-i-Khwaja, he was lucky enough to discover the remains of a Buddhist sanctuary, the first ever traced on Iranian soil. Finally, passing through Baluchistan, he reached the Indian railway system at Nushki, by which he arrived at

FIG. 3.—Glacier peaks of "Muz-tagh" above Muk-su, seen from watershed (about 11,000 ft.) on Tars-agar Pass. From the *Geographical Journal.*

Delhi to report the result of his journey to Lord Hardinge.

We cannot discuss the many interesting results of this remarkable journey. In the Pei-shan Sir Aurel Stein remarks that inscribed slips of wood, thrown out of ancient office-rooms, were often found in refuse-heaps, covered only by a few inches of gravel or *débris,* their preservation in such condition presupposing a remarkable dryness of climate during the last two thousand years. On the other hand, he points out that the final abandonment of the Khara-Khoto settlement was brought about by difficulties of irrigation, and "it was not possible to determine by conclusive evidence whether this failure of irrigation had been the result of desiccation in the Etsin-gol delta, or had been caused by some change in the river-course at canal-head, with which the settlement for some reason was unable to cope. But there seemed to me good reason to believe that the water-supply now reaching the delta during a few summer months would no longer suffice to assure adequate irrigation for the once cultivated area." Obviously the problem of the changes of climate during the historical period will need much further investigation before it can be finally solved, and in the present fragmentary state of our information the question should not be treated in a spirit of confident dogmatism.

It has been arranged that the Indian Government, which liberally contributed to the expenses of the journey, shall receive a considerable portion of the finds, which will be deposited in the new Museum of Indian Art and Ethnography which has been planned at Delhi. We are now so accustomed to the periodical reports of Sir Aurel Stein's explorations that we may fail to appreciate the remarkable courage, tenacity, and executive ability which he has shown in opening up a new region and in reconstructing a hitherto unknown chapter in the history of man.

NOTES.

MR. RUNCIMAN announced in the House of Commons on Tuesday that he had decided to combine the existing Commercial Intelligence Branch of the Board of Trade and the Exhibitions Branch into a new and enlarged Commercial Intelligence Department. The reorganisation of the department is now proceeding.

A ROYAL Commission has been appointed "to inquire into the supply of wheat and flour in the United Kingdom; to purchase, sell, and control the delivery of wheat and flour on behalf of his Majesty's Government; and generally to take such steps as may seem desirable for maintaining the supply." The names of the members of the Commission are:—The Earl of Crawford (chairman), Alan Garratt Anderson (vice-chairman), Sir Henry Rew, K.C.B., Sir George Saltmarsh, H. W. Patrick, Hugh Rathbone, Oswald Robinson, J. F. Beale, and T. B. Royden. Communications intended for the Commission should be addressed to the secretary at Trafalgar House, W.C.

THE Harveian oration of the Royal College of Physicians of London will be delivered on Wednesday, October 18, by Sir Thomas Barlow.

THE Thomas Hawksley lecture of the Institution of Mechanical Engineers will be delivered by Mr. H. E. Jones on Friday, November 3, upon the subject of "The Gas Engineer of the Last Century."

WE learn from the *Times* that Prof. W. von Waldeyer, professor of anatomy in the University of Berlin, has been raised to hereditary nobility on the occasion of his sixtieth birthday.

THE death is announced, at seventy-seven years of age, of Mr. Herbert Jones, known by his work in archæology, particularly with reference to the Roman occupation of Britain, and investigations relating to it at Silchester, Carlisle, Roxeter, and Greenwich.

DR. LE ROY C. COOLEY has died at his home at Poughkeepsie, N.Y., at the age of eighty-three. He was professor of physical science at the N.Y. State Normal College from 1860 to 1874. In the latter year he became professor of physics and chemistry at Vassar College. He held that post until 1894, when he was appointed to the chair of physics in the same institution. He retired in 1907. He was the author of several text-books of physics and chemistry. In 1899 he was elected president of the N.Y. State Science Teachers' Association.

THE death is announced, in his fifty-seventh year, of Dr. C. S. Prosser, head of the department of geology in the Ohio State University, with which he had been connected since 1899. He had previously occupied the chair of natural history at Washburn College, Topeka, Kansas, and of geology at Union College, N.Y. He was an assistant-geologist of the U.S. Geological Survey, and of the State Geological Surveys of Kansas, New York, Ohio, and Maryland. In addition to many official reports, he had published works on the stratigraphic geology and palæontology of Pennsylvania, New York, Kansas, Nebraska, Maryland, and Ohio, the Devonian of New York, Pennsylvania, and Maryland, and the Permian of Nebraska, Kansas, and Oklahoma.

WE regret to note in *Engineering* for October 6 the death, on October 1, in his seventy-sixth year, of Sir W. Theodore Doxford, at his residence, Grindon Hall, Sunderland. As a shipbuilder Sir Theodore greatly assisted in the development and improvement of cargo-carrying steamers. In 1895 the output of the works on the Wear with which his name is associated exceeded that of any other shipbuilding establishment in the country. Sir Theodore became a member of the council of the Institution of Naval Architects in 1896, and was president of the North-East Coast Institution of Engineers and Shipbuilders in 1886–87. He took an active part in the public life of the district in which his works were located, and was a Deputy-Lieutenant of the county of Durham.

MR. J. ACKWORTH PLOMMER has presented to the Geological Department of the British Museum an unusually fine portion of a Hippurite from the Chalk of Boughton-under-Blean, near Faversham, Kent. The specimen is part of the conical valve of the shell, which must have measured from 2 to 3 ft. in length, with a maximum diameter of about 8 in. The shell-substance is more than 2 in. in thickness, and of the usual open texture. The fossil seems to belong to a species, *Radiolites mortoni,* which is already known by fragments from the English Chalk, and by finer specimens from the Cambridge Greensand. The rarity of Hippurites in the Chalk is curious considering their immense abundance in the limestones of corresponding age in central and southern Europe, and in certain regions of Asia, where they form the main part of some mountains.

When the Gilbert Club was inaugurated in 1889, it had nearly one hundred members. The president was Lord Kelvin, and the secretaries were Mr. Conrad W. Cooke, Prof. R. Meldola, and Prof. S. P. Thompson, all of whom, except Mr. Cooke, have since died. The first object of the club was to produce and issue an English translation of Gilbert's "De Magnete" in the manner of the folio of 1600. This was done, but no general meeting has been held since the club was inaugurated, and as the principal founder, Prof. Thompson, has passed away, it is proposed to wind up the affairs of the club. A general meeting will be held, therefore, in the rooms of the Royal Society of Arts on Wednesday, October 18, at 3.30 o'clock p.m., the Right Hon. Lord Moulton in the chair, for this purpose. Proposals will be made as to the disposal of the property of the club, consisting of the remaining copies of the book, as well as of such funds as are in the hands of the hon. treasurer, and matters will be brought forward of considerable interest to all who wish to perpetuate the memory of William Gilbert of Colchester.

The death of Dr. Joseph Anderson, of Edinburgh, at the ripe age of eighty-four, removes a notable personality from the ranks of scientific workers. Born in 1832, he originally intended to devote himself to a scholastic career. After several years of teaching, three of which (1856–59) were spent in Constantinople, he turned to journalism instead, becoming editor of an important provincial newspaper in the extreme north of Scotland. It was during his nine years of residence at Wick that he found his true vocation. Caithness is singularly rich in prehistoric monuments, and Anderson's acute intelligence was at once attracted by the difficult problems which these present. He realised from the outset that the only hope of a solution lay in the rigid application of the methods of science. He therefore set himself to ascertain the precise facts, resolutely refusing to theorise unless and until a sufficient basis for induction had been securely established. His earliest results were so full of promise and were set forth in so lucid and incisive a style that, on a vacancy occurring in 1869, he received a unanimous invitation to accept the keepership of the National Museum of Antiquities in Edinburgh, and with it the assistant-secretaryship of the Society of Antiquaries of Scotland. These posts he held until 1913, when he retired with a Civil List pension. It is not too much to say that in the interval he revolutionised the whole study of Scottish archæology, his chief publications being his five series of Rhind lectures, which stamp him indubitably as a master of the science of research and of the art of clear exposition.

Sir Robert Hudson, chairman of the Joint Finance Committee of the British Red Cross Society and the Order of St. John (83 Pall Mall), publishes in the *Times* of October 10 the following letter received by him from "A Past President of the Chemical Society" and "A Past President of the Society of Chemical Industry":—"An industrial body in the United States of America recently requested our scientific advice. We felt bound to reply that all extraneous work not desired by the State could only be undertaken on behalf of the British Red Cross Society, to which any honorarium must be directly transmitted. The corporation having responded most handsomely to our terms, we gladly hand over cheques each for 1000 guineas, forwarded under the condition above specified. The bounds of the scientific profession are very extensive, and many individuals are receiving large pecuniary benefits accruing, directly or indirectly, out of applied science. We earnestly hope that many colleagues will come forward and help on the beneficent work of the British Red Cross Society." Sir Robert Hudson expresses the hope that the fine example thus set by his two correspondents will commend itself to others; and we are sure that no objects make a stronger appeal to the scientific world than those with which he is associated. Very few men of science, however, are receiving such handsome fees as those which have just been forwarded to him, and most of them are engaged in national work of one kind or another without receiving any payment for their services. The appeal should be, therefore, not so much to scientific workers as to manufacturers and others who are benefiting by expert knowledge, often given gratuitously.

In the June issue of the Journal of the Royal Society of Antiquaries of Ireland the address delivered by the president, Mr. T. J. Westropp, on "The Progress of Irish Archæology" is published. The society was founded in Kilkenny in 1849, and since then has held a high record for a long series of valuable papers published in its Proceedings. It was said when the society migrated from Kilkenny to Dublin that archæology in Ireland sprang from the novels of Sir Walter Scott or from Macpherson's "Ossian." There is some truth in this statement. The president's account of the early Irish antiquaries, among whom portraits of W. Mollineaux, C. O'Connor, C. Vallancey, and G. Petrie accompany his address, is lively and interesting. He speaks hopefully of the study of Irish antiquities, which, among its ablest students, exhibits a dislike for sweeping theories. But he remarks:—"In our country a bad theory—no matter how often refuted—never dies. Scientific antiquaries have too much to do to refute for the tenth or twelfth time these absurdities. We shall never be in a satisfactory position till in archæology, as in natural science, the man who attempts to revive an exploded error only slays his reputation and deceives no one but himself."

The problem of the origin of what he called the Indo-Aryan type of Indian temples was never completely solved by James Fergusson, and later inquirers have done little to produce a solution. In the June issue of the Journal of the Bihar and Orissa Research Society Dr. D. B. Spooner, well known for his excavations at the site of Pataliputra, has in a great measure solved the difficulty. Beginning with the most primitive form of shrine, little more than a square box, he shows that the desire of the Indian architect was to produce a play of light and shade by advancing the central portion a little way, and then to repeat the process, so as to produce a lower structure decorated with three miniatures. At some stage of the local architectural history this threefold division seems to have come prominently into notice, and the architect conceived the idea of balancing this triplicity rhythmically by a corresponding threefold division of his tower in horizontal stories. This idea of the architectural rhythm is very ingeniously developed by Dr. Spooner, and his paper deserves the attention of architects. He closes by saying:—"The people of Tirhut are to be warmly congratulated on the possession of so complete a series of temples as they now possess, a series sufficient to illustrate the whole development of this important style, and a series including many shrines of special interest and beauty. Let us hope that they will do their best to safeguard their inheritance, and to maintain the temples we have seen in good condition."

THE "Terrapin" scale (*Eulecanium nigrofasciatum*) is the subject of Bulletin No. 351 of the U.S. Dept. of Agriculture, written by Mr. F. L. Simanton. This is a North American insect, closely allied to our European *E. persicae*, destructive to peach and plum, and feeding also on thirty other trees and shrubs. The females hibernate on the twigs, where, instead of laying eggs, they give birth to active young, which migrate to the leaves. Much damage is caused by the insects' honeydew secretion, which disfigures the fruit. The bulletin is well illustrated, and contains directions for remedial treatment, early spraying with a linseed oil and gasolene emulsion being especially recommended.

NOTES of much interest appear in the *Zoologist* for September on the mammalian fauna of North Cardiganshire. The author, Mr. Frank Wright, records the occurrence, during the last ten or twelve years, of a number of polecats of a very light colour, some individuals, furthermore, exceeding in size the more normally coloured animal. Both light- and dark-coloured individuals have been taken from the same pest. The pine-marten, he remarks, is now exceedingly rare, but a few apparently survive on the high plateau east of Tregaron. The foxes of the uplands also seem to differ from the type in the matter of coloration, being much greyer. But a specimen taken near the summit of Plinlimmon was quite black instead of white on the under parts.

MR. ZONIA BABER, in the *Scientific Monthly* for September, raises a timely protest against the wholesale slaughter of whales which is at present taking place throughout the seas of the world, and this without the slightest attempt at preventive legislation. The author, in his essay, "The Oceans: Our Future Pastures," holds that the time will come when men will have to depend upon the larger Cetacea for their meat supply, since the grazing of cattle will be impossible owing to the density of the population, which will cover the whole habitable globe. While we by no means agree with this view, we are at one with him that, for other and scarcely less cogent reasons, the present ruthless and wasteful exploitation of our whale fisheries constitutes a deplorable lack of foresight on the part of those engaged therein. The matter demanded international legislation long ago, and even now it is not too late, though, unless it come speedily, the Greenland and humped-back whales and the grey whale (*Rhachi anectes*) will have taken their places with Steller's sea-cow and the great auk—victims to man's greed.

IT is clear from the annual report of the British Museum (1915) that the Natural History Departments have been able to render useful aid to the military authorities in matters directly bearing on the war. In one case a leech, removed from the nose of a soldier invalided home from the Dardanelles, was sent to the museum from the military hospital in order that it might be identified and its habits described. A report on the matter was prepared by the keeper of the Zoological Department embodying useful advice and instructions, and this report was sent to the medical officers serving in the Mediterranean in order that the necessary precautions to avoid further infection might be taken. The Botanical Department was enabled to furnish the authorities of the Naval Air Service with valuable information in regard to wood suitable for airship construction. Further assistance was also given in regard to a fungus which was attacking the fabric of airships. Valuable work has also been done in regard to the supposed hibernation of the house-fly, and to the whaling industry in the Antarctic seas, which is carried on in the neighbourhood of South Georgia so thoroughly that some species are threatened with extinction.

THE best-known instances of luminosity in insects are to be found among the beetles; the various species of glow-worm and firefly belong to this order. But the same, or an analogous, phenomenon is occasionally observable in other insect groups, as, for example, in the "fungus gnats" and crickets. There are at least two well-authenticated records of luminosity in the larvæ of moths, and quite recently the Rev. J. Holroyde, vicar of Patcham, has reported to us an observation of luminous larvæ near Brighton. The species of these larvæ was not determined, but they appear to have been the caterpillars of a moth, probably a Noctuid. Boisduval, whose record is one of those above alluded to, believed that the luminescence in his larvæ was due to disease, and it has been suggested that decomposition due to bacterial infection is the cause of a similar appearance that has been described in other insects not usually luminous, as Chironomus (a kind of gnat) and the so-called "lantern flies" of South America. It is evident that the exceptional production of light in the cases just mentioned is very different in nature from the entirely normal illumination of the glow-worms and fireflies, though it may equally be due to the oxidation of some organic material.

THE excellent work in agricultural science which is being carried on at Moscow under the guidance of Prof. D. N. Prianichnikow is amply illustrated in the recently issued report (vol. x.) of the Agronomical Laboratory for the year 1914. As in past years, much attention has been devoted to the investigation of the merits as fertilisers of various natural phosphates and potash-bearing minerals, fully one-half of the papers included in the report having reference to these products. The assimilation and utilisation of ammonia by the plant have also received considerable attention. The experiments with phosphates have demonstrated the relatively high value of certain of the Russian phosphorite deposits, increases of crop as high as 60 to 70 per cent. of the highest obtained with superphosphate having been recorded in tests with cereal crops. This is in marked contrast to the results of earlier experiments recorded in previous reports, which indicated that, in general, phosphorites are almost valueless for cereal crops, though of appreciable value for leguminous crops.

USEFUL data as to the limits of tolerance of crop plants for sodium salts present in the soil are given by Messrs. Headley, Curtis, and Scofield in the latest issue of the *Journal of Agricultural Research* (vol. vi., p. 857). Experiments in Nevada have shown that the limit of tolerance is extremely variable, being influenced not only by such factors as kind of soil, salt, or crop, but the same crop plant shows marked differences in tolerance at different periods of its growth. So far as the amount of salt is concerned the limit of tolerance is dependent not so much upon the total quantity of the salt that may be present in the soil as upon the quantity that exists in the soil solution, and is recoverable from the soil by means of extraction with water. In pot experiments with soil from a tract of salt land in Nevada it was found that the proportion of recoverable salt which would reduce by one-half the growth of wheat seedlings was for sodium carbonate or bicarbonate 0·04 per cent. of the dry weight of the soil, for sodium chloride 0·16 per cent., and for sodium sulphate 0·35 per cent. The proportion of recoverable salt which prevented germination of wheat was for the carbonates 0·13 per cent., for the chloride 0·52 per cent., and for the sulphate 0·56 per cent.

The investigation of the equations of motion of an aeroplane under the action of atmospheric disturbances such as gusts of wind is a problem to which attention was directed by Prof. Bryan in 1911 ("Stability in Aviation," pp. 178–79, problems 4, 13). An attempt to solve this problem has now been made by Prof. Edwin Bidwell Wilson (S. Doc., 268, Sixty-fourth Cong., 1st sess.). The method adopted in this case consists in treating the disturbed motion as a forced oscillation, the disturbance being expressed in the form of an exponential function of the time. Unfortunately, however, it is not possible to obtain a simple solution of the problem in a symbolic form, and what Prof. Wilson has been able to do is to obtain numerical results for a particular aeroplane of which the values of the stability-coefficients have been determined experimentally. It will thus be necessary to repeat the calculations every time a new aeroplane is built. Prof. Wilson has for no adequate reason departed from the standard notation in his choice of axes. The problem with which he is dealing is only the two-dimensional case of longitudinal disturbances, and it is the universal custom in treatises both on pure and applied mathematics to choose x and y as co-ordinates in all two-dimensional problems. The same practice was followed in the earliest stability investigations both in England and abroad, and the difference of notation is bound to cause confusion.

In a paper which appears in the August number of the Science Reports of the University of Seddai Messrs. Honda and Okubo arrive at an expression for the force on one of the elementary magnets of a group arranged in a space-lattice due to the presence of the other magnets of the group. From this, on calculating the effect of an external field, they are able to obtain the magnetisation curve, and find it is identical with the well-known experimental curve. On varying the external field in the usual cyclic manner, the hysteresis loop is reproduced. It is then shown that the whole of the magnetic properties of magnetite can be reproduced on the theory that the elementary magnets constitute a cubic space-lattice, while those of pyrrhotine require a hexagonal lattice, as would be expected from its crystalline form. This molecular configuration for magnetite does not agree with that deduced by Bragg from the behaviour of the crystal towards X-rays. Finally, the authors show that the properties of ferromagnetic materials can be more completely and satisfactorily explained on the basis of the mutual action of elementary magnets than by the molecular field theory of Weiss.

A recent publication of the U.S. Coast and Geodetic Survey (Serial No. 23, Washington, 1916) gives the results obtained during 1913 and 1914 at the observatory near Tucson, Arizona. This observatory, which commenced operations in 1910, has a set of Eschenhagen magnetographs. The annual variation of temperature in the magnetograph chamber is about 13° C., but the diurnal range is only about 0·1°. Notwithstanding the favourable temperature conditions, the horizontal and vertical force magnetographs have given considerable trouble, large variations taking place in the scale values. The declination magnetograph has worked more satisfactorily, and as three absolute declination observations are taken weekly, the results for that element should be especially trustworthy. The Coast and Geodetic Survey has decided to refer all observations of horizontal force to the so-called "international standard" of the Carnegie Institution of Washington. This entails the application of a correction of $-23\gamma(1\gamma \equiv 1 \times 10^{-5}$ C.G.S. unit) to previously published values of horizontal force at Tucson, and of a corresponding correction to vertical force. Thus the mean annual values for earlier years printed in the present volume differ from those previously published. Opinions may differ as to whether this departure is not a little premature. Diurnal inequalities are given for the ten quietest days of each month and also for the five international quiet days. Mean monthly values are given for both these sets of days, as well as for all days. The all-day mean in horizontal force, on the average of the twenty-four months of the two years, is about 2·6 γ below the other two means. Seven folding plates reproduce the magnetograms showing the chief disturbances of the two years. The largest disturbance in both years occurred in April, but no disturbances were of outstanding magnitude. The observatory also possesses a Bosch-Omori seismograph recording N.-S. and E.-W. components of seismic motion. The earthquakes recorded are enumerated, and particulars are given of their principal features, but there is no information as to their epicentres. Much the largest disturbance recorded was that of March 30, 1914.

Many engineers contend that the pressure over the teeth in modern high-speed gearing must be far from uniformly distributed. An interesting and new method for preventing any excessive concentration of the load on any part of the teeth is described in *Engineering* for October 6. The gearing was constructed by the General Electric Company of Schenectady, and used for coupling a high-speed steam turbine to a low-speed continuous-current generator. The wheels have double helical teeth, and the large wheel is built up of several comparatively thin discs, each separated from its neighbour by a small interval. The discs are bolted solidly together at their inner peripheries, but stand free from each other at their outer circumferences. Each disc has thus considerable axial flexibility, and if the load tends to be concentrated on any one of the discs, that disc bends axially, since the teeth are of the helical type. In this way the disc is relieved of the excess pressure, and a fairly uniform distribution of the load is secured. To enable the teeth to be cut on the rims of the discs, the discs are so made in the first instance as to be in contact also at the outer peripheries. The teeth can thus be milled without the discs springing, and after this operation is finished a narrow cut is made between the discs so as to obtain the required axial flexibility.

A shilling edition of Sir Ray Lankester's well-known and deservedly popular "Science from an Easy Chair" has been published by Messrs. Methuen and Co., Ltd. This is the ninth edition of the book, which was first published in April, 1910, and reviewed in our issue of July 14 of that year (vol. lxxxiv., p. 37)

A French translation of Prof. F. Soddy's monograph on the chemistry of the radio-elements, published in 1912, has been made by M. E. Philippi, and is issued by MM. Gauthier-Villars and Co., in Paris, under the title "La Chimie des Eléments Radioactifs." The price of the volume is 5 francs.

The Wireless Press, Ltd., will shortly publish "The Measurement of Capacity and Inductance," by W. H. Nottage, illustrated, and a new and enlarged edition of "Elementary Principles of Wireless Telegraphy," by R. D. Bangay.

The recently issued announcement list of the J. B. Lippincott Company includes the following new books and new editions :—"Shakespeare and Precious Stones," Dr. G. F. Kunz, illustrated: the work will treat of all the known references to precious stones in Shakespeare's works, with comments as to the origin of his material, the knowledge of the poet concerning precious stones, and references as to where the precious stones of his time came from; "Rings," Dr. G. F. Kunz, illustrated; "The Art of Anæsthesia," Dr. P. J. Flagg, illustrated; and (in "Lippincott's Farm Manuals") "Productive Sheep Husbandry," Prof. W. C. Coffey, illustrated; "Productive Marketing of Farm Products," A. E. Cance, illustrated; "Productive Feeding of Farm Animals," Prof. F. W. Woll, new edition, illustrated; "Productive Soil Maintenance," C. E. Thorne, illustrated; "Animal Husbandry," Prof. C. W. Gay, illustrated; "Productive Grape Growing," Prof. B. S. Pickett, illustrated.

OUR ASTRONOMICAL COLUMN.

Fireball of October 3.—Probably what was the most brilliant meteor that has appeared in the present year was seen on Tuesday, October 3, at 8.5 p.m. It passed over Devonshire, and, though the night was cloudy, it gave a very vivid illumination of the sky and landscape, and its apparition was witnessed by great numbers of persons in the S.W. counties of England.

The observations are, however, not very accurate or consistent one with another in consequence of there being very few, if any, stars visible at the time from which its path might be taken. The flight was vertical as observed at Bristol, and was similarly described at various stations in Devon and Cornwall, so that a radiant at or near the zenith is inferred. At Launceston, however, the course is stated to have been from E. to W., and the fireball burst when near the zenith. Mr. W. F. Denning has determined the real path from the data at hand, and places the probable radiant in the head of Cepheus. The height of the meteor was about 67 to 30 miles above a point of the earth's surface some 15 miles E.N.E. of Exeter. A few further observations from Dorset or Devon would be very valuable as affording a test of the accuracy of this result; any such observations should be sent to Mr. Denning, 44 Egerton Road, Bristol.

Mercury Visible Before Sunrise.—Mercury will be a morning star during the latter half of this month, and at its greatest western elongation at midnight following October 20. The planet will rise from a point a little S. of due E. at the following times:—

	Mercury rises a.m.	Sun rises a.m.	Mercury precedes Sun h. m.
Oct. 15	4 51	6 26	1 35
17	4 48	6 29	1 41
19	4 46	6 32	1 46
21	4 46	6 36	1 50
23	4 50	6 39	1 49
25	4 58	6 42	1 44
27	5 8	6 46	1 38
29	5 17	6 49	1 32
31	5 27	6 53	1 26

The waning crescent of the moon will be in the same region of Mercury on the morning of October 25.

The Distribution of B Stars.—An important memoir on the distances and distribution of the B (helium) stars has been published by Prof. Charlier (Nova Acta Reg. Soc. Sci., Upsala, series iv., vol. iv., No. 7). It contains all the details which led to the general conclusions previously announced (Nature, vol. xcvii., p. 369). In a group of stars having the same luminosity, the distance (r) of each individual star can be deduced from the apparent magnitude (m) by the relation $r = R.10^{0\cdot2\,m}$, where the parameter R is the distance for apparent magnitude 0·0. A first determination of R was based upon the proper motions and radial velocities of 156 stars brighter than 5th magnitude, for which the requisite data were available; its value is 4·76 siriometers (1 siriometer = a million times earth's distance from sun). The corresponding absolute magnitude, or apparent magnitude at a distance of one siriometer, is given by $M = -5 \log R$, and is equal to $-3\cdot39$. It was next discovered that the fainter stars gave a somewhat smaller value of R, and the brighter stars a higher value. This anomaly was found to be due to the varying luminosities of the different sub-classes. Separate investigation of these showed, in the main, that types B1 and B2 have the greatest luminosity, R being 7·4 sir., whereas types B0, B3, B5 have a value of R = 3·3 sir. For each subclass the value of R appears to be independent of apparent magnitude. Having the value of R for each sub-class, the position in space of each star at once follows, and it results that the B stars form a well-defined cluster, gradually thinning out from the centre to a distance of 200 siriometers. The centre of the cluster, which Prof. Charlier supposes to be coincident with the centre of the stellar universe, is in R.A. 7·7h., declination $-55\cdot6°$; it lies in a rich region in Carina, at a distance of 18·2 sir. from the sun. The cluster has an extension nearly three times as great in the plane of the Milky Way as in the direction at right angles, and the sun lies eccentrically with respect to it, at a distance of 4 sir. above the fundamental plane of the Milky Way. The mean density amounts to 0·0026 stars per cubic siriometer. A catalogue of the 804 known B stars is given, showing all the data relating to type, magnitude, distance, galactic co-ordinates, and so on. The distribution of the stars is further shown diagrammatically, and stereoscopic charts are in course of preparation. It is of interest to note further that the nearest B star is α Eridani, with a distance of only 4 sir. ($\pi = 0\cdot0516''$), while the three stars in the belt of Orion come next, with a distance of 8 sir. So far as they go, direct determinations of parallaxes support the values of R used in the investigation.

The Spectroscopic Binary χ Aurigæ.—An orbit for the spectroscopic binary χ Aurigæ (type B1) has been calculated by R. K. Young from eighty-eight single-prism spectrograms taken at Ottawa in the years 1913–16 (Journ. R.A.S. Canada, vol. x., p. 358). The period has the exceptional value, for an early type star, of $655\cdot16 \pm 5\cdot26$ days; the eccentricity is 0·171, and the orbital velocity 20·53 km./sec. The residuals from the simple elliptic orbit were examined for indications of the presence of a third body, but no secondary period was found; further investigation of this point, with high dispersion, is considered desirable. The calcium lines (H and K) have an amplitude of about half that shown by other lines of the spectrum. A useful summary is given of the different cases of anomalous behaviour of the calcium lines at present known, and Mr. Young considers that the phenomena are best explained on the supposition that there is a calcium cloud surrounding the binary, the absorption of this substance taking place at a much higher level than that of the other elements.

A New Astronomical Journal.—We have pleasure in directing attention to the publication in France of a new monthly periodical devoted to astronomy and meteorology. It bears the title *La Revue Verte*, and is edited by the Abbé Th. Moreux. The journal is intended especially for amateurs, and will include articles giving practical instruction in methods of observation, in addition to general astronomical news, and notes on celestial phenomena during each month. In the first number there is an article on sun-spots and meteorology by the editor, and the first of a series of articles on variable stars by Prof. Moye. There is also a brief biography, with portrait, of M. Baillaud, director of the Paris Observatory. All communications are to be addressed to M. l'Abbé Th. Moreux, Observatoire de Bourges (Cher), France. The annual subscription is 6 francs in France, and 7 francs for other countries.

GEOLOGICAL WORK IN THE UNITED STATES.

THE United States Geological Survey, under the directorship of G. Otis Smith, continues to discuss theoretical and practical problems from the most liberal point of view. T. Nelson Dale's account (Bulletin 589) of "Marble and Dolomite of Eastern Vermont" directs attention to a rose-coloured manganiferous calcite marble, "alternating in very small beds with equally small beds of fine-textured white dolomite." The author refers to his previous discussion of dolomite (Bull. 521), and suggests that the dolomite layers were precipitated inorganically, while the pink calcite layers received their manganese from organisms. Both the hard and soft parts of molluscs may contain appreciable percentages of manganese; but why should rose-coloured marbles be comparatively rare? The examples from Vermont lose their colour if used for external decoration.

In Monograph lxiii. F. Leverett and F. B. Taylor provide a detailed description of the "Pleistocene of Indiana and Michigan and the History of the Great Lakes." They conclude that the changes and deformations of shore-lines in this region may be due to crust-creep, as well as to alterations in the ice-burden, but (p. 333) that the land is at present stable. The long eskers, formed during glacier-retreat in channels bounded by the ice, are excellently illustrated in the maps (see, for example, plate viii.), and the elaborate nature of the survey may be judged from the folded sheet, plate vii., where the moraines of the peninsula between Lake Michigan and Lake Hudson, with the lacustrine clays deposited behind them, are shown over a region measuring 300 by 200 miles. The Michigan Geological Survey has furnished important data for this memoir.

Bulletin 600 is a popular guide to the geology and scenery of "The Glacier National Park," Montana. The Continental Divide runs through the park, among peaks carved out of stratified rocks, which are from 9000 to 10,000 ft. in height, and some 6000 ft. above the valley-floors. A few residual glaciers still linger in the cirques. The region was originally purchased from the reservation of the Blackfeet Indians, in order to encourage copper-mining. The mines having proved unprofitable, the beauty of the country was represented to Congress in 1910 (Fig. 1). A good map accompanies this bulletin; but those who become interested in the folding and overthrusting and subsequent dissection of the strata of the park may like to learn more about their geological age than that they "are very, very old."

In North Park, Colorado (Bull. 596), lenticular masses of coal of extraordinary thickness occur in Upper Cretaceous or early Cainozoic strata. These coals may be 20, 35, or even 53 ft. thick, and are referred by A. L. Beekly (p. 94) to local marsh-areas, unconnected with one another, which encouraged rapid accumulation of vegetable or other organic matter. North Park is unfortunately bounded by a ring of mountains, away from trade-routes, and the remarkable cleanness of the coal is likely to prove its chief recommendation.

W. W. Attwood (Prof. Paper 95B) records and illustrates a rather widely spread glacial boulder-clay of Eocene age in south-western Colorado. In a review of recorded "ice-ages," which excludes the evidences of mere valley-glaciers, the author finds no parallel with the Colorado instance, unless in the Eocene of North Italy. W. T. Lee (*ibid.*, 95C) provides a possible source of the Eocene ice-flow in a review of the "Relation of the Cretaceous Formations to the Rocky Mountains in Colorado and New Mexico." He urges that all the Cretaceous coal-seams of the region, from Dakota times onward, were deposited on the margins and sometimes towards the centre of a single gradually subsiding shallow basin, which (p. 57) reached from the Gulf of Mexico to the Arctic Ocean and from Utah to the Mississippi. The orogenic movement of Eocene times resuscitated the Rocky Mountain mass, which had been worn down and buried beneath these Cretaceous strata. Hence the beds which contain conglomerates derived from the newly raised mountains must all be regarded as of Cainozoic age. The folding experienced by the coal-bearing strata during the uplift is well seen in the illustrations from Utah in Bulletin 581E.

From Nevada (Prof. Paper 95A) W. B. Hicks

FIG. 1.—St. Mary Lake and Red Eagle Mountain, Glacier National Park, Montana.

draws interesting conclusions as to the apparent disappearance of potassium from the brines and saline deposits of the desert-basin regions. High percentages of potassium are obtained by boiling the muds of Columbus Marsh with water, and the author believes (p. 9) that these muds have withdrawn potash from percolating solutions, holding it in virtue of their colloids or in a weak chemical combination. Only a small proportion of the potash can be referred to extraction from the mud-forming minerals, and (p. 8) "the potash content of the muds is roughly constant without regard to the character of the material," *i.e.* whether this is sand or clay. The retention of potash by soil-particles has, of course, been discussed by agricultural investigators, and it here receives a wide geological application. Hoyt S. Gale, in describing (Bull. 580L) the salines of Borax or Searles Lake, San Bernardino Co., California, touches on the same point, and regards the preservation of potassium chloride in the brine of this lake-area as quite exceptional. The analysis quoted on p. 294 of his paper, on which so much depends (see p. 311), seems to have gone far astray. Should we read 12·30 for the percentage of potassium chloride, in place of 1·50? The author's well-illustrated account of the salts crystallised in this desiccating region forms a convenient synopsis for students of mineralogy. Bull. 603 is of interest from the evidence given that the mineral oils north of Coalinga, California, originated in the decay of diatoms of Upper Cretaceous age.

In discussing a "Gold-Platinum-Palladium Lode in Southern Nevada" (Bull. 620A), Adolph Knopf reviews the known occurrences of platinum, and points out that this metal may be reasonably looked for in copper ores, having, as Kemp suggested, migrated with them in solution. At the Boss Mine, in Nevada, the gold and platinum occur alloyed in almost equal quantities by weight. W. Lindgren describes (Bull. 601) the rich gold ores of the national mining district in northern Nevada, where the exceptional attractions of quartz "averaging about $30,000 a ton in gold of a value of $10.60 an ounce" led, as recently as 1912, to armed alarums and excursions of the good old western type. A defensive searchlight has been kept playing on the entrance of the National Mine. Outside the National lode, the veins contain silver and antimony ores; but all the minerals are probably connected in depth, as products of ephemeral hot springs at a late stage in the eruption of Cainozoic (Miocene?) rhyolites.

G. C. Matson's description (Bull. 604) of "The Phosphate Deposits of Florida" is accompanied by a large coloured geological map of the State, on the scale of 1 : 1,000,000. The most interesting feature of this is the famous Florida East Coast Railroad, which steps from isle to isle of coral, and ends on the Pleistocene oolite of Key West. The marine concretionary phosphates are believed (p. 64) to have originated from the remains of plants and animals, while the fluviatile Bone Valley Gravel, in which teeth of Mastodon and other vertebrate remains occur, is held to have received its calcium phosphate from the detritus of the underlying marine bedrock.

Among several publications that indicate the rapid progress of surveying in the difficult regions of Alaska, we note Bulletin 587, by G. C. Martin, B. L. Johnson, and U. S. Grant, on the Kenai Peninsula. Cainozoic coal-seams occur near the sea; but they seem unlikely to compete with the coals of higher grade available on the Pacific coast. It is of interest to find (p. 52) a series of "green scoriaceous and ellipsoidal lavas" of Triassic age overlain by radiolarian cherts. Once more we see that a particular marine condition has brought about the formation of these two dissimilar rock-types, though the clear evidence of succession in this case prevents our ascribing the abundance of radiolarians to the emanation of silica from the lavas. The detailed work by C. W. Wright on Copper Mountain and Kasaan Peninsula (Prof. Paper 87) includes well-illustrated observations on contact-metamorphism. Some of the aplite veins (p. 81) contain as much as 9 per cent. of primary calcite, a mineral that has already taken its place as an original constituent of igneous rocks. S. R. Capps (*ibid.*, 95D) traces the volcanic ash layer of the Yukon basin to a "centre of dispersion," by no means central, north of Mount Logan. At this point the deposit is 300 ft. thick, fading away to a foot in about 150 miles to eastward. The layer is traceable over 140,000 square miles, and, from the thickness of peat above it on the White River, is ascribed to an eruption that took place on the north of the Mount St. Elias region about 1400 years ago. The report by A. H. Brooks, who superintends the surveying work in Alaska, on the mineral resources of the region in 1914 (Bulletin 622) includes an unfavourable judgment on some of the coals from the point of view of the Navy Department; the coal of the Matanuska field, however, is regarded as of excellent steaming quality, and the progress of gold-mining, the great industry of Alaska, may possibly open up this field.

W. B. Clark and M. W. Twitchell have written a monograph on "The Mesozoic and Cenozoic Echinodermata of the United States" (Monograph liv.), illustrated with 108 plates of drawings and direct photographs. While the genera are for the most part of world-wide occurrence, few of the familiar European species are found in American deposits. F. W. Clarke and W. C. Wheeler (Prof. Paper 90L) follow up their work on the composition of crinoid skeletons by an examination of the hard parts of other recent echinoderms. Magnesium carbonate is found in these also; the quantity is large in tropical forms as compared with those from cold waters, and may reach 14 per cent. The authors conclude that a rock formed from any kind of echinoderm "will have the composition of a moderately magnesian limestone." As previous workers have pointed out, the calcium carbonate of echinoderms is always in the calcite form.

Mineralogists and chemists will alike appreciate F. W. Clarke's essay on "The Constitution of the Natural Silicates" (Bull. 588), in which consideration is given to their alteration-products, as suggesting the structure of the molecule of the original mineral. The treatment of spodumene (p. 98) serves as an interesting example, and leads on to new interpretations of the pyroxenes and the amphiboles, which are worked out as mixtures of orthosilicates and trisilicates, while wollastonite and pectolite, which are easily decomposed by dilute acids, remain isolated as metasilicates. Whitman Cross (Prof. Paper 88) enlarges our imperfect knowledge of "The Lavas of Hawaii and their Relations," covering the Hawaian Islands as a whole. The mountain-chain of which these are the unsubmerged peaks extends for 1800 miles in a north-north-westerly direction. The rock-types offer no support to the suggestion of a distinctively Pacific group of igneous rocks, or a group produced under Pacific conditions, and the alkalic and calcic rocks of Rosenbusch occur in the islands (p. 86) as derivatives from a common source. The author doubts (p. 90) Daly's view that limestone has had an influence in promoting the occurrence of the types rich in alkalis. His visit to the islands in 1902 enables him to review his specimens as parts of some of the most striking volcanic landscapes in the world.

The twenty-third volume of the Iowa Geological Survey (1914) consists of O. P. Hay's monograph on "The Pleistocene Mammals of Iowa," the remains being found in interglacial beds. The Aftonian stage, following the first Glacial or Nebraskan stage, is especially the horizon of Mylodon, in North America, and of the last North American Camelidæ. The memoir is fully illustrated. R. S. Lull reviews (*American Journal of Science*, vol. xl., 1915, p. 319) "The Mammals and Horned Dinosaurs of the Lance Formation of Niobrara County, Wyoming," and shows that mammalian remains, including throughout the older multituberculate types, are found in almost all the beds that contain Ceratopsia. The trituberculate mammals occur, however, on the upper horizons, and may still have existing representatives. H. F. Osborn discusses the "Close of Jurassic and Opening of Cretaceous Time in North America" (Bull. Geol. Soc. America, vol. xxvi., 1915, p. 295), as an introduction to a symposium on the Morrison formation. This discussion has a special application in England to the Purbeck-Wealden question.

The Wisconsin Geological and Natural History Survey has reported on the north-western area of the State (Bulletin No. 45, Madison, 1915), where very little geological work had been done prior to the official entry of Mr. W. O. Hotchkiss and his assistants in 1913. Since the area lies in the Lake Superior iron district, great stress has been laid upon a continuous magnetic survey, the principles of which are set out in chapter iv. This illustrated essay of sixty pages will be of service to mining students in general. The ores are the well-known sedimentary masses of Huronian age, and the extent of the Huronian beds beneath the glacial drift has been largely determined by magnetic readings. Bush-covered ground and rivers, as indicated in the sympathetic pictures of geologists at work, have often hindered observation, and only the most careful organisation could have carried out the survey in so comparatively short a time.

G. A. J. C.

THE ZOOLOGICAL SURVEY OF INDIA.

WITH the sanction of the Secretary of State the Government of India has recently converted the professional staff and entire working machinery of the zoological section of the Indian Museum into an autonomous Government department, under the name and style of the Zoological Survey of India.

This conversion, if it were—as to superficial view it might appear—merely a change of name, could pass without comment in a momentous time like the present; but inasmuch as it effects a long-desired and fundamental improvement in the prospects and official status of zoology in India—a country where, private enterprise in the domain of natural science being undeveloped, no branch of science that lacks independent and avowed recognition in the highest official quarters can hope to expand to its full extent—it deserves some notice.

In times not very long past the zoological section of the Indian Museum was administered by trustees, on the model of the British Museum, an arrangement ill-suited to a polity where, outside official circles, trustees with the necessary academic experience are not easy to find. One of the most unsatisfactory results of this system was that, although all ate of one salt and owned the Government as their father and mother, the zoological officers—irrespective of professional seniority or length of service—had always to be the official subordinates of their *confrères* in kindred scientific departments, who were constantly associated with the museum as trustees.

This anomaly was rectified by making the senior zoological officer eligible for the office of trustee, a resort to legal fiction which, although it placed zoology in proper official perspective, was calculated to offend tender consciences.

All such fictions are now obviated by bringing the whole zoological staff and its appurtenance into line with other scientific departments of the Government of India, and placing the senior representative of zoology on the same footing as the directors of the kindred scientific surveys—a position in which his opportunities of advocating and initiating research are much augmented and his responsibilities as an independent scientific adviser to Government are distinct and direct.

In notifying this auspicious change the Government expresses the hope that the establishment of a zoological survey will be of value to India; and when it is remembered—apart from all the economic reflections of the matter—that in territories like India more than 75 per cent. of the annual mortality is due either directly or proximately to noxious animals and animalcules, so that rural sanitation in such countries must rest in the first instance upon accurate and comprehensive zoological foundations, there seems every assurance that this hope will be justified.

Apart from these internal changes, which bring field-work from a precarious position in the rear into the very front rank of the duties of the staff, and transform the trustees from responsible guardians into authorised visitors of the collections, the zoological section of the museum as a going concern will not be altered in any way. Nor is any extra expenditure anticipated for the immediate future, since the available museum grant is ample for the intended purpose, and the collaboration of the Marine Survey Department and the close co-operation of the Forest and Agricultural Departments are assured.

Under the new *régime* the national zoological museum of India promises to be, like some other Indian official organisations, an institution of an exemplary kind.

GENETIC STUDIES IN PLANTS.

IN a paper on "Growth and Variation in Maize" (*Zeitschr. f. indukt. Abstammungs- und Vererbungslehre*, xiv., 1915, Nos. 3–4), Drs. Raymond Pearl and F. M. Surface combine the statistical and individual methods of inquiry. "We have tried," they write, "by studying the growth of the individual to analyse the adult variation curve into its component elements." Height is the character chosen for investigation; the relative variability as observed throughout the season "shows a marked progressive diminution," and the authors believe that the maize plant grows "in a series of cycles." In a second part of the paper they discuss the relation of variation to growth, and from the distribution of small, medium, and large plants conclude that the manner of growth is dependent on Mendelian factors.

Maize is also the subject of a paper in the *Journ. Agric. Research* (vi., No. 12) by G. N. Collins, who deals with "correlated characters" in the species. Eleven characters were selected for study, and of fifty-five possible combinations twenty were found to show significant correlations; but in all but five these appear to be physiological rather than genetic, and in no instance is the coefficient higher than 0·5. The author fears, therefore, that the method of isolating types is inapplicable to maize, though desirable characters derived from different parents may be easily combined.

The "Suppression of Characters on Crossing," illustrated by experiments on species of wheat, is discussed in a paper by R. H. Biffen (*Journ. of Genetics*, v., No. 4). He finds that dominant features, such as greyness of chaff or redness of grain, may be suppressed, so that "recessives make their appearance in F_2 generations from crosses of parents showing dominant characters only." This may perhaps be due to the existence of more than one factor giving rise to apparently the same dominant character, and the consequent possibility that two factors determining the recessive may meet in some of the zygotes that give rise to the F_2 generation.

Dr. T. Tammes contributes a paper to the Proceedings (xviii., No. 7) of the Kon. Akad. v. Wetensch. Amsterdam "On the Mutual Effect of Genotypic Factors." She has experimented by crossing varieties of flax differing in colour (blue or white) and breadth of the petals. The results are complicated, and not readily summarised, but they confirm a generalisation already established by work in hybridisation among both plants and animals: that "views on the presence and action of factors obtained by an investigation of one single crossing are liable to modification when one of the forms investigated is crossed with a third form. Hence it is necessary to cross the same form with more than one partner in order to arrive, step by step, at the truth."

MATHEMATICS AND PHYSICS AT THE BRITISH ASSOCIATION.

THE first of the two organised discussions arranged for this section was on "Gravitation." The discussion followed immediately after Prof. Whitehead's presidential address, and it happened that the arrangement was appropriate, for the president's exposition of the logical texture of geometry had carried us far from the ordinary conceptions of space, and paved the way for the revolutionary ideas associated with the space-time world of Einstein and Minkowski. Mr. E. Cunningham, who opened the discussion, and Prof. A. S. Eddington, who followed, dealt with Einstein's recent work, which brings gravitation within the scope of the principle of relativity. If an observer is in a closed lift, it is well understood that an acceleration of the lift upwards is exactly equivalent to an increase of the force of gravity, so far as mechanical phenomena inside the lift are concerned. There would, however, be minute differences in the optical phenomena according to the ordinary theory; relatively to the accelerated lift the path of a ray of light would seem to be curved, whereas for the stationary lift it would be straight if the increased gravitational field makes no difference. Accordingly, the first suggestion towards a relativity theory which shall include gravitation is that the path of a ray of light must be bent by the gravitational field, just as it is apparently bent by an acceleration of the framework of reference. The curvature to be expected is extremely small—amounting to a change of direction of $1{\cdot}7''$ in the case of a star seen close to the sun's limb—and it has not been possible to prove or disprove the hypothesis directly. Meanwhile the theory has been elaborated and generalised by Einstein, who has at length been able to throw the laws of motion, of electrodynamics, and of gravitation into a form which makes the sequence of phenomena entirely independent of any particular framework of reference. The result has been to yield a very striking confirmation of the theory, for it is found to predict a motion of the perihelion of Mercury amounting to $43''$ per century—just the amount of the hitherto unexplained discordance. The new theory removes what is probably the most celebrated of the few cases of failure of gravitational astronomy. The discussion afterwards turned to the experimental side. Dr. P. E. Shaw gave an account of his experiments which appear to indicate a change in the constant of gravitation with temperature, and Prof. R. A. Sampson urged that astronomical evidence is not capable of denying this possibility. Dr. W. G. Duffield read a report of the Committee on the Determination of Gravity at Sea, considering especially the difficulties attending the use of the aneroid method, and the possibility of improvements in future attempts.

A paper by Sir Ernest Rutherford on the "X-Ray Spectra of the Elements" was of special interest. He referred particularly to the researches of Siegbahn and Friman, who have extended the work of Moseley to the elements of high atomic weight from gold to uranium by examining the L spectra. It appears that there are ninety-two elements up to uranium. By finding the atomic number of lead it has now been possible to assign the whole series of radio-active products to their places in the scheme. Sir E. Rutherford further described the work done in America with the Coolidge tube, which provides a steady high voltage. It is found that the maximum frequency of the rays which can be obtained follows closely the quantum relation $Ve=h\nu$, the accuracy between 20,000 and 100,000 volts being one per cent. To excite the characteristic radiation of a substance a rather higher voltage is needed than that given by the quantum relation, as though it were necessary to expend some energy in disturbing an oscillator.

Prof. H. H. Turner read a paper on the "Measurement of Time," dealing with daylight saving and justifying the innovation from a scientific point of view. The paper elicited an interesting speech from Prof. J. Perry, who admitted that he had formerly rather thoughtlessly opposed the scheme, and urged the warning against being led by authority in science. Other members, however, professed themselves still unconverted.

Prof. T. H. Havelock gave a review of recent work on the "Propagation of a Signal in a Dispersive Medium." He described the approximate methods of calculation which have been used, showing the relation between the recent methods of contour integration and the older work of Hamilton and Kelvin. The precise nature of the "forerunner," or minute disturbance which travels through the medium in advance of the main signal, is a matter of special difficulty, and an exact solution for any particular cases that may prove tractable would be a great help towards progress.

The absence of several speakers who had been expected to take part rather detracted from a discussion on "Osmotic Pressure," opened by Prof. A. W. Porter. There were many other interesting papers, most of which we must pass unnoticed for want of space, but special mention may be made of Prof. J. C. McLennan's paper on "Ionisation Potential," continuing and extending the results communicated last year; also of Sir F. W. Dyson's "Mean Parallaxes of Stars of Different Magnitudes," which in the main confirm the well-known formulæ given by Kapteyn in 1901. At a separate meeting of the department of mathematics Prof. G. N. Watson gave a general survey of the recent developments of the theory of asymptotic series.

A new departure, which it is hoped may lead to important results, was the formation of a committee representing Sections A and E to consider the needs of geodetic research. This arose from the presentation of a report by Col. Close, Sir F. W. Dyson, and Col. Hills, prepared at the request of the Organising Committee of Section A. The report brought out clearly the lack of organisation and general neglect of higher geodesy in this country, and there was a unanimous feeling that steps should be taken towards the constitution of some committee or association responsible for stimulating this branch of science.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION D.

ZOOLOGY.

ABSTRACT OF THE OPENING ADDRESS BY PROF. E. W. MACBRIDE, M.A., D.Sc., F.R.S., PRESIDENT OF THE SECTION.

THE decision of the Organising Committee to devote the sittings of the section chiefly to the economic and medical applications of zoology must not divert us from the task of research into fundamental laws. The laws of heredity had been intensively studied for the last twenty years by selective mating, but the study of the laws governing the development of the germ into the adult organism—in a word, of experimental embryology—might eventually throw a great deal of light on the laws of heredity.

After alluding to the work of His, who sketched out the programme of the new science, Prof. MacBride described the work of the first experimenters—Roux, Hertwig, and Driesch—in some detail. He pointed out that the results obtained by these zoologists led them to conclusions about the nature of development which were fundamentally opposed to one another; for Roux, having produced half-embryos by destroying one blastomere of the two-cell stage of the frog's egg, supported the principle of "specific organ-forming regions of the germ," whilst Driesch, having reared a perfect Echinoderm larva of diminished size from one of the first four blastomeres of an Echinus egg, asserted that "the fate of a cell was a function of its position in the embryo," and in this conclusion he was supported by Hertwig, who attempted to interpret Roux's results in a different manner. Even Roux admitted that although half-embryos were formed at first, if they survived they regenerated the missing parts; Roux accounted for his results by supposing that each region of the germ had its peculiar organ-forming substance, or "idioplasson," which conferred on it the power to develop into a definite organ; the regeneration of lost parts he attributed to a special substance, which he called "reserve-idioplasson," which came into play only when mutilation had occurred. Driesch assumed, on the other hand, the existence of a purposeful "entelechy," or "psychoid," inhabiting the living material, and even when, as in his experiments with Ctenophore eggs, he found that isolated blastomeres gave rise to partial larvæ, he did not conclude that definite organ-forming substances were localised in each of the first eight blastomeres; but rather that in these eggs the cytoplasm was so specialised or "stiffened" that the indwelling entelechy could not mould it to its will.

The definite proof of the existence of *organ-forming substances*—a proof which was regarded as one of the great advances made by experimental embryology—was brought by Crampton and by Wilson in their studies of the developing eggs of Mollusca. In the developing egg of Dentalium and of some other Mollusca the first cleavage appeared to divide the egg into three cells, but one of these cells was a mere protrusion devoid of a nucleus, termed the *first polar lobe*, which was reabsorbed before the next cleavage. At the next cleavage five cells were apparently produced, but again one of these was a transitory *second polar lobe*, which melted into one of the four blastomeres before the cleavage to form eight cells began. If the first polar lobe were cut off, the egg developed into a trochophore larva, which was devoid of the apical plate and apical tuft of cilia and also of mesoderm, and of the whole post-trochal region. If the second polar lobe were cut off, a trochophore larva was formed, provided with apical plate and apical tuft, but devoid, as before, of mesoderm and of post-trochal region. The conclusion was inevitable that the specific material for the apical plate and post-trochal region was contained in the first polar lobe, but that the second polar lobe only contained the necessary material for the post-trochal region.

Driesch's objections to this conclusion were founded on the difficulty of conceiving what an organ-forming substance could be like, it being very difficult to picture a substance the molecules of which had the power of "crystallising" into organs, such as, for instance, arms and legs. But if we fell back on our ultimate conception of what we meant by "explanation," we found that it always consisted in comparing a less familiar phenomenon with one about which we thought we knew more. Driesch's entelechy was really an attempt to compare the forces which organise development with the purpose of an intelligent being who wanted to build a house, and, in principle, no fault could be found with it. The great difficulty about it was that this comparison does not help us to understand in the least a large number of phenomena which could be far better "explained" by the theory of organ-forming substances, even although we could not tell what these substances were like. In the development of the Ascidian, *Cynthia partita*, as described by Conklin, the cytoplasm was rendered slaty-blue by inclusions of yolk, and in its outermost zone were numerous particles of bright yellow pigment. Before fertilisation the large germinal vesicle burst, and its contents formed a cap of clear fluid at one pole of the egg. The spermatozoon entered at the opposite pole, and then the clear substance and the yellow pigment were drawn down to meet it, and eventually formed two concentric crescents round the lower pole of the egg. Subsequent development made it plain that the clear substance gave rise to the ectoderm, the slaty-blue cytoplasm to the endoderm, and the yellow material to the mesoderm of the Ascidian tadpole. If one of the first four cells of the segmenting egg were killed, the other three continued their development, and an imperfect embryo was produced; if this cell happened to be one of the two containing yellow substance, a tadpole was produced which had muscles only on one side of its tail. Clearly in this case the organ-forming substances were visible to the naked eye, since they were distinguishable in colour, and their segregation in different regions of the embryo was the real cause of the *differentiation of the germ-layers*. In this process the individual cell was not a unit of any importance; both notochord and nerve-cord arose from the same group of cells, termed by Conklin *chorda-neural cells*; but the cytoplasm of these cells consisted of clear and blue portions, and in the subsequent divisions the clear portions were added to the ectodermic neural plate, whilst the blue portions became the endodermic notochord.

Driesch explained phenomena like these by asserting that these substances were the *conditions*, not the *causes*, of the development of organs; but another experiment, due to Morgan, which had been repeated in the laboratory of the Imperial College of Science, appeared to dispose completely of the idea of there being an intelligent entelechy presiding over development. This experiment consisted in fastening frogs' eggs to a slide, with the black pole uppermost, and fertilising them in this position. When the eggs had divided into two another slide was laid on the top of them and clamped in this position; the whole preparation was then inverted and allowed to develop for five or six days in this position. At the conclusion of this period a double-headed, or double-tailed tadpole was produced. In this case nothing was added to the egg, but the dark substance, which was specifically lighter than the white substance which constituted the rest of the egg, had readjusted itself in each cell under the influence of gravity, in a similar manner to what it would have done in the whole egg if this had been inverted before division into two had taken place. Hence the condition of the formation of a frog embryo must be the *proper spatial relationship between two organ-forming substances*.

If we adopted the view that organ-forming substances were the all-important agents in development, it became of the utmost importance to learn more about them. Observation of the developing egg of Ascaris showed that the relative proportion of such a substance in one cell as compared with its quantity in a neighbouring cell could determine the fate of the cell. This egg divided into two cells at its first cleavage, one of which produced the ectoderm and the other the internal organs. Boveri showed that if these eggs were fixed to a slide which was inserted in a centrifugal machine and a rapid rate of rotation maintained whilst the egg developed, some of them the axes of which happened to lie exactly in the radius of rotation divided into two equal cells, both of which formed internal organs, and neither of which behaved like the cell in the normal embryo, which produced ectoderm. The slightest obliquity of the egg axis to this radius caused the egg to undergo normal development. This experiment, which had been repeated by us in the Imperial College of Science, showed that some substance was present in greater quantity on the outer part of the egg, so that the upper of the first two cells received more of it than the other, and was thus determined to form ectoderm, but that when under stress of the centrifugal force the division plane separating the first two blastomeres took up an exactly radial position, so that this substance was equally distributed to both cells, neither developed into ectoderm.

The question where these substances were formed was of great importance. *A priori* considerations suggested that they must emanate from the chromatin of the nucleus, since the father was as potent in heredity as the mother, and his contribution to the zygote consisted merely of a mass of chromatin. This conclusion was confirmed both by observation and experiment. In the unripe egg of Cynthia, Schaxel had shown that streams of chromatin poured from the nucleus into the cytoplasm, and if the unripe egg of Ascaris was subjected to the most violent centrifugal force, so that it lost large portions of its substance, and was afterwards fertilised, it gave rise to a normal embryo of diminished size, showing that its cytoplasm was not yet organised as was that of the ripe egg, the different development of which under the stress of centrifugal force we have just described. The pressure experiments of Driesch and Hertwig, in which, by allowing eggs to develop in cramped positions, they disarranged the normal order of the nuclei, showed that the nuclei of the segmenting egg were alike, each possessing all the potentialities of the species, for these distorted eggs when relieved from pressure developed into normal embryos, although the nuclei had assumed abnormal positions, and it was the relative position of the *substances* produced by these nuclei, not of the nuclei themselves, which determined differentiation. Sometimes, as in Herbst's famous experiment of allowing Echinus eggs to develop in seawater to which salts of lithium had been added, it was possible to inhibit the formation of one of these substances and produce an embryo consisting entirely, or almost entirely, of endoderm. The formation of these substances appeared to last for only a short period; after that, the nuclei appeared to be without formative influence on the cytoplasm, but in animals like Polyzoa and Ascidians which bud, this budding could be best explained as due to a renewed production of organ-forming substances by the nuclei. These substances were often not distributed to the formative tissues of the bud in the same manner as in the embryo, and hence the development of the bud often followed a different course from that initiated by the embryo. The "post-generation" of the missing half, observed by Roux in his half-tadpoles, and by Chun and Mortensen in their half-Ctenophore larvæ, could be explained in a similar way by postulating a renewed activity of the nuclei at the cut surface. Considerations of this kind were fatal to the conception of Weismann of the definite segregation of germ-cells from body-cells at the beginning of development, dependent on a differential division of nuclei, or, as he termed it, the formation of definite *germ tracks*. Indeed, Gatenby had lately shown that in the frog the supposed germ-cells which were segregated at an early period of development would scarcely supply the needs of the first spawning season, and that the eggs needed for subsequent seasons were formed by the metamorphosis of ordinary peritoneal cells.

Next to the discovery of organ-forming substances perhaps the greatest discovery in experimental embryology was the influence which the primary organs exerted on each other's further development. The first discovery of this influence was due to Herbst, who showed that if the ocular peduncle of a shrimp were amputated, the animal was able to regenerate a new one, as was the case also if the other limbs were cut off; but that if the optic ganglion was also removed then an antenna-like organ was regenerated in place of an eye. From this experiment the conclusion was forced on us that in the normal development of the shrimp the ectoderm was caused to mould itself into the retinulæ and crystalline cones of the eye by some influence emanating from the optic ganglion. This influence must be some chemical substance emitted into the blood and comparable to the hormones, which we know to be emitted by organs like the thyroid gland, which so powerfully influence growth in man. Another instance of the same thing was afforded by the experiments of Lewis; this observer cut off the optic vesicle from the brain of a young tadpole, and pushed the amputated organ backwards under the skin to a new position; the wound healed up; no lens developed in the normal position, but a lens was developed from the skin situated over the optic vesicle. This experiment proved that no part of the skin was predestined to form the lens of the eye, but that any part could form the lens if acted on by the emanations from the optic vesicle beneath. A third instance was discovered from experiments in the Imperial College of Science in the rearing of the larvæ of the sea-urchin, *Echinus miliaris*. In normal development the rudiment of the water-vascular system or "hydrocœle" was formed from the cœlomic vesicle on the left side of the larva. Above it the ectoderm became invaginated so as to form the amniotic pit, from the floor of which were developed pointed spines and tube-feet, whilst beneath the hydrocœle a series of pockets grew out from the left posterior cœlomic vesicle which developed into Aristotle's lantern. On the right side of the larva two calcareous plates were developed bearing square-topped spines and pedicellariæ. Under the influence of certain stimuli the larva could be made to develop a second hydrocœle on its right side, and when this took place, from the octoderm of the right side and from the right posterior cœlomic vesicle respectively a right amniotic pit with spines and tube-feet and a right Aristotle's lantern were developed. In other circumstances the formation of a hydrocœle could be inhibited altogether, and then calcareous plates bearing spines were formed on both sides of the larva.

If the second or right hydrocœle was small, it failed to inhibit the formation of plates bearing spines and pedicellariæ proper to the right side, so that both hydrocœle and pedicellariæ could be present together on the same side. The only possible explanation of these facts was the view that any part of the ectoderm could form an amniotic pit, and either left or right cœlomic vesicles could form an Aristotle's lantern, if acted on by influences emanating from the hydrocœle, and that both sides of the larva were really alike in their constitution, and that in the total absence of a hydrocœle each produced calcareous plates with spines.

The discovery of the profound influence exercised by the growing tissues of the embryo on one another lent some support to Dr. J. T. Cunningham's theory of the inheritance of acquired qualities based on the facts known as to the influence of hormones on the growth of the human body. If it should turn out, as seems, from the results of these experiments, to be the case, that the production of hormones was not at all confined to certain ductless glands, but was a much more widespread phenomenon, we could understand that if, through an alteration in external conditions, a change was induced in some tissue, its chemical emanations would be altered. If, further, these altered substances, circulating in the body fluids, were ultimately stored up in the germ-cells, then eventually as the germ developed the corresponding alteration would be produced in the tissues of the young animal, even before it was exposed to the changed environment.

Of course, the proof that such an influence of a changed environment on subsequent generations was possible must ultimately be found by experiment, and the inherent difficulty of such experiments was very great, but some suggestive work by Kammerer on the inheritance of colour in Salamanders seemed really to supply positive evidence in favour of the inheritance of environmental influence.

In conclusion, let us bear in mind that the hormone theory of the inheritance of acquired characters which a study of experimental embryology inclines us to regard with favour was in principle identical with the theory of "pangenesis" propounded by the founder of modern biology, Charles Darwin.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

London.—A series of public lectures, under the general title of "The University and the Nation," will be delivered on Wednesdays, at 5.15 p.m., at King's College. The lectures will be as follows:—October 25, The Root Fault in the English Attitude to Education, Dr. Burrows, Principal of King's College; November 1, Science and Industry, Mr. James Swinburne; November 8, Science and the Training of the Citizen, Principal Griffiths; November 15, The Spiritual Appeal of the Humanities, Mr. A. C. Clutton-Brock; November 22, The Intellectual Groundwork of Politics, Dr. H. A. L. Fisher; November 29, Education—the Curse of Convention, Mr. Graham Wallas.

Dr. Marie Stopes will begin a course of six lectures and demonstrations on "The Bennettitales" on October 17, at 5 p.m., at University College. The course will be illustrated by lantern-slides and specimens, including microscopic sections of new species. Further particulars can be obtained from the secretary of University College.

Prof. J. A. Fleming will deliver a public lecture on "Long-Distance Telegraphy and Telephony," at University College, on Wednesday, October 18, at 5.30 p.m. This lecture is open to the public without fee or ticket.

Oxford.—On October 7 the Vice-Chancellor (the Very Rev. T. B. Strong, dean of Christ Church), on entering upon his fourth year of office, delivered the customary address. After mentioning that about 10,500 members of the University were serving in the Army and Navy, and about 500 were in other Government employment, he spoke of the distinctions gained by them in the present war, including 9 V.C.'s, 120 D.S.O.'s, and 700 mentions in despatches. Passing on to speak of the educational deficiencies which had been disclosed by the war, he said that the University must find some way to remedy the neglect of the claims of natural science. Average people were not likely to become advanced students of science, but they wanted everybody, including the average people, to be aware of, or in some degree to understand, the scientific point of view. The country would have to give up its prevalent attitude of distrust towards expert knowledge. The new statute relating to the Honour School of Chemistry was an attempt by the University to put the study of that science on a more satisfactory footing. But it should not be forgotten that the majority of Oxford men would be engaged in the work of administration, for which the knowledge of men was essential.

The University has received with much regret the news of the death of Mr. Horace Hart, who for more than thirty years conducted, as controller, the business of the University Press with marked ability and success.

A meeting of the Association of Technical Institutions will be held in London on Friday and Saturday, October 20–21. For some time it has been felt that the members of the association should meet together to consider educational questions having special bearing on the work of technical schools and colleges. The governors of the Imperial College of Science and Technology, South Kensington, have placed rooms in the college at the disposal of the association for the purposes of the conference. Sir Alfred Keogh, K.C.B., president of the association, will preside over the meeting. The Right Hon. A. H. Dyke Acland, chairman of the Executive Committee of the Governors of the Imperial College, will welcome the delegates to the college at their first session. On the Friday morning Lord Haldane will deliver an address on "Education after the War, with Special Reference to Technical Instruction." This will be followed by a paper by Sir Trevor Dawson (of Vickers, Sons and Maxim) on "Education after the War, with Special Reference to Engineering Instruction." The afternoon of Friday will be devoted to a discussion of the address and paper. On Saturday, October 21, Major Mitchell, director of the Regent Street Polytechnic, London, will read a paper on "What Can be Done to Train Disabled Sailors and Soldiers in Technical Institutions," to be followed by a discussion.

In presenting the Education Estimates to the House of Commons on July 18, the President of the Board of Education said that in addition to three committees of experts to investigate different educational questions, a fourth committee was to be appointed which would be a Reviewing Committee. The three expert committees are dealing respectively with the education and care of young persons after the war, and the position of science and modern languages in our educational system. Mr. Bonar Law stated, in the House of Commons on October 10, that the Reviewing Committee, which will be a sub-committee of the Prime Minister's Reconstruction Committee, has for its terms of reference:—"To consider the system of education as a whole; to review and formulate from that point of view proposals for developing it, particularly in directions indicated as desirable or necessary by experience gained during the war, and with special reference to:—(*a*) Proposals prepared before the war for the development of the national system of education; (*b*) the memoranda already submitted by the Education Departments for the consideration of the Reconstruction Committee; (*c*) any proposals submitted hereafter from the departments, or from special committees, or from other responsible organisations; and to recommend from time to time such action, whether by way of legislation or otherwise, as may be practicable." It is understood that this Reviewing Committee will consist of Cabinet and ex-Cabinet Ministers, and possibly of some other persons to be called in for advisory purposes, but no announcement has yet been made as to the actual membership.

At the invitation of the Universities of Leeds and Sheffield a party representative of the Institute of Journalists, the Circle of Scientific, Technical, and

Trade Journalists, and the British Association of Trade and Technical Journalists paid a visit to these cities on October 8–10. At Leeds University the visitors were received by the Vice-Chancellor, Dr. M. E. Sadler, who gave an inspiring address descriptive of the University's work and its close associations with local industries. The departments visited included those dealing with organic and tinctorial chemistry, leather manufacture, textile work, gas and fuel. The members of the party were then the guests of the Leeds Luncheon Club, after which the Leeds Army Clothing Depôt, the works of Messrs. Albrecht and Albrecht (khaki garment manufacturers), and the Cardigan Boot Factory were inspected, these industries being selected in view of their close connection with the work of the University. Finally, the visitors were the guests of the Lord Mayor for tea. At Sheffield the Vice-Chancellor, Dr. H. A. L. Fisher, also addressed the visitors, who were conducted over the chemical and medical departments, while Prof. Ripper gave an account of the many special interesting researches undertaken on metallurgy and the testing of steel. The factories visited included the armament works of Messrs. John Brown and Co., where the party was invited to lunch by the Master Cutler, and the shell factory of Messrs. Thos. Firth and Sons. A feature in the arrangements at both cities was the co-operation of journalists representing the local papers, and the visits furnish an interesting illustration of the growing desire for closer relations between the universities and the Press. The visitors were much struck by the pride taken by Leeds and Sheffield in their universities, and the general recognition among local manufacturers of the value of the work that is being done there.

BOOKS RECEIVED.

The Loose Leaf Laboratory Manual. Electrical Measurements and Testing Direct and Alternating Current. By C. L. Dawes. (New York: J. Wiley and Sons, Inc.) 3*s.* net.

Lectures on Ten British Mathematicians of the Nineteenth Century. By A. Macfarlane. Pp. 148. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5*s.* 6*d.* net.

Engineering Applications of Higher Mathematics. By V. Karapetoff. Part ii., pp. v+103. Part iii., pp. v+113. Part iv., pp. v+81. Part v., pp. vii+65. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 3*s.* net each.

The Psychology of the Organized Group Game, with Special Reference to its Place in the Play System and its Educational Value. By M. J. Reaney. Pp. 76. (Cambridge: At the University Press.) 5*s.* net.

A History of British Mammals. By G. E. H. Barrett-Hamilton and M. A. C. Hinton. Part xix. (London: Gurney and Jackson.) 2*s.* 6*d.* net.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. iii., part 7. (Sydney: W. A. Gullick.) 2*s.* 6*d.*

The Essentials of Chemical Physiology. By Prof. W. D. Halliburton. Ninth edition. Pp. xi+324. (London: Longmans and Co.) 6*s.* net.

The Rt. Hon. Sir Henry Enfield Roscoe. a Biographical Sketch. By Sir E. Thorpe. Pp. viii+208. (London: Longmans and Co.) 7*s.* 6*d.* net.

La Chimie des Eléments Radioactifs. By Prof. F. Soddy. Translated by E. Philippi. Pp. 173. (Paris: Gauthier-Villars et Cie.) 5 francs.

Aérodynamique. By N. Joukowski. Translated by S. Drzewiecki. Pp. xviii+227. (Paris: Gauthier-Villars et Cie.) 11 francs.

Notions Générales sur les Appareils à Réaction. By P. Popovatz. Pp. 35. (Paris: Gauthier-Villars et Cie.)

Report of the Director-General of Public Health, New South Wales, for the Year ended December 31, 1914. Pp. v+206. (Sydney: W. A. Gullick.) 7*s.*

Carnegie Endowment for International Peace. Year Book for 1916. Pp. xvii+204. (Washington, D.C.)

The Geology of Ben Nevis and Glen Coe, and the Surrounding Country. By E. B. Bailey and others. Pp. x+247. (Edinburgh: H.M.S.O.; London: E. Stanford, Ltd., and others.) 7*s.* 6*d.*

The Technical Chemists' Handbook. By Prof. G. Lunge. Second edition. Pp. xvi+264. (London: Gurney and Jackson.) 10*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, OCTOBER 12.

CHILD STUDY SOCIETY, at 6.—The French Child at School: Cloudesley Brereton.

TUESDAY, OCTOBER 17.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Norfolk Oil shales: W. Forbes-Leslie.

WEDNESDAY, OCTOBER 18.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Certain Parasites of the Mouth in Cases of Pyorrhœa: Dr H. Pixell Goodrich and M. Moseley.

ENTOMOLOGICAL SOCIETY, at 8.—Parthenogenesis in Stick-Insects: H. Ling Roth.—Diptera from the Falkland Islands: C. G. Lamb.

FRIDAY, OCTOBER 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Trials on a Diesel Engine, and Application of Energy Diagram to obtain Heat Balance: The late Lieut. Trevor Wilkins; presented by Prof. Burstall.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

No. 2451, Vol. 98] THURSDAY, OCTOBER 19, 1916 [Price Sixpence.

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THURSDAY, OCTOBER 19, 1916.

REMINISCENCES OF RAPHAEL MELDOLA.

Raphael Meldola: Reminiscences of his Worth and Work by Those Who Knew Him, together with a Chronological List of his Publications, MDCCCLXIX–MDCCCCXV. Edited by James Marchant. Pp. xv+225. (London: Williams and Norgate, 1916.) Price 5s. net.

ALTHOUGH the late Prof. Meldola's oft-repeated warnings to the nation on the decline of our chemical industries would fully entitle him to a place among the prophets, yet it could not truly be said of him, as was stated of the earlier seers, that he was "not without honour, save in his own country," for in spite of the distractions and anxieties of the present troublous times, more than twenty of his friends and colleagues, men eminent in their respective professions, have already in a few months contributed in his memory their tributes of appreciation and respect. These reminiscences of Meldola's worth and work have now been collected in a convenient volume which includes a chronological list of his original papers and other publications.

The biographical memoir by Sir William Tilden serves to emphasise the many-sided character of Meldola's scientific activities. Not only was he a brilliant chemist of wide experience, with special knowledge of synthetic dyes, but he was also a practical astronomer and a first-rate biologist.

A glimpse of Meldola's early days is furnished by Miss Neumegen, whose father taught him from the age of seven to fourteen years. His first chemical lecture was delivered at the age of fifteen to an audience of schoolfellows, of whom Sir Isidore Spielmann was one. Reminiscences extending over a period of forty years are contributed by Sir Edward Thorpe. Some of the incidents recorded have their humorous side, and testify to Meldola's sense of fun and love of the whimsical. His surpassing merits as professor of chemistry are cordially depicted by his former pupils, Dr. M. O. Forster and Prof. W. J. Pope, and by his colleagues of the Finsbury Technical College, where he presided over the chemical department for thirty years.

Prof. Green deals sympathetically with the classification of his technical and scientific researches. The technical investigations were often of a pioneer character. They opened up new ground, but in many cases the harvest was reaped in other countries. The first oxazine dye, "Meldola's blue," was not introduced into commerce in England, but was manufactured in Germany, where it became the forerunner of the still more important gallocyanine blues. His study of beta-naphthylated rosaniline led to a sulphonic acid which has since acquired importance in cotton dyeing. The researches on azo-dyes, although ignored in England, were utilised profitably by the astute colour-makers of Germany. His scientific chemical work can be classified under eight headings, of which the most important are the studies on azo- and diazoamino-compounds, and on substitution in the naphthalene series. In recent years Meldola and his assistants were engaged in studying imidazole and quinone ammonium bases, these researches being still in progress when death overtook him last November.

Prof. Poulton, who edits the bibliography of published works, contributes also an essay on Meldola as a naturalist. This appreciation contains many interesting reminiscences, some of which are published for the first time. Although Meldola received numerous scientific and academic honours from British sources, it is significant that during his lifetime he was even more appreciated in France. Twice he was offered a decoration of the Legion of Honour, and one learns with amazement that on each occasion the Foreign Office forbade him to accept this distinction!

Where so many distinguished contributors have united in a labour of love to place on record their happy recollections of this great teacher's work and personality, it would be superfluous to add more than that all these praises are worthily bestowed as a last fitting tribute to a life of high ideals and great accomplishment. It may, however, be mentioned that in addition to his published works and the grateful remembrances of his pupils, Meldola leaves behind another memorial in the form of a unique collection of research chemicals. The writer and two other former students of Prof. Meldola have spent a portion of the summer recess in arranging and cataloguing this collection, of which the specimens represent every phase in his career as chemical investigator. The preservation and study of these historical substances will constitute another method of keeping his memory green in the school of chemistry which he inspired and adorned for many years.

G. T. M.

ANIMA ANIMANS.

The Breath of Life. By John Burroughs. Pp. xi+295. (London: Constable and Co., Ltd., 1915.) Price 5s. net.

TWO ideas struggle for mastery in the mature reflections of this lover of nature and poetry: the one the super-mechanical and super-chemical character of living creatures, the other the continuity of natural processes and the universality of natural law. Living organisms transcend machinery; they are so persistent, insurgent, constructive, and inventive; but they are not possessed by any extraneous entelechy. They are solidary with the inanimate, though the creative energy or "procreant urge" finds freer expression in them than it does in crystal or star. It is a modernised hylozoism to which the essays composing this volume give beautiful expression: "The psychic arises out of the organic, and the organic arises out of the inorganic, and the inorganic arises out of—what? The relation of each to the other is as

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intimate as that of the soul to the body; we cannot get between them even in thought, but the difference is one of kind and not of degree." There is much in the volume about the wonders of the inorganic domain, especially under the eyes of modern chemists and physicists, but the refrain is always what Tyndall called "the mystery and the miracle of vitality." Thus, to mention half of the fascinating studies, we have discussions of "The Breath of Life," "The Living Wave," "The Baffling Problem," "Scientific Vitalism," and "The Vital Order."

It is not easy to describe the life of the bee-hive without the postulate of psychical organisation, what Maeterlinck called the Spirit of the Hive; so to Burroughs it appears necessary to recognise a more than physico-chemical unity of the organism, in which the cells are the bees, and thus he speaks of the Spirit of the Body. But this vitality is potential in all matter, though it finds opportunity to manifest itself with emphasis in protoplasm. Vitality begins in the inmost sanctuary of the molecules, "but whether as the result of their peculiar and very complex compounding or as the cause of the compounding—how are we ever to know?" The striking essay entitled "A Bird of Passage" develops the idea that life plays a very small part in the total scheme of things, "the great cosmic machine would go on just as well without it." Yet it is only in the highest expressions of life that the total scheme of things acquires any meaning at all. And the author ends with the thought, which he knows to be beyond science, that there is a kind of universal mind pervading not only living matter, but the stuff of which the whole world has been spun. As the reader is warned in the preface, there is considerable reiteration in the course of the essays, but with a writer like Burroughs the impression left is that of music with a recurrent theme.

J. A. T.

DIOPHANTINE ANALYSIS.

Mathematical Monographs. No. 16, *Diophantine Analysis*. By R. D. Carmichael. Pp. vi+118. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 5*s*. 6*d*. net.

THE remarkable thing about Diophantine analysis is that, although it is quite respectably old, it is still in that stage where the amateur is on an equal footing with the professional. If it be true, as we are inclined to think, that Fermat's last theorem admits of a Diophantine proof, this is as likely to be discovered by a schoolboy as by a professor steeped in all the lore of modern analysis.

Prof. Carmichael's book is welcome because it gives, either in the text or in the examples, a great deal of the actual results hitherto obtained; and the author has done something towards sorting out these results and adumbrating a real theory. In this respect chap ii. (on multiplicative domains) is the most valuable. Chap. v. gives a brief but up-to-date account of what is known about Fermat's last theorem. Important sections are those which treat of Fermat's methods of "descent" and of "double equations"; these, at any rate, are definite processes capable of extension to various cases.

The weak point of the book, in our opinion, is that the author never looks at a problem from a geometrical point of view. Of course, in the last resort, geometry is irrelevant; but in research it is very valuable. For instance, let $F(x, y, z)$ be a homogeneous cubic; then from the theory of curves we can conclude that if $F=0$ has an integral solution (x_1, y_1, z_1), it has a sequence (x_n, y_n, z_n) of integral solutions, which in most cases corresponds to a compact set of points on the curve $F=0$. The proof of this is most easily obtained from elliptic functions; there ought to be a purely Diophantine proof, but the difficulty is that we have to estimate the "nearness" of a solution (x', y', z') to a solution (x, y, z), and (x_2, y_2, z_2) in the sequence is not generally "near" to (x_1, y_1, z_1) in the geometrical sense. Again, if we have a unicursal surface, such as that given by the parametric equations,

$$x=\frac{a(\lambda\mu+1)}{\lambda+\mu},\quad y=\frac{b(\lambda-\mu)}{\lambda+\mu},\quad z=\frac{c(\lambda\mu-1)}{\lambda+\mu},$$

whence $x^2/a^2+y^2/b^2-z^2/c^2=1$, this suggests corresponding Diophantine theorems. Then, too, we have to consider solutions which, though not integral in the ordinary sense, are integral in certain algebraic fields; for instance, if $2\rho=-1+i\sqrt{3}$, then $(25-6\rho,\ 1-9\rho,\ 8+30\rho)$ is a solution of $x^3+7y^3-z^3=0$, which is integral in the field (ρ), although it is not so in the field (1). In the latter field we have the solution $(1, 1, 2)$; the reader is left to discover whether there are any other ordinary integral solutions, and if so, how many.

There are numerous exercises in the book which ought to stimulate the reader; some of them are practically suggestions for research. As a rule, it is unfair to expect a mathematical writer to give exact references to the sources of his examples; but in this case we wish Prof. Carmichael had been a little more definite, because in this subject even a short note on a very special problem may possibly contain the germ of an important discovery. As an instance of what we mean, Eisenstein's proof of the irreducibility of $(1-x^p)/(1-x)$, when p is prime, is based on a theorem of his which must surely admit of some generalisation. To find whether any given polynomial is irreducible or not is practically such a laborious task (though theoretically possible) that special theorems like Eisenstein's are always welcome.

We hope that this book will have a wide circulation among mathematicians of all ages and capacities; it is rather a disgrace to the moderns that in this field they have added so little to the work of that great triumvirate, Diophantus, Fermat, and Euler.

G. B. M.

THREE TEXT-BOOKS OF PHYSICS.

(1) *A Manual of Practical Physics.* By H. E. Hadley. Pp. viii+262. (London: Macmillan and Co., Ltd., 1916.) Price 3s.

(2) *Text-book of Mechanics.* By Prof. Louis A. Martin, jun. Pp. xviii+313. Vol. vi: *Thermodynamics.* (London: Chapman and Hall, Ltd., 1916.) Price 7s. 6d. net.

(3) *An Intermediate Text-book of Magnetism and Electricity.* By G. F. Woodhouse. Pp. x+264. (Sedbergh: Jackson and Son, 1916.) 6s. net.

IT is always of interest to study text-books written by those engaged in teaching, and to note the special points which their experience as teachers leads them to emphasise.

(1) Mr. Hadley, who is principal of the School of Science at Kidderminster, is the author of a number of excellent works on physics, and the present small volume gives further proof of his ability as a clear exponent of physical principles. The book is suitable for the upper classes at schools where practical physics forms, as it should do, part of the science course. It is scarcely correct to say that it covers the work necessary for a present-day intermediate course, as many of the experiments described are qualitative rather than quantitative, and some are more suitable for the teacher to demonstrate in front of his class than for the students themselves to carry out. A noteworthy feature is the simple apparatus required for most of the work—the determination of the centre of gravity of a wickerwork basket suggests a new use for the editorial wastepaper basket!

It is open to question whether it is desirable to retain the definition of specific heat as a ratio (p. 116). In actual practice what is required most frequently is the "thermal capacity of unit mass," which is expressed in calories per gram per degree. Unless this is used the "dimensions" of an ordinary heat equation are incorrect. We may note in passing that for the same reason the value of a latent heat should be expressed, not in calories (p. 122), but in calories per gram. It has been pointed out in NATURE (vol. xcv., p. 427) that the British use of "specific" is hopelessly inconsistent, and it is only necessary to compare the definition of specific resistance on p. 225 with that of specific heat to appreciate the absurdity of our present nomenclature. A new term to denote the thermal capacity of unit mass of a substance is much to be desired.

A series of observations with an ammeter and a tangent galvanometer is followed by the remark: "This demonstrates that the current is proportional to the tangent of the angle of deflection." As the tangent galvanometer is an absolute instrument, it is obvious that no such result can be proved by its use.

(2) Prof. Martin has produced a useful text-book on thermodynamics for engineering students. It forms the sixth volume of a series by the same author. Without going into excessive detail the writer has succeeded in giving a remarkably clear outline of the essentials of the subject. Although the treatment is elementary, differential equations are used throughout, their meaning being explained in such a way as to lead the student forward step by step. A large number of numerical exercises are provided throughout the work and at the end of the book. British thermal units are alone employed. The diagrams are very good, and the typography is such as to give every assistance to the student in his study of the subject.

(3) The "Intermediate Text-book of Magnetism and Electricity," by Mr. Woodhouse, senior science master at Sedbergh School, combines practical instruction with theoretical discussion. A large number of simple experiments described in the text may be carried out by the student with no great outlay in apparatus. The author is probably right in saying that the electrolytic definition of the unit of current is more readily grasped by the average student than the electro-magnetic, but we are of opinion that greater emphasis should be laid on the distinction between the practical definitions of electrical units (the so-called international units) and the absolute definitions. The book would be much improved by a careful revision: the style is frequently curt and sometimes inelegant. Many students have been penalised in examinations for giving as the second law of electrolysis: "The weight of an element deposited is proportional to the electro-chemical equivalent." The strength of a magnetic field is not measured in dynes (p. 53), but in dynes per unit pole or gausses.

We strongly endorse the opinion of the author that all students of physics should learn the calculus. A portion of Appendix I. is devoted to explaining, briefly, the principles and method of differentiating and integrating simple quantities. Several well-known text-books of physics are marred by attempts to evade the use of the calculus. It is far better to adopt the author's plan and devote a little space and time to introducing the elements of the calculus than to employ tedious and unnecessary investigations which are only differentiation or integration in disguise. Appendix II. contains a description by Mr. J. W. Shepherd of a wireless set which, in more favourable days than the present, may be set up by the student who has obtained permission from the Postmaster-General.

H. S. A.

OUR BOOKSHELF.

Le Climat de la France: Température, Pression, Vents. By G. Bigourdan. Pp. 135. (Paris: Gauthier-Villars et Cie.) Price 4·fr.

THIS publication, dealing particularly with temperature, pressure, and winds, is rather a compilation than otherwise, free use being made of the original scientific discussions by M. Angot. Temperature observations made in France go back to the middle of the seventeenth century, but, as in other countries, the early observations were made with imperfect instruments, and the exposure was often bad, the results in consequence being unsatisfactory. There are only fourteen stations in France at which the observations cover a period of fifty years, from 1851–1900, but fairly long periods are given for fifty-eight stations which constitute the principal values dealt with. Mean temperature charts are given for each month, and there are also seasonal charts for winter, summer, and for the year. Diurnal range of temperature is also dealt with. Barometric pressure is treated in a very similar manner to the temperature, and mean pressure charts are given for all months and for the year. A chapter is devoted to the disturbances of the atmosphere, and a detailed description is given of the general movement of cyclonic and anticyclonic systems. Maps are given showing the prevailing winds and the resultants for the four seasons of the year. M. Bigourdan provides a good *résumé* of the climate of France in about 130 pages, and the information is expressed in a popular manner, although its scientific accuracy is all that could be wished. The numerous charts enable the reader to obtain the several meteorological factors for any part of France.

The Psychology of Relaxation. By Prof. G. T. Patrick. Pp. viii + 280. (London: Constable and Co., Ltd., 1916.) Price 5*s*. net.

On the further side of the Atlantic one of the world's great peoples has been swept away by a passion for wild and crazy amusement; on this side the others are locked in the bloodiest war the world has seen: these are the phenomena, at first sight antithetically diverse, which Prof. Patrick brings together in his study of "relaxation." With them he sets the craving for alcohol, constantly rising in spite of prohibitive legislation, and—*longo intervallo*—the habits, widespread if not omnipresent, of laughter and profane language. In the author's view all these forms of human behaviour are, at bottom, illustrative of a single principle. The activities and relations of civilised life imply the upbuilding and functioning of extremely complex mental mechanisms, full of tensions, restraints, and inhibitions. To maintain these always in operation is an impossible task. From time to time, therefore, the complexes break up, and man falls back with relief into conduct expressive of simpler mental structures organised and consolidated in the far distant days of the race's childhood: he plays, he laughs, he swears, he fights. Alternatively, he seeks the same end—the temporary dissociation of his too complex mental mechanisms—by means of the narcotic power of alcohol.

Prof. Patrick finds much to say in defence of his thesis—even for his rather startling view of war as a gigantic "rest-cure"—and says it very well. The cautious reader will, however, feel that he has pressed a sound principle of interpretation much too far—that he has brought into clear relief one factor in the phenomena he analyses, but at the expense of neglecting others of equal significance. Still, *his* factor is undoubtedly one of great importance, and his exposition of its *rôle* is both informative and pleasant to read.

T. P. N.

LETTERS TO THE EDITOR.

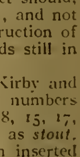
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Elasticity and Entomology.

In NATURE for June 22 (vol. xcvii., p. 340) there appeared an interesting letter under the above heading from the pen of Prof. Bryan. Perhaps I may be permitted to contribute some further remarks on the same subject, although my distance from the centre of Empire must necessarily entail a long delay before publication.

Unfortunately, the method of setting insects upon "Continental" pins does not appear to be "old-fashioned," for a large number of specimens received by me from all countries (excluding England, where, on the other hand, the insects are often set too low) are set in this obnoxious manner. In dealing with the same I always handle them by placing the forceps upon them under the insect, at a point only slightly above the level to which they are to be driven into the cork. Even so, the danger of vibrations, causing loss of antennæ, etc., cannot wholly be obviated. After many years' experience I have come to the conclusion that the shorter pins of English make, be they "silvered," "gold," or black, are in every way preferable to the long German pins. The insect should, however, be set at least half-way up the pin, and not so low down as is necessitated by the construction of many of the peculiar "curved" setting-boards still in use in England.

Using the numbers of the well-known "Kirby and Beard" make of pins, out of the following numbers which I have in use every day, viz. 1, 3, 5, 8, 15, 17, and 19, Nos. 1, 3, 5, and 8 may be classed as *stout*, and can be relied upon never to bend when inserted into cork or "lino," unless handled extremely roughly. Nor, so far as I can see, is there any deterioration in the elastic quality of such pins over a period of at least twenty years. On the other hand, Nos. 15, 17, and 19 must be classed as *slender* pins, and can never be relied upon, for certain, not to buckle under the pressure necessary to place the insect firmly in the cabinet. As all the smaller kinds of insects must be set upon one or other of these pins, or upon the even smaller silver-wire pins known as "caps," I have come to the conclusion that the only safe plan in all these cases is to use the Polyporus strips first suggested by Lord Walsingham—who, I believe, found this fungus growing in Merton Park, and ingeniously turned it to entomological use. As these strips are now sold by at least one firm in Australia, no doubt they are easily obtainable in England. A short piece of the strip is cut off and placed on a No. 8 pin, as shown in the illustration; the finer pin carrying the insect is gently inserted into the other end of the strip. The label may then be placed on the larger pin, below the strip, *facing upwards*, so that it can be read without moving the insect. I have a series of a new species of Coniopterygid, expanse only 3 mm., and the smallest Neuropterous insect known to me, set in this manner upon "caps," and they look extremely neat in the cabinet.



Returning to the subject of vibrations, might I suggest the use of a very simple expedient to obviate the constant breaking-up of the abdomen in those insects with long or fragile bodies, such as dragonflies? This is the process of bristling, which I have used with success for years, but which I have never seen adopted in the setting of specimens received from my brother entomologists. For large species the "bristle" should be a true hog's bristle of the kind obtainable at curriers'; for smaller, a stiff horse-hair. The "bristle" is sharpened by a diagonal cut with the scissors, and is then inserted between, and a little in front of, the mesocoxæ, and is run down to near the end of the abdomen, care being taken not to damage the appendages, and allowing a little space over for shrinkage during drying. It is then cut off close to the thorax. Even the soft-bodied Perlidæ can be much improved by this method.

R. J. Tillyard.

Hornsby, N.S.W.

Early Use of the Word "Blizzard."

In a communication to Nature of June 22 (vol. xcvii., p. 341) Mr. Miller Christy states that the first appearance of the word "blizzard" in "permanent literature" was in 1885, when he used it in his work, "Manitoba Described," and that the description of the phenomenon therein by Mr. Thompson Seton was the earliest ever published.

As one of the American meteorological specialities, the blizzard has always received attention by the Canadian and United States Weather Bureaus. The very earliest use of the word has not yet been ascertained, but it has been found in current use as the name of the storm Mr. Christy describes, at least as early as 1867. In that year the *Dakota Republican* published, at Vermilion, Dakota, an account of the blizzard that suddenly approached that town, and called the storm by *that name as one in common use* when applied to a sudden change from warm and balmy weather to a blinding snow with cold north-west winds.

The earliest known description of "blizzard" phenomena seems to have been that by Henry Ellis in his account of his visit to Hudson's Bay in the *California* in 1746, and his winter at York Factory. However, Ellis did not apply the name "blizzard" to the storms he described.

Brief notes on the name "blizzard" will be found in the *Monthly Weather Review*, Washington, December, 1898, p. 562; January, 1899, p. 18; and December, 1914, p. 692.

The name "blizzard" for "a cold-wave gale with very low temperature and fine driving snow" is recorded by C. A. Lounsberry as being in use in Dakota, Iowa, and Minnesota as early as 1865. The *American Meteorological Journal*, July, 1886, pp. 112–14, quotes an excellent description of the blizzard by Mr. Lounsberry in the *Northwest Magazine*.

Otto Klotz.

Dominion Observatory, Ottawa, October 2.

THE FUTURE OF THE ZINC-SMELTING INDUSTRY IN GREAT BRITAIN.

In 1913 the world's production of the metal zinc, or, to give it its trade name, spelter, was 985,142 English tons (2240 lb.). Of this Great Britain produced 58,298 tons, *i.e.* 5·9 per cent. On the authority of Moulden,[1] however, it may be stated that "probably not more than 31,290 tons were 'primary' spelter in the sense of being extracted from ores, the balance of 27,008 tons being the result of treatment of by-products, galvanisers' ashes, hard-spelter, etc." In the same year Great Britain imported 145,004 tons of spelter, which, at the average ruling price, "ex ship," represents a total value of 3,291,772*l*. In other words, this country in the year before the outbreak of war was producing—even including "secondary" metal—only 30·1 per cent. of its spelter requirements. The galvanised iron industry absorbed about 60 per cent. of the above production, the manufacture of brass from 20 to 25 per cent., while the remainder was used for the manufacture of sheets, alloys other than brass, etc.

The bulk of the spelter imports was obtained from Germany and Belgium, each of them a large producer of the metal, and each of them a large importer of zinc ore from the most important zinc mine in the British Empire, at Broken Hill, Australia. This ore consists of an intimate mixture of argentiferous galena and blende occurring in a gangue chiefly composed of rhodonite, quartz, and garnet. It is treated by concentration and separation processes so as to give two main products, a lead ore and a zinc ore concentrate, the latter containing about 46–48 per cent. of zinc with certain values in lead and silver. The output of zinc concentrates before the war was about 500,000 tons annually. Apart from the ore which was smelted at Port Pirie, and about 20,000 tons which were sent to England and smelted at the Sulphide Corporation works at Seaton Carew, "the whole of the zinc concentrates in the past has been sold under long-term contracts to smelters in Belgium and Germany."[2] The Germans had acquired a controlling interest in the most important Belgian works, and, according to Moulden, utilised this control to make money, which they did by passing the greater part of their concentrates on to the Belgian works for smelting. "Of the total Australian output Belgium smelted at least 75 per cent. and Germany only 14 per cent."[3]

On the outbreak of war in August, 1914, the following situation arose:—

(1) Germany was unable to take delivery of Broken Hill concentrates owing to the command of the seas which Great Britain immediately obtained and has ever since held.

(2) The Belgian works, which soon fell into German hands as a result of the military invasion, were equally unable to receive their share of the concentrates.

(3) Australia thus lost nearly all her market for zinc concentrates.

(4) Great Britain was deprived of by far the greater part of her imports of spelter.

Great Britain thus found herself in the anomalous and dangerous position that, with the command of the seas and an immense supply of zinc ore in the Empire, there was, owing to the lack of smelting works, no prospect of converting it into metallic zinc; and zinc as a constituent of cartridge brass is an indispensable munition metal. It is, of course, obvious that such a situation should never have been allowed to arise, and it will naturally be asked why should not all

[1] Le Neve Foster Prize Essay. Journal of the Royal Society of Arts, 1916, p. 526.

[2] Smith, "The Development of the Spelter Industry." Journal of the Institute of Metals, No. 2, 1916.

[3] Journal of the Royal Society of Arts, 1916, p. 528.

the Broken Hill concentrates have been treated in the British Empire. The answer is that they could have been, they should have been, and perhaps they may yet be.

The effect of the above situation was felt more quickly in Australia than in Great Britain. The mines, deprived of the greater part of their market, had to curtail production very considerably, and it is to their credit that, in order to minimise hardships among their labouring population, they continued to produce considerably more ore than they could for the time being dispose of. It was not until the spring of 1915, when the Ministry of Munitions was created in this country, and it was realised upon what a gigantic scale it would be necessary to manufacture cartridges, shells, etc., that the extent of the shortage of zinc became apparent. Moreover, the zinc famine was not confined to Great Britain. France could produce nothing like her requirements, Russia and Italy still less, Belgium and Serbia none at all.

With one accord the Allied countries turned to the United States of America, the largest producer of zinc in the world, and it is no exaggeration, but the simple truth, to say that that country saved the situation. Her zinc smelters have been very highly paid for their services. For many months Great Britain was obliged to pay more than 100*l.*, and sometimes 125*l.*, a ton for metal which normally costs between 22*l.* and 25*l.* But the dominating fact is that no other nation could have come to the rescue in the way the United States did. In 1913 they produced 320,283 metric tons of zinc (2204·6 lb.); they consumed 313,300. The balance available for export was thus 6983 tons. In other words, the American smelters had practically no balance available, and had to create with the utmost rapidity conditions which would enable the very large demands of the Allies to be met. Mr. W. R. Ingalls, one of the greatest authorities on zinc smelting in the United States, estimates [4] that the spelter production in 1915 was 452,000 English tons, and that for 1916 an output of at least 714,000 tons seems assured. What these figures mean can be adequately appreciated only by those who know what is involved in the expansion of an industry where mining and ore-dressing operations, transport and assemblage of materials, erection and operation of furnaces, and, most difficult of all, the training of the necessary labour are concerned. Mr. Ingalls contents himself with remarking that "the manner in which our spelter production in 1915 was expanded is one of the romances of our industry."

Canada and Japan have increased their output of zinc to a considerable extent, but the augmentation of output in Great Britain and Australia has not been large. What is going to be the future of the zinc-smelting industry in this country? This is the question which has been exercising the minds of those who have the welfare of this industry at heart ever since the lamentable and dangerous situation at the outbreak of war was revealed. There is no doubt at all that Great Britain can become, and indeed ought to become, one of the greatest centres of production of spelter in the world. But is she going to, and are steps being taken to see that she shall? Certain considerations appear to bear on this question, and an enumeration of them may perhaps aid in presenting the situation as it appears to the writer.

(1) No zinc concentrates will be shipped to Germany in future. Australian legislation, confirmed by the House of Lords, has decided this. The Australian mine-owners will therefore have to find fresh markets for that proportion of their ore which previously went to Germany.

(2) Germany, in spite of the length of time that her own ore deposits have been worked, still has large supplies. She has also considerable zinc-mining interests in China, and before the war shipped zinc concentrates from that country. She will not fail to develop her trade in this direction after the war, and will continue to be an important producer of spelter.

(3) The United States zinc smelters will be very formidable competitors after the war. They have used their large profits wisely in making their plants efficient and up-to-date, and in accumulating large financial reserves. Their present rate of production is sufficient for more than 70 per cent. of the world's peace requirements before the war. They will have considerable tonnages of the metal available for export. They have very large ore supplies, not only of "straight" zinc ores, but of the complex ores in which zinc blende is associated with galena and other metallic sulphides, and which now constitute an increasingly important source of spelter. It is very unlikely, therefore—quite apart from the 10 per cent. *ad valorem* tariff to which zinc ores imported into the United States are liable—that Australian zinc concentrates will find a market in America.

(4) The Canadian Government is encouraging zinc smelting by granting bounties on zinc produced in Canada from Canadian ores. Australian concentrates are, therefore, not likely to enter Canada to any great extent.

(5) The future of the Belgian industry is quite uncertain, but it is much to be hoped that it will be re-established after the war, and in this case, as it will depend largely on imported ores, there may be a renewal of the contracts with the Broken Hill mine-owners.

(6) By virtue of the magnitude of its population, its transport facilities, markets, and the raw materials necessary for zinc smelting—apart from the ore itself—Great Britain is the most suitable country for the treatment of Broken Hill concentrates exported from Australia. The Swansea district is one of the most favourably situated places in the world for the production of zinc, and is the chief seat of the British industry.

The complete treatment of Broken Hill concentrates involves, however, more than the mere production of zinc. They are a potential source of (1) sulphuric acid, (2) zinc, (3) lead, and (4)

[4] *The Engineering and Mining Journal*, April 1, 1916

silver, and should be worked up to produce all of these. This being so, it does not follow that the roasting of the ore for acid should necessarily be carried on at the same place as the smelting of the roasted material for the metals. Moreover, it is just the fact that this ore is a potential source of acid which renders it necessary for the bulk of the concentrates to be shipped from Australia, where the market for acid is limited, to a country like Great Britain, with nine times the population of Australia, and highly developed industries which can absorb the acid.

Stated broadly, if Great Britain is going to produce all the zinc needed for home consumption, the output of "primary" spelter will have to be increased at least fivefold. At present neither electrolytic zinc nor electro-thermally distilled zinc can compete commercially in this country with that obtained by distillation with coal in externally fired retorts heated by gas. Unquestionably the most difficult part of the problem is the training and organisation of the labour required for this process. Difficult though this is, it should be undertaken without delay, for America has shown that it can be done, and done rapidly when necessary. The establishment in this country of a zinc-smelting industry on a scale commensurate with its needs is most urgently required. There is no reason, if there is a proper application of organising ability, technical knowledge, perseverance, and resourcefulness—such as is now being exhibited on the British battle-front—why success should not be achieved. It would be an industrial victory of the first magnitude, and it would remove a peril in which this country was placed by the outbreak of war, which has been all too imperfectly realised, and should never be allowed to recur.

No reference has been made in this article to the possibility of assistance to be given by the British Government. As already mentioned, the Australian Government has dealt with the situation created there, and the Prime Minister, Mr. Hughes, is credited with having a very definite policy as to the future of the zinc mining and smelting industry, a policy in which Australia and Great Britain are immediately concerned. Whether and to what extent the statements relative to this which have appeared in the Press are trustworthy and authentic it is impossible to say. Some of them have been so inherently improbable that it is wisest to suspend judgment until the matter has been settled and an authoritative announcement made. There is every reason why there should be as little delay as possible in reaching a decision and acting upon it.

H. C. H. Carpenter.

PROF. PIERRE DUHEM.

The precise formulation of the fundamental principles of mathematical physics may be said to be the outstanding feature of the work of Pierre Maurice Marie Duhem, whose sudden death at Cabrespine (Aude) on September 14 was announced in Nature of September 21.

Born at Paris on June 10, 1861, Duhem in due course graduated in science, and for many years past held the chair of theoretical physics in the University of Bordeaux.

Although for a considerable time a corresponding member of the Academy of Sciences, it was not until 1913 that the distinction of full membership was conferred on him

Unlike most physicists, who take as their starting-point the equations of reversible dynamics, Duhem commenced with thermodynamics, and his treatise on the Thermodynamic Potential, published in 1886, will always remain a classical work of reference on the subject. At that time the work of Willard Gibbs (1876–8) was beginning to attract attention to the potentialities of thermodynamics in relation to chemical theory, and Duhem became an early exponent of the new methods. In 1893 he published his "Introduction à la Mécanique chimique," which was followed in 1897–9 by a much more comprehensive work in four volumes, entitled "Traité élémentaire de mécanique chimique fondée sur la Thermodynamique."

A large portion of this work is in a high degree original. We may instance the detailed studies of ternary and other mixtures and the use of trilinear co-ordinates in this connection as one of the interesting features of the work, but perhaps the most remarkable sections are those dealing with false equilibria and explosions, in which the author abandons the limitations of "classical mechanics" and invokes the assistance of a retardation analogous to friction in explanation of the observed phenomena. About the same time also appeared his "Cours de physique mathématique," dealing with hydrodynamics, elasticity, and acoustics.

The more technical applications of Duhem's work on physical chemistry form the basis of his "Thermodynamique et Chimie," which appeared a little later, and has been translated into English. In 1911 Duhem endeavoured to unite thermodynamics and mechanics in a comprehensive treatise on energetics covering statics, dynamics, hydrodynamics, elasticity, and physical chemistry. In a series of smaller contributions, entitled "Recherches sur l'Hydrodynamique," Duhem gave a detailed discussion of certain aspects of the study of fluid motions.

If the properties of matter occupied so large a place in Duhem's work, electricity was by no means overlooked. A volume of 228 pages, published in 1902 (Paris: A. Hermann), is devoted to a critical and historic study of Maxwell's electric theories. About the same time appeared the volumes in commemoration of the twenty-fifth anniversary of the doctorate of H. A. Lorentz (1900), and the sixtieth birthday of Boltzmann (1904). To the former Duhem contributed a paper on Helmholtz's electrodynamic theories and the electromagnetic theory of light, while to the latter he presented in June, 1903, an important contribution on the problem of electric stability.

Historical studies would likewise appear to have had considerable attraction for Duhem. On the origins of statics he published two volumes, but the crowning work of Duhem's later years would appear to be a work of ten volumes on the history of astronomy up to Copernicus, of which so far only four have appeared.

The writer of this notice visited Duhem at Bordeaux in 1901. He was a shortish man with a very pleasing manner, in which could be observed that element of preciseness which characterises his writings. It will readily be understood that a vast laboratory fitted with costly and complicated apparatus was not needed by a mathematical physicist like Duhem, and it was interesting to compare the simple equipments at Bordeaux with the rather less simple, but more dusty, pieces of apparatus used by another mathematical physicist, Ludwig Boltzmann, at the dingy buildings in the Türkenstrasse at Vienna. But if Duhem did not indulge in superfluous luxuries, he made the best use possible of all the essential apparatus, and on the occasion of the visit he demonstrated the then newly discovered properties of radio-active substances with the same care and attention to detail that are so noticeable in his theories.

If Duhem did not concentrate his main efforts on the discovery of new phenomena or the measurement and re-measurement of physical constants, he has at least played an equally important part in the advancement of our knowledge by evolving order out of chaos, and uniting isolated portions of mathematical physics in the form of a connected and logical theory.

G. H. Bryan.

NOTES.

A meeting to consider the steps to be taken to raise a memorial to the late Sir William Ramsay will be held at University College, London, on Tuesday, October 31, at 4.30 p.m. Invitations will be sent out on or about October 20. It will, however, greatly help in making the arrangements if all persons wishing to be present, including in particular scientific friends and former students of Sir William Ramsay, will send a postcard to the secretary, University College, London, intimating their desire. Those who thus apply will not be asked to reply to the invitation when issued. Further particulars of the arrangements for the meeting will be issued in a few days. After the meeting the director of the University College Chemical Laboratories, Prof. J. Norman Collie, will deliver a memorial lecture on "The Scientific Work of Sir William Ramsay," at 5.30 p.m.

The annual Huxley Memorial Lecture of the Royal Anthropological Institute will be delivered on Tuesday, November 14, by Sir J. G. Frazer; the title of the lecture is "Ancient Stories of a Great Flood."

Mr. H. G. Nagel and Mr. A. D. Hall have been appointed members of the Government committee which is considering the question of the teaching of science.

We learn through the *Electrical Review* that it has been decided, owing to the war, not to hold the Hobart meeting of the Australasian Association for the Advancement of Science, which had been arranged for January, 1917.

The meetings of the London Mathematical Society will be held during the session 1916–17 in the rooms of the Royal Astronomical Society, Burlington House, W. They will not always be on the second Thursday of each month, as hitherto, but on dates and days announced by the council in the list just issued.

The twenty-fourth "James Forrest" lecture of the Institution of Civil Engineers will be delivered on Tuesday, October 24, at 5.30 p.m., by Sir John Purser Griffith. The subject will be "The Development of Appliances for Handling Raw Materials and Merchandise at Ports and other Large Centres of Traffic."

The death is recorded in the *Revue Scientifique* of Dr. Valentin J. J. Magnan, a leading French authority on mental disorders. Dr. Magnan was elected a member of the Paris Académie de Médecine in 1893, and became president in 1915. He was the author of "Leçons cliniques sur les Maladies mentales."

The death is announced in action on September 28 of Capt. E. J. Smith, Duke of Wellington's Regiment. Before joining the forces, at the outbreak of war, he was senior science master at Sexey's School, Blackford, Cheddar. While in Gallipoli he was shot through the shoulder when in command of the snipers of his battalion. Later he commanded the Brigade Bombing School at Suvla Bay.

The Hippurite from the chalk near Faversham, noticed in our last issue, has now been placed, with some other illustrative specimens, on exhibition in the Gallery of Fossil Reptiles at the Natural History Museum, since the galleries containing fossil invertebrates are closed to the public.

Reports from the Swedish expedition to Spitsbergen, noticed in Nature for July 27 (p. 448), show that valuable work has been done, especially in the detailed mapping of the district. Besides conducting the investigations previously mentioned, the expedition has made several excavations in the old moraines on the shore, resulting in the discovery of deep-seated ice, many thousands of years old. How thick a covering of rock such fossil ice can support is a question worth solving. At any rate, deep borings have proved that it does not continue under the floor of the harbour. A Norwegian expedition to Spitsbergen, which has been investigating the Svalbard Company's coalfield, reports that it is of colossal size, containing, according to calculation, as many as 880 million tons. Norway's yearly consumption of coal is 2·8 million tons.

Replying, in the House of Commons, to a question by Mr. Ashley, M.P., on October 12, Mr. McKinnon Wood said:—"The direct savings resulting from closing the national museums and picture galleries to the public are estimated at approximately 50,000*l*. per annum, in addition to which a large economy results from freeing staffs, and in several cases accommodation, for purposes of immediate national importance at the present time." The sum named is that which was put forward by the Government when the proposal was first mooted, and, relatively small though it be, it is satisfactory to learn that this regrettable step has actually resulted in such direct addition to the National Exchequer. It must not, however, be forgotten that the museums in question had already forgone their purchase grants and had in other directions greatly reduced their expenditure, while continuing to perform, as exemplified in our last issue, important national services. It would be interesting to compare the actual expenditure on museum work at the present time with the pre-war expenditure. In such a comparison the salaries of all employees now on war service would, of course, be deducted.

Dr. J. S. Flett, F.R.S., will deliver the Swiney lectures this year. The subject selected by the trustees of the British Museum, "The Mineral Resources of Europe," is very appropriate to the circumstances of the time. The lectures, twelve in number, will be delivered in the hall of the Royal Society of Arts, commencing on November 14. Dr. Flett will deal with the coal resources, petroleum, iron ores, copper, tin, lead, and the precious metals of all the European countries, and one lecture will be devoted to the salt deposits of Germany, France, and Great Britain, and to a general review of the mineral resources of the countries of Europe, and their importance in the world's trade and industry.

A remarkably fine skull of the Cretaceous horned dinosaur, Monoclonius, has just been added to the remains of fossil reptiles exhibited in the Geological Department of the British Museum (Natural History). The specimen, which measures nearly 5 ft. in length, was discovered by Mr. W. E. Cutler in the Belly River formation of Alberta, Canada, and is interesting for comparison with the still larger skull of Triceratops from Wyoming, U.S.A., already in the museum. Monoclonius is peculiar in having the largest horn on the nose, only diminutive horns above the eyes, while its extensive bony frill over the neck is pierced by two vacuities and provided behind with a pair of remarkable forwardly directed prominences. The brain-case of the fossil is especially well preserved, and a plaster cast of the cavity shows the usual diminutive size of the brain.

We regret to learn from the *Revue Scientifique* that Dr. Jean Boussac has died from wounds received in action in France. Dr. Boussac, who was born on March 19, 1885, was one of the most active and brilliant geologists of the younger French school, and had done much important work for the Geological Survey of France. He was especially interested in the Eocene Nummulitic formations, and had travelled extensively in Europe and Egypt while attempting to correlate these deposits. His stratigraphical researches led to interesting results in understanding and restoring the oceanography of Eocene times. He also undertook a revision of the species of Nummulites to facilitate their use in geological work, and made many valuable observations on the evolution of the shells of the Cerithiidæ. All Dr. Boussac's researches were characterised by marked originality, and his death causes a serious loss to geological science.

The Norwegian explorer, Dr. Carl Lumholtz, has recently returned from a prolonged journey in the heart of Borneo. From the *Daily Chronicle* we learn some details of his work. After spending two months among the Murang Dyaks, he started on his journey to central Borneo in December, 1915. The route was from Banjermassin up the Barito and the Busang to the Müller mountains, thence by the Mahakkan river back to the coast. Dr. Lumholtz's work includes a new map of the watershed region of central Borneo and anthropological and photographic records of the Dyaks of the Upper Mahakkan. He has also brought back large ethnographical and zoological collections. The expedition reached Samarinda on August 22 this year.

A new expedition to tropical South America is announced by Dr. Hamilton Rice. In the *Geographical Journal* for October (vol. xlviii., No. 4) Dr. Rice says that he proposes to leave New York this month for Brazil, and to ascend the Amazon and Rio Negro to Santa Isabel, pushing on thence by steam launch to the Guainia. He hopes to reach the sources of the Guainia, which lies between the Papunaua branch of the Inirida and the Isana. Further, he proposes to survey and map the Casiquiari, which links the basins of the Orinoco and Amazon, and to solve some of the hydrographical problems of this region. Dr. Rice hopes to determine some longitudes with the help of wireless telegraphy, and to effect barometric determinations of altitude which will form the basis for a more accurate knowledge of the hypsometry of this part of South America than exists at present.

Prof. Vinzenz Czerny, news of whose death, at seventy-four years of age, was received last week, was professor of surgery at Heidelberg University, and director of the Institute for Cancer Research in the same town. At the commencement of his career he showed for the first time that normal life was possible after extirpation of the stomach by operations on two dogs, one of which was alive and well five years later. Apart from his eminence as a surgeon, he will chiefly be remembered by his exertions in founding the Institute for Cancer Research at Heidelberg, of which he was the first director, a task to which he brought all the energies of an enthusiastic and generous personality. He was president of the International Conference on Cancer Research held in Paris in 1910, under the patronage of the President of the French Republic.

By the death, in Edinburgh, of Dr. James Burgess, at the age of eighty-four, India has lost a veteran archæologist. Arriving in India before the Mutiny days, he was engaged in educational work at Calcutta and Bombay. But his bent for archæology led him to found the *Indian Antiquary*, which, since 1872, has taken a leading part in antiquarian and linguistic research. In 1874 he was placed in charge of the Archæological Survey of Western India, and at the close of his official career he had held for three years the post of director of the Archæological Survey of India. His original work was chiefly confined to his careful survey of the antiquities of Gujarat, and he published useful monographs on Elephanta, Somanath, Junagadh, and Girnar. He was closely associated with the great architect and antiquary, James Fergusson, and collaborated with him in the work on the "Cave Temples of India." It was near the close of his literary career that he undertook a new edition of Fergusson's standard "History of Indian and Eastern Architecture," with somewhat disappointing results. It is on his work as a careful and energetic field-worker in the survey of Indian antiquities that his reputation mainly depends.

The death on September 11, at the age of twenty-five, of Second-Lieut. Archibald W. R. Don, while on active service abroad, deprives the scientific world of one who showed exceptional promise. He was the fourth son of Mr. and Mrs. R. B. Don, of Tealing House, Forfarshire, and The Lodge, Broughty Ferry. Educated at Winchester and Trinity College, Cambridge, he won a major scholarship at the latter, and graduated first class in the Natural Sciences Tripos in 1912. He was much loved and respected in a wide circle of undergraduates and senior members of the University, where his great influence was ever exerted for good. He devoted his attention to geology early in life, but determined to follow the profession of medicine, and after leaving Cambridge entered at St. Bartholomew's Hospital. He intended, however, to pursue the study of his favourite science during his leisure hours, and had already written, with Dr. G. Hickling, a paper on the problematical *Parka decipiens*, which was read before the Geological Society, but is not yet published. He obtained a commission in the Black Watch in December, 1914, and while on service at home and abroad collected geological specimens for the Sedgwick Museum.

The council of the Chemical Society has arranged for three lectures to be delivered at the ordinary scientific meetings during the session 1916–17. The first of these lectures, entitled "Alloys of Copper and Tin, Aluminium and Gold," will be delivered on January 18 by Col. C. T. Heycock, F.R.S. On March 15 Dr. Horace T. Brown, F.R.S., will lecture on "The Principles of Diffusion: their Analogies and Applications"; and the third lecture, entitled "Some Main Lines of Advance in the Domain of Modern Analytical Chemistry," will be given on May 17 by Mr. A. Chaston Chapman. The ordinary scientific meetings commence at 8 p.m. In order to afford facilities to fellows for meeting each other informally, the council has again arranged to hold three informal meetings during the session, on October 19, 1916, and on January 11 and May 10, 1917. The council will gladly welcome any offers of assistance from fellows willing to show experiments and apparatus at these meetings, and such offers should be made to the assistant secretary not later than the Monday previous to the meeting.

The gift of the Wright aeronautical patents to the British nation has caused some comment in the Press. Without in any way underestimating the magnificent pioneer work of the brothers Wright, it must be admitted that the majority of the ideas covered by their patents are now out of date. One of the main patents is connected with the warping of the wings, and the interconnection of the warp and rudder controls. At the present time warping has been almost entirely superseded by the use of wing flaps, which are more effective aerodynamically, besides being much easier to design from a mechanical point of view. Patents connected with automatic stabilisers are also useless, for machines can now be built which are inherently stable, both longitudinally and laterally, so that the necessity of an automatic stabiliser is removed. The Wrights themselves seemed to think that such a stabiliser was unnecessary. The action of the Wright Company in accepting 15,000*l.* compensation instead of proceeding with their action against the War Office for infringement was highly laudable at a time when the co-operation of all aeronautical firms was so much needed. It seems doubtful, however, whether the gift of their patents to the nation will produce any great benefit at the present stage of the development of aeronautics

The thirteenth memorandum of the Health of Munition Workers Committee, which has just been issued, deals with juvenile employment. It is pointed out that the hours of work are extremely long—sixty hours a week—and that in many cases this limit has been exceeded, and the weekly hours have been extended to sixty-seven hours, or even longer. The long hours of work react unfavourably on the health of the workers, not only owing to the physical strain involved in the work, but also because the limited opportunities for recreation often lead to deterioration of character. These harmful effects are clearly more liable to occur in the young, whose development is still incomplete and whose character is not yet formed and stable. The committee recommends the abolition of Sunday work, and, except in special circumstances, of night work. It does not feel justified, however, under the present conditions, in suggesting the limitation of the hours of work to less than sixty hours weekly for those under sixteen, and sixty-five hours for those above sixteen years of age. A further excellent suggestion is the appointment of visitors, whose work is directed to improving the physical and moral welfare of the boys in factories by organising facilities for recreation, by personal supervision, and by direct association with the boys; this plan has already been adopted in at least one factory.

The Secretary of State for India has authorised the Indian Committee of the Imperial Institute to inquire into and report on the possibilities of extending further the industrial and commercial utilisation of Indian raw materials in this country and elsewhere in the Empire. The committee has already commenced its work and has appointed a number of sub-committees to deal with the more important groups of materials, to consider the results of investigations and inquiries already conducted by the Imperial Institute, and to obtain the views of leading merchants, manufacturers, and other users of the raw products of India. One of the important aspects of the committee's work will be to suggest openings for the employment of those Indian materials which before the war went to enemy countries. The Indian Committee of the Imperial Institute includes Lord Islington (Under-Secretary of State for India), Sir Marshall Reid (member of the India Council), Prof. Wyndham Dunstan (director of the Imperial Institute), Mr. L. J. Kershaw (secretary, Revenue and Statistical Department, India Office), Sir John Hewett (formerly Lieutenant-Governor of the United Provinces), Mr. G. B. Allen (of Messrs. Allen Bros. and Co. and Messrs. Cooper Allen, Cawnpore), Mr. Yusuf Ali (late Indian Civil Service), Sir R. W. Carlyle (lately member of the Viceroy's Council), and Sir J. Dunlop Smith. Mr. C. C. McLeod, chairman of the London Jute Association, is chairman of the committee, and the secretary is Mr. A. J. Hedgeland, of the Imperial Institute.

Mr. F. R. Rowley, the curator of the Royal Albert Museum, Exeter, has contributed some valuable notes to the *Museums Journal* for October on objects preserved in arsenious acid glycerine jelly. His method is an adaptation of, and an improvement on, that devised by Prof. Delépine. The advantage of this method of preservation is purely one of convenience, since it affords a means of avoiding the introduction of spirit, or other fluid preservative, among dry preparations. The successful preservation of colour varies according to circumstances, but experiments with seaweeds have given extremely satisfactory results. So far, however, this medium has failed in regard to flowers.

The relationship between the geographical distribution of megalithic monuments and ancient mines is discussed at length in an able essay by Mr. W. J. Perry in the Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1915–16. The author contends that the weaving of linen, the use of pearls, precious stones and metals, and of conch-shell trumpets, are all accompaniments of the megalithic culture, which had its origin in Egypt. Thence it spread through Europe to Britain, on one hand, and eastward through India and the East Indian Archipelago, and thence out across the Pacific by way of the Carolines, Solomons, New Hebrides, Fiji, and Easter Island to America. The agents in this distribution were the Phœnicians, and the part they played in this is discussed at length by Prof. G. Elliot Smith in an appendix to Mr. Perry's paper. Herein evidence, which seems to be beyond dispute, is produced to show that the Phœnicians played the part of distributing agents of this culture, and not that of missionaries. The search for wealth was the underlying factor in this distribution, and provided the motive for the widespread travellings of these people. To assist in this search they employed expert gold-miners from the Black Sea and from Colchis, hence the megalithic monuments in the mining camps. That these two contributions will give rise to much discussion in the immediate future need scarcely be said, for the theme is one of first-rate importance; but there can be little doubt that the views they have so skilfully expressed will meet with general acceptance.

SPORADIC migrations of butterflies, moths, and dragonflies have long been known, and have generally been regarded as comparable to the similar migrations of locusts. But Mr. Howard J. Shannon, in the *Scientific Monthly* for September, under the title "Insect Migrations as Related to Those of Birds," has marshalled a host of facts which apparently show that certain North American species of butterflies, diptera, and dragonflies annually migrate southwards in the autumn, following well-defined routes corresponding to those taken by the birds of the same regions. The author does no more than hint at a return migration in the spring, expressing curiosity as to whether such migrants are of the same individuals which passed southwards in the autumn, or whether they represent a new generation, bred in the southern winter quarters. Some idea of the magnitude of these migrations may be gathered from the author's statements in regard to the monarch butterflies (*Danais archippus*), which, "in mingled myriads, move forwards . . . in swarms . . . forming veritable crimson clouds . . . miles in width and streaming backwards for equal distances . . . casting below them as they go perceptible shadows."

UNDER the modest title, "Notes on Some Palæozoic Fishes," Messrs. D. M. S. Watson and Henry Day have enriched the Memoirs and Proceedings of the Manchester Literary and Philosophical Society with a contribution of first-rate importance. They have described and figured in detail the skulls of Holoptychius, Glyptopomus, and Osteolepis, and the whole fish of Rhizodopsis. These studies have shown that the Rhipidistian skull is considerably more complicated than has previously been supposed, and that the short type of paired fin found in Eusthenopteron is older than, and has given rise to, the biserial "archipterygial" fin of Holoptychius. In Rhizodopsis and Glyptopomus they have given an account of the palate which considerably extends our knowledge of the structure of this region, and has a very important bearing on the problem of Amphibian ancestry. Further, they show that Ceratodus is derived by a process of specialisation and reduction from Dipterus, while Uronemus and Ctenodus are shown to belong to different lines of descent, and the conclusion is reached that *Dipterus valencennes* is the most primitive, as it is the oldest, known Dipnoan.

DR. C. A. BARBER, sugar-cane expert to the Government of India, describes, in a recent number of the Memoirs of the Agricultural Department of India (Botanical Series, vol. viii., No. 3), some results of the work done at the Coimbatore Cane-Breeding Station since 1912, when, for the first time in India, seedling canes were raised successfully. The object of the work is to produce canes for cultivation in northern India under field conditions possible to the Indian peasant. The work is therefore limited in its objective, and is also handicapped by unsuitability of soil, insufficient chemical assistance, etc.; but in spite of these difficulties substantial progress has been made and certain provisional conclusions of general interest have been reached. Special attention may especially be directed to the various devices adopted to save labour and simplify the laborious business of selection. Arising out of this aspect of the subject, the possible correlation of morphological characters with richness of juice has been specially studied, and already Dr. Barber is able to say that "from this study it would appear that the seedlings in any general collection, with higher sucrose content, would be marked out by rather narrow, short leaves, but with a relatively high leaf module, with canes that might be thick or thin, but with a leaning towards the thin side, rather long, but not very, and with a moderately high cane module." To this rule there are, however, many and notable exceptions, particularly in the case of definite crosses. It is clear from Dr. Barber's memoir that the initial difficulties experienced at Coimbatore have been successfully overcome to a considerable extent, and the results obtained in the next few years should be of great value to the Indian sugar-cane industry, which has a great deal of leeway to make up before it reaches the level attained in other tropical sugar-producing countries, both on the scientific and the manufacturing sides.

IN a paper read before the Franklin Institute in April Mr. C. J. Gadd, chief engineer of the American Iron and Steel Manufacturing Company, directed attention to the progress which has been made recently in the application of powdered coal to the heating of furnaces for metallurgical and other purposes. If slack coal is dried, pulverised until 83 per cent. of it will pass through a sieve with 200 meshes to the inch, and delivered to the furnace in this finely divided state, its combustion is completed while it is still in suspension, and as high a temperature is attained as with producer gas. From the experience gained with the apparatus used by the American company Mr. Gadd concludes that on further development powdered coal will entirely displace oil, tar, and producer gas in the fields in which they are now supreme. The paper is reproduced in the September number of the Journal of the Franklin Institute.

SOME definite evidence regarding the cause of the accident at the new Quebec Bridge on September 11 has now reached this country, and is dealt with at considerable length by *Engineering* and the *Engineer* for October 13. The accident occurred while the central span was being raised into position, and the whole of this heavy portion of the structure fell into the river. Facilities were given to the representatives of the *Engineering News* to inspect the parts which failed, and from their report it appears that one of the four rocker bearings which supported the central span whilst in course of construction gave way when the span had been raised about 30 ft. *Engineering* hesitates to criticise, since the St. Lawrence Company had sought the advice of many able engineers, but at the same time considers that the design of the rocker bearings was very unsatisfactory in view of the immense load of 1300 tons to be imposed on each. So soon as the span was lifted there was no longer any need for rocker bearings, as each corner of the great girder was suspended from the corresponding corner of one of the cantilevers quite freely. It was only during transit on the barge that the rocker bearings could serve any purpose. Once the lifting was commenced they were superfluous, and, as the event showed, an imminent source of danger.

OUR ASTRONOMICAL COLUMN.

FIREBALL OF OCTOBER 3.—A large number of additional observations have come to hand, and Mr. Denning writes us that the brilliant object was well observed as far north as Huddersfield and as far east as Hertford. Even at Huddersfield, where the observer was about 210 miles distant from the object, it exhibited a Venus-like lustre, and was followed until it disappeared in the mist very near the S.S.W. horizon. The new observations confirm, in general, the deductions already stated as regards the position and height of the fireball, but the exact place of the radiant point remains a little doubtful. With reference to the elevation at disappearance, this may have been less than thirty miles, for there are several observations indicating it at about twenty-four miles. The cloudy or misty condition of the sky at many places, however, hindered efforts at exact observation. Everywhere the spectators speak of the astonishing brilliancy of the object and admit that its startling aspect at first aroused fears of a calamitous sequel.

Erratum.—By a clerical error Launceston was mentioned instead of Seaton, East Devon, in NATURE, October 12, p. 116.

ANOMALOUS DISPERSION IN THE SUN.—The search for evidence of anomalous dispersion in the sun continues to attract considerable attention. Dr. Albrecht recently concluded that Rowland's measurements gave distinct indications of a mutual repulsion in close pairs of lines, such as is required by the anomalous dispersion theory. Mr. Evershed and Dr. Royds, however, have questioned the validity of this result, since it is not supported by data obtained at Kodaikanal by more direct methods (the *Observatory*, October, 1916). In agreement with Dr. St. John, Mr. Evershed finds that Rowland's separations were almost invariably over-estimated; for eighteen pairs having a mean separation of 0·1920 according to Rowland, the Kodaikanal mean value was 0·1836. The tendency of Rowland was therefore to displace the violet components to the violet, and the red components to the red, thus simulating the effects of anomalous dispersion. Mr. Evershed considers that his results are decidedly against the view that anomalous dispersion is an effective agent in displacing solar lines.

Dr. St. John has also made an exhaustive examination of the cases included in Albrecht's list, and is strongly of opinion that the deviations are merely due to systematic errors in Rowland's measures of close lines (Proc. Nat. Acad. Sci., vol. ii., p. 458). He finds that the separations of pairs in the solar spectrum are identical with those obtained from terrestrial sources. "Within the limits of error, evidence of mutual influence is absent from the solar spectrum, and in so far as mutual influence is a necessary corollary of anomalous dispersion in the sun, evidence for it also is absent."

Experimental work bearing upon this question has been carried out at the Pasadena laboratory by Dr. A. S. King (Proc. Nat. Acad. Sci., vol. ii., p. 461). Anomalous dispersion effects in metallic vapours were obtained by the use of the electric furnace, in which a strong density gradient was produced by water-cooling the upper part of the tube. Tests for the mutual influence of lines were made on the mixed vapours of titanium, calcium, and chromium, in which certain lines of the two former elements fall well within the curved spectra given by the anomalous dispersion of chromium lines. When compared with the corresponding emission spectra of the mixture, and of the elements separately, the measures gave no evidence whatever of a mutual repulsion between close lines when anomalous dispersion is active.

THE VARIABLE STAR SZ CYGNI.—Extensive observations of SZ Cygni, covering the period from November, 1912, to August, 1916, have been made by F. C. Leonard (Mon. Reg. Soc. Prac. Astr., vol. viii., No. 5). The star is of the δ Cephei class, having a mean magnitude of 8·96 at maximum and 9·74 at minimum. The mean period is 15·10 days, with an interval of 6·6 days from minimum to maximum. Both range and period appear to be subject to slight variations. The star is stated to be of a reddish tinge, and to deepen in colour as the brightness diminishes.

FISHERIES INVESTIGATIONS AND DEVELOPMENT.

THE importance of utilising more fully the fisheries around our coasts was emphasised at the recent Newcastle meeting of the British Association, one day being devoted to papers and discussions on this and kindred subjects.

Prof. Herdman urged that with the view of making a rapid recovery from the effects of war, food-producing industries should be encouraged, and, among others, the inshore fisheries should be exploited. Shell-fish cultivation, shrimping and prawning, whitebait and sprat fishing, and herring fishing and curing, if extended and exploited judiciously, would add to employment, increase the national food supply, and might lead to the establishment of permanent industries of a profitable nature. He illustrated by several instances how the transplantation of stunted mussels from an overcrowded area to suitable neighbouring areas resulted in the rapid production of mussels of good quality which were sold for eight to ten times the sum expended on their transplantation. As examples of local fisheries started recently, Prof. Herdman mentioned the winter sprat fishery in Morecambe Bay and the summer herring fishery in the Irish Sea.

Prof. Meek gave an account of the inshore fisheries of Northumberland, and pointed out what had been done to preserve them by legislation and to encourage them by such an attempt as that now being made to establish a mussel-bed large enough to supply the wants of the district. The importance to the nation of the fishermen of the smaller fishing stations has been emphasised during the present war. With the problem of the preservation and extension of the coastal fisheries is involved the economic consideration of better buying and selling, and also the social question of making life in the fishing village more attractive.

In his paper on the further development of the shell-fisheries Dr. James Johnstone dealt especially with the coasts of Lancashire, Cheshire, and North Wales, where such fisheries are of considerable actual value and of very great potential value. Here mussels and cockles exist in incredible abundance, though in certain areas a considerable proportion are always smaller than the specified legal size. Mussels are found to prefer shallow estuarine water of low salinity containing the drainage from cultivated land or from human communities. Dr. Johnstone dealt with the rationale of successful transplantation, and calculated that the yield in assimilable food substance of high nutritive value of a cultivated mussel-bed was probably greater than that of a similar area of land bearing a food crop. He pointed out that although mussels feed on contaminated material they can be cleansed, and regarded as pure, by placing them in an area where water coming in from the sea washes over them during the last hour of flood-tide for two to four days. Although it is practicable to develop the yield of the shell-fisheries to an enormous extent, it is difficult to see how this can be brought about without some measure of State organisation for redepositing and cleaning the shell-fish. Dr. Johnstone considered briefly some of the administrative problems involved.

Dr. A. T. Masterman stated that in running sterile water mussels will, in three hours, cleanse themselves of sewage organisms which have been introduced into their mantle cavity and alimentary canal with food. Mussels may be relied upon to feed at night and at a suitably low temperature. It was found that chlorine in any form was not available as a direct sterilising agent, for its presence in the water in any appreciable quantity (0·5 per million) interfered with the normal functions of the mussel, and retarded the self-cleansing processes. Efficient sterilisation of sea-water can, however, be produced by the use of chlorine, and the following process of mussel purification has been devised at Conway by the Board of Agriculture and Fisheries. Into an upper tank river-water (80,000 gallons) is pumped and allowed to settle, and the clean water is run into a lower tank, together with sufficient hypochlorite solution to produce an initial strength of three parts per million. Sterilisation of the water is effected overnight. In other still lower, shallow tanks mussels, which have been thoroughly washed, scoured, and picked over, are placed two deep on grids. The sterile water is then passed into the mussel tanks, its surplus of hypochlorite being removed during its passage by addition of sodium thiosulphate. The mussels remain in the sterile water for at least one night, and are then washed and hosed. They are left in sterile water for another night, and are then ready for packing.

Dr. E. J. Allen referred to the account given by Prof. Herdman of the establishment of a fishery for sprats on the Lancashire coast, and expressed the hope that attempts would be made to establish in this country an industry for preserving these fish in oil, as had been done on a large scale in Norway. He thought that a great deal more might be done in the way of preserving fish if the matter were properly organised. There were often gluts, when large quantities of fish were wasted which might well be saved and made available as food.

In his account of the scales of fishes and their value as an aid to investigation Prof. Meek pointed out that it had been established by a wealth of observations that the physiological processes in fishes suffer a relapse in winter, and that the seasonal diminution in the rate of growth is recorded on the scales, as in other skeletal structures. This discovery has enabled investigators to state the rate of growth, the age-composition of samples, and other important correlated facts. The method was illustrated by photographs of the scales of the herring, bass, and several Gadoids and Pleuronectids.

Dr. Masterman stated that although the great majority of scales in a Gadoid fish, *e.g.* the haddock, show the same number of annual rings, it was possible to find a certain percentage with a smaller or greater number. In large samples of haddock from the Dogger Bank and other parts of the North Sea the scales showed evidence of active growth for two separate periods of the year, the explanation of which is obscure. In the salmon the determination of age is complicated by cessation of growth at certain periods, and also by destruction of the edge of the scale at spawning. As a general rule, the zones on the scales of fishes are an expression of variations in growth dependent upon seasonal changes, but the interpretation of individual cases is full of pitfalls.

Dr. E. C. Jee reviewed the fluctuations of the herring, mackerel, and pilchard fisheries off the south-west coasts in the light of seasonal variations of hydrographical factors. The landings of herring, mainly at Plymouth in December, appear to be heavier in those years in which the sea-temperature is below the normal, but are also dependent in some way upon the preceding summer maximum. During the years 1904–11 (inclusive) the landings of mackerel, which are caught chiefly in May, seem to be correlated with the sea-temperature of that month. For the years 1905–10 (inclusive) the yields of the pilchard fishery fluctuated in the same manner as the magnitude of the seasonal salinity ranges. These are probable measures of the strength of the Atlantic current, which was therefore stronger in those seasons which were followed by a more successful pilchard fishery.

J. H. A.

BITTER PIT.[1]

THE disease of apples (and pears) known as bitter pit manifests itself externally by depressions of the surface of the fruit and internally by patches of discoloured and dead tissue. It is a disease which may make its appearance whilst the fruit still hangs on the tree, or it may declare itself in the fruit-room and even in cold storage.

This disease has been, and still is, the cause of great loss to growers Thus it has happened not infrequently that whole consignments of apples shipped from Australia to England have developed the disease so severely as to have become unsaleable. Hence it is not surprising that so progressive a community as the Commonwealth of Australia should have instituted, with the co-operation of the State Governments, a special research into the nature of the disease, its remedy and prevention. This research, endowed for a period of four years, was entrusted to Prof. D. McAlpine, and the fourth and final report now issued testifies to the assiduity and thoroughness with which both Prof. McAlpine and his colleagues have prosecuted their inquiries. As is pointed out in the introduction to the report, when the investigations which it summarises were begun bitter pit was regarded as a mysterious disease. It is associated with the presence of no parasite, nor is it a consequence of puncture by insects of the skin of the fruit. Ewert had, it is true, advanced evidence in support of the view that bitter pit is a result of the local toxic action of copper-containing spray fluids. That hypothesis has not, however, met with general acceptance.

Our knowledge of the ætiology of this disease being so vague, we turn with interest and curiosity to learn the results of Prof. McAlpine's inquiries; but it must be confessed that although we discover much valuable and interesting information in this large and admirably illustrated volume, we fail to find the revelation of the mystery. The symptoms of the disease are described in detail; evidence is brought forward that severely pruned trees yield more pitted fruit than is produced by lightly pruned trees; that nitrogenous manures appear, albeit often to no considerable degree, to increase the pitting of fruit; that certain varieties are more resistant and certain others more susceptible to the disease—in fine, we learn much that is useful and suggestive, but of the cause or causes of bitter pit we are no wiser after than before the perusal of this monograph. We insist on this point with some emphasis because we think that it should have been made clear at the outset of the report, instead of which we find it there claimed that the research has been brought to a successful issue.

[1] "Bitter Pit Investigation. The Experimental Results in Relation to Bitter Pit, and a General Summary of the Investigation." By D. McAlpine, appointed by the Commonwealth and State Governments of Australia. Fourth Report, 1914–15. Pp. 178+70 figures and coloured frontispiece. (Melbourne: The Government Printer.)

That Prof. McAlpine has made a definite and valuable contribution to our knowledge of this pathological problem will appear presently, but this is only an added reason why he would have done well to make it perfectly clear that the main problem still remains to be resolved. To conclude that the "immediate cause" of the disease is "the concentration of the cell sap" (p. 75) is not to discover a cause, but to use words the meaning of which is at least as obscure as the nature of bitter pit. Moreover, if quick-acting nitrogenous manures, which lead to sappy growth, encourage bitter pit, how may that disease be attributed to concentration of sap?

Perhaps the most valuable part of Prof. McAlpine's studies is that which demonstrates the possibility of preventing the outbreak of bitter pit in cold-stored apples. As the result of experiment, he shows that if apples be stored at a temperature of about 30° or 32° F., and if fluctuations beyond these limits be prevented, no bitter pit manifests itself during a period sufficiently prolonged to transport the fruit from Australia to Europe. This is a great gain, and the practical results accruing from it should not only pay for the cost of this elaborate investigation, but encourage the Commonwealth to promote further investigations into the origin of the disease.

A point of some interest on the scientific side of the problem is the fact that starch persists in the broken-down tissue of the pitted region of the apple pulp, whence it is concluded that the incipient but invisible stage of the disease occurs in the pre-ripening phase, or at all events during the phase in which starch gives place to sugar. This is plausible, but the opposite view is not precluded that the starch of the bitter pit arises as a result of a reconversion of sugar. In favour, however, of the view that bitter pit develops, although it is not apparent, at an early stage is the evidence obtained by subjecting suspected apples to X-rays, as a result of which it is claimed, and the claim is supported by photographs, that prospective pit areas appear on the radiographs.

Prof. McAlpine is hopeful that the loss due to bitter pit may be ultimately prevented by breeding pit-resistant varieties. It is a work worth undertaking, but nevertheless is not to be undertaken lightly, for it may prove a long business.

F. K.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE president, Prof. W. S. Boulton, delivered his address on Wednesday, September 6, to a good audience, and was followed by Prof. G. A. Lebour, who described the general geology of the rocks round Newcastle.

The Permian formation, which forms such a large part of the surface geology in the neighbourhood, received special treatment at the hands of Dr. D. Woolacott, who has made it a detailed study, and brought order out of the complicated bedding. He shows that the Middle Permian Beds consist of a fossiliferous, unbedded reef formation, which ran parallel to the coast of the Permian sea, and on each side of which are well-stratified, unfossiliferous limestones, which were formed in waters permeated with calcium sulphate, which afterwards formed gypsum beds. The concretionary formations found in the various beds were lucidly dealt with.

During the meeting Dr. Woolacott took the geologists to see several typical sections of the Permian beds, and exhibited interesting evidence in proof of his contentions.

The important questions of the underground mapping of prominent coal seams were dealt with by Mr. Wickham King in his plexographic model of the South Staffordshire thick seam, by Dr. G. Hickling in diagrams of the Black Mine coal of Lancashire, and by Prof. W. G. Fearnsides in maps of the Barnsley Bed.

In the afternoon a special joint meeting with Section K was held to receive the report of the Research Committee appointed to investigate the Old Red Sandstone of Rhynie, Aberdeenshire, and to hear a paper by Dr. R. Kidston and Prof. W. H. Lang describing the very interesting fossil remains found in that deposit. The present paper dealt only with one of these, *Rhynia gwynne-vaughani*, which is the oldest known peat. The plants, which were rootless and leafless, and grew crowded together, consisted entirely of a system of cylindrical stems, attaining a height of 8 in. or more, and ranging in diameter from 1 to 6 mm. The stems bore small hemispherical projections, from some of which lateral branches were developed. The aerial stems had a thick-walled epidermis with stomata, a cortex, and a simple central cylinder. Large cylindrical sporangia, containing numerous spores, were found in the peat. They were evidently borne terminally on some of the leafless aerial stems.

On Thursday there was an important joint discussion with the members of Section B, which dealt with the investigation of the constitution and classification of coal. A combined geological and chemical study was recognised by all speakers as an essential to success. There was also general agreement as to the need for more systematic and careful selection of samples, for the separate investigation of the various constituent elements of seams, and for the microscopic examination of the specimens analysed. The great national importance of the work was also emphasised. The discussion was opened by Prof. G. A. Lebour, followed by Prof. W. A. Bone, Prof. P. F. Kendall, Prof. P. P. Bedson, Dr. J. T. Dunn, Mr. D. Trevor Jones, Dr. Marie C. Stopes, Dr. G. Hickling, Prof. W. G. Fearnsides, and Prof. W. Boyd Dawkins.

At the close of the discussion Dr. J. W. Evans gave a suggestive description of a method of representing geological formations and structures in black and white on maps. Mr. Leonard Hawkes described the Tertiary acid volcanic rocks of Iceland. In places this acid series is at least 2000 ft. in thickness, and consists of tuffs, sphæro-like liparites, and obsidians. The eruptions were similar to those of post-Glacial times. The uneroded character of the liparite lavas shows how rapidly the successive basalts which submerged them were poured out. Since the close of the Tertiary volcanic period enormous denudation has obtained, and the varying resistance offered to erosive agents by acid and basic rocks has produced remarkable topographical effects.

Dr. Alexander Scott gave the results of an extensive examination of the Arran pitchstones, describing four groups varying from non-porphyritic glasses with abundant microlites of hornblende, to a more basic type with scarce phenocrysts, but with abundance of pyroxene microlites. An attempt had been made to determine the cooling histories from an examination of the field relations and the microscopic structures of the various types, and also to indicate the conditions which were responsible for such a large development of glassy intrusive rocks.

On Friday a joint meeting was held with Section E, to hear a paper by Dr. Albert Wilmore on the Northern Pennines. The structure of the range and its gaps with the intervening rock-blocks were described. The effects of the fault and fold systems on the scenery were dealt with, and many interesting problems which still leave scope for careful investigation were pointed out.

A paper was contributed by Prof. W. G. Fearnsides and Dr. P. G. H. Boswell on the occurrence of refractory sands and associated materials in hollows in the surface of the Mountain Limestone district of Derbyshire and Staffordshire. Then Dr. P. G. H. Boswell dealt with the geological characters of sands used in glass manufacture, which gave interesting and important glimpses of the new efforts being put forward to supply our present economic necessities. The report of the committee appointed to investigate the flora of the Lower Carboniferous Beds of Gullane described the finding of a petrified flora in 1914, the most important form of which was Pitys. Many examples of this fossil plant were found, some with bark, and one, a branch tip, still clothed with needle-like leaves. These enabled the connection between leaf and stem to be determined, and much light had been thrown on the stem-structure of the genus. The whole assemblage of plant types exhibited a close similarity with the flora of the Pettycur Limestone in Fife.

W. L. C.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION F.

ECONOMIC SCIENCE AND STATISTICS.

Opening Address (Abridged) by Prof. A. W. Kirkaldy, M.A., B.Litt., M.Com., President of the Section.

The Need for National Organisation.

As the war developed there has been a growing tendency to demand organisation in every sphere of national life. The striking successes scored by Germany have been universally, and probably rightly, ascribed to thoroughness of organisation and complete preparedness before provoking the conflict. As a consequence, a comparison has been made between English and German military policy, greatly to the detriment of the former. And, not content with this, further comparisons have been made, with the result that, if one believed all that was printed in the newspapers or accepted what passes in private conversation, we should be led to believe that rule of thumb has been the leading British characteristic. It has been forgotten that Germany has for many decades prided herself on her Army, even as England has relied on her Navy. One has been a great military Power; the other equally great at sea. The test of war has proved that Germany was a very difficult country to oppose by land, but that in naval matters England is supreme. The economist, however, has to go further and investigate into those matters which are connected with his science—namely, the production, the distribution, and the consumption of wealth. Can it be said that the want of organisation and other faults of our military system are typical of what has been going on in the industrial and commercial sphere? I for one cannot bring myself to accept the truth of this. Had our economic interests been carried on under so-called War Office principles we could not have built up the great position we occupy as world traders. What, then, are the facts? To answer this question one should remember the leading facts connected with our industrial development. This brings out some points which the superficial observer inevitably misses. For upwards of a century our industries have been gradually developing, and the progress has on the whole been along healthy lines—each decade has seen some advance more or less great.

German attention to industry and commerce is much more recent. She was able to benefit by our experience, nor was she slow in doing so. The agitation for Tariff Reform and Colonial Preferences is a proof that several years before the war broke out some Englishmen were awake to the fact that a new condition had come into existence, and that, if we were to preserve our advantageous position, we must take careful stock of newly arisen factors in world-trade. For Germany was not the only one, nor perhaps the most serious, of these factors. The United States of America, from the time of the Civil War, had bent her energies to the work of internal development. Having concentrated on this for nearly forty years, she began to expand a world-policy, both political and commercial. Japan, too, emerged with unexpected suddenness into the arena. Thus, as the nineteenth century drew to a close, the economic interests of England required careful and earnest attention. The fiscal controversy undoubtedly had the great and important effect of waking English traders out of the lotus-eating condition into which they were in danger of sinking. All our principal, and many of our less important, industries were carefully reviewed, with results that can be realised by a study of the annual statistics published by the Board of Trade. There was, however, a very subtle policy being pursued, which required very minute knowledge and wide experience to grasp. It was our proud boast that we left trade free and untrammelled, that we believed in the health-giving effects of open competition. It needed the stern lesson of the war to make known how this generous policy could be utilised to our detriment by a rival commercial nation. The facts as to the exploiting of the mineral resources of the Empire, as to how the dye and colour industry and various by-product industries have been developed so that certain vital trades almost passed under foreign control, came to light only just in time.

It became plain, as these facts leaked out, that we needed a better system of industrial and commercial intelligence. There was also a lack of unity of working among our principal industries incompatible with the growing interdependence which has been a marked feature of modern economic life.

Hitherto, apparently, it has been no one's business to survey comprehensively the resources whence our raw materials are drawn. Even those resources within the Empire have been nervelessly left to be exploited by the first-comer, and the mask of an English name has enabled foreign capital and energy to divert some of our valuable minerals to foreign countries, whence we have been compelled to purchase them at unnaturally enhanced prices. Sufficient of the facts have been made public to warrant the demand for reconstruction and improved organisation of those departments responsible for the national trade.

It would be most unwise as well as ungenerous to attempt to blame our Board of Trade. That department has, on the whole, worked hard and well for British interests. But it is both wise and necessary to criticise the policy that has overweighted this one Government department. And although there should be very careful consideration before either recommending or making a drastic change, attention ought to be given to the frequently expressed opinions of both chambers of commerce and individual traders in favour of the creation of a Ministry of Commerce. To this Ministry there might be transferred some of the functions of the Board of Trade, whilst at the same time the new Ministry might be responsible for maintaining that general survey over trade and commerce without which any organisation we may attempt would be incomplete.

Industrial Organisation.

The organisation that has grown up with the development of our industries includes two very important but unequally developed sets of organisation. The industrial army of labour force of this country includes all those who either organise industry or take any part, however important or however humble, in its working. From the captain of industry, or *entrepreneur,* as our brave Allies call him, down to the humblest weekly wage-earner, we have a labour force which ought to be looked upon as one and indivisible. In connection with this force we now have two sets of organisations the interests of which some people consider to be antagonistic. I would emphasise the fact that these two are really one force, their main interests are identical, and they can best serve these interests by striving to minimise differences and by doing all that is possible to work in harmony.

Though theoretically one, the labour force has internally developed two sets of organisations. Manual labour has its trade unions; the organisers of industry have their associations; British trade unions have a fairly long history behind them, and may be said to be in advance of any similar unions the world over. But the fact that of recent years there has been a tendency for small unofficial sections of given unions to kick over the traces and disregard the policy and agreements of their leaders shows that perfection of organisation has by no means been attained.

Employers' associations are of more recent formation, nor have they so far attained to anything like the same completeness. Both organisations, especially the employers', are in need of further development. It is scarcely for the economist to show how this can be effected. He can point to imperfections and make suggestions—only those conversant with practical working facts can formulate a practical policy. The most patent defects of these associations are due to the very virtues of their members. The individual British business man is unexcelled by the business man of any other country. In times of rapid transition and crisis he has again and again shown his leadership. He knows his business thoroughly, and as a working unit he has taken a very high place. But one of the most marked developments of modern trade is a growing interdependence of industries. Hand in hand with this we have become familiar with another phenomenon, the amalgamation of businesses of various dimensions into one great company or corporation. This phenomenon is common to both commercial and manufacturing interests. It is as marked among banks as among steel and iron companies. The comparatively small manufacturer or business man is giving place to bigger and inclusive organisations. These two and somewhat parallel developments are making a new demand on the individual. He and his predecessors exemplified individualism; the new stage upon which we have entered demands a modification of the old policy. Business, like everything else, is subject to evolution, and evolution on healthy lines can only be obtained by grasping fundamental facts and applying experience in accordance with economic laws. There need be nothing revolutionary about the required changes in our business organisation. We merely have to note what has already occurred, mark healthy tendencies, and clear away or prevent obstructions to natural growth. Our past history amply justifies us in pursuing this policy without uncertainty as to the result. Our entire industrial history is one of the best examples of steady, and on the whole well-ordered, evolution. We have shown our ability to adapt ourselves to the needs of the moment. As a race we are healthily conservative without being reactionary. That is to say, we know how to preserve what is good in the old and amalgamate it with the new. In other words, our organisation enjoys that useful quality of elasticity which enables us to keep abreast of the times.

Bearing this in mind, where are the defects of our business man, and to what does he need to give attention in order to come into line with the most recent requirements?

As I have just said, our business man's qualities emphasise his defects. For generations our business men have worked as units, and individualism has become almost second nature. The call now is that the individual shall sink a part of his personality and become, so far as one side of his activities is concerned, a member of an association. We have had employers' alliances, federations, and associations. Some have failed, some have managed to keep afloat, others have had a certain amount of success. None have hitherto quite attained to what is required. To the onlooker it would appear that when our employers meet as an association there is a lack of sympathy among the members, and if this should persist it would be fatal. Each individual knows his own business; he does not know, and perhaps it would be true to say he does not care to know, his neighbour's concerns. At any rate, as a result there is a lack of cohesion, there is a lack, too, of that co-operation which is required if the association is to be really successful and accomplish the objects for which it has been formed. This working in co-operation, the large organisations of capital, and the working together in associations, are comparatively new things to our business community. Time and experience will put things right; at present we have not accustomed ourselves to a newly developing condition of affairs. Our business men, then, need to focus their attention on these early ailments of the movement and get them removed as soon as possible.

A second group of defects arises indirectly but almost inevitably from that which has just been considered. Some alliances, rings, and associations have failed and come to an end. And in certain cases the cause has been unmistakable, for there has been a lamentable want of loyalty, and even in some cases it must be said honesty, to the agreements entered into by the association.

Only to mention one group as an instance of this —the New Trades Combination Movement, which caused quite a considerable stir during the late 'nineties of last century, especially in the Midlands, among the metal trades. Articles appeared in the journals, and a book[1] was written explaining the movement and great hopes were entertained that a new era had opened out before both Capital and Labour. But all ended in a failure. There was for a time a kind of Syndicalism—a syndicated industry enabling employers to increase their profits, and the workpeople to earn abnormally high wages. So long as competition could be kept out of the market, things went swimmingly and a specious prosperity developed. But the consumer was being exploited—the increased prices charged for such goods as metal bedsteads gave would-be competitors and unscrupulous members of the alliance their chance. The cheap wooden bedstead, however, made its appearance on one hand, and on the other there were such things as secret discounts and commissions, and this special alliance ended in failure. The history of that short, but industrially instructive, movement has yet to be written.

1 "The New Trades Combination Movement." E. J. Smith (Rivingtons, 1899).

its cardinal facts should be known to those who now have an opportunity for shaping the industrial future of this country.

Three lessons stand out from this experience :—

(1) We must learn to work together in association.

(2) All members of an association must be absolutely loyal and honest to their engagements, either written or implied.

(3) Such associations must be regulated or the community will be exploited.

Nor is it impossible to suggest a method by means of which this may result. When employers' associations have justified themselves it should be possible to obtain State recognition for them, and it would be practical politics, when both employers' associations and trade unions have developed to the point at which both merit State recognition, to enforce under penalty agreements made between them on all those, either employers or workpeople, who wished to work at the industry within the area under the recognised organisations. Thus it would not be necessary to make membership compulsory; self-interest would be the extent of the pressure.

Turning to workpeople's unions, we also find defects which require removing. The policy of union has been practised among the workers for upwards of a century, and for at least half that time with well-marked success in certain directions. In the first instance it was the aristocracy of labour that realised the advantage of collective action, but, notably since the late 'eighties of last century, efforts have been made to extend the policy to all grades of labour. Hence the ailments which have to be noted are rather more mature than those affecting employers' associations. Success in certain directions has perhaps led some of the more ardent spirits to expect more from their unions than working conditions allow. The experience of old and tried leaders has led them to adopt a more cautious policy than the young bloods are inclined to accept. Hence there has been a want of loyalty, different, it is true, from that met with among employers, but equally disastrous if persisted in to the object in view.

All the men in a given industry should be members of the union, provided that the union is well organised and ably administered. This should, however, be the result of self-interest and a regard for the good of fellow-workers, rather than of compulsion; how that may be attained has been suggested. Perfection of organisation will come when workpeople not only realise the real possibilities of collective action, but are prepared to follow loyally leaders who have been constitutionally elected. The leaders are in a better position to know the facts of the case immediately under review, but if their leadership has been found faulty there should be adequate machinery for replacing them with men who command the confidence of the majority of the members. When agreements have been entered into, the terms should be implicitly observed, even though they may turn out to be less advantageous than was expected. Periodical revision would make it possible to rectify mistakes or misapprehensions. But it cannot be too strongly emphasised that for both sets of organisation the great factor making for smooth and satisfactory working is absolute loyalty to the pledged word. A large employer of skilled labour writing to me on this point said :—"In my opinion no industrial harmony can exist between employers and employees until trade unions through their executives can compel their members to adhere to and honourably carry out all agreements entered into with the employers. . . . In fact, until a more honest code of morals exists on both sides no improvement can be looked for."

Further, there is a need for a more complete and authoritative central authority, both for individual industries and for federated trades. The machinery for this exists, it merely requires development. When the local and central machinery has been perfected, the right to *strike*, which, in common with the right to *lock out* as a final resource, should be jealously maintained, would be carefully regulated, and would only be resorted to as the considered judgment of the most experienced men on either side. It should be impossible for either an individual association or a section of it to order a strike or a lock-out on its own responsibility.

What, then, do I consider should be the main outline of industrial organisation? Employers should be organised into :—

(*a*) Associations of one trade in a given district.
(*b*) National associations of one trade.
(*c*) Local federations of trades.
(*d*) National federations of trades.

Of these, (*b*) and (*d*) should be organised under a system of representation.

Workpeople should have unions and federations corresponding to those of the employers, and in both cases the national federations should be carefully organised councils, who would enjoy a large measure of authority, tempered by the necessity to win and preserve the confidence of their electors. From these two representative bodies there could be elected an industrial council as a court of appeal, representative of the whole industrial activity of the country, and so far as these various bodies were approved by the State they would enjoy far-reaching powers.

Approval by the State should depend on the observance of moderation and working in conformity with carefully devised regulations. For the State in this matter would be the representative of the consumer and of the national interest. Without this you get something not very far removed from Syndicalism, but under careful regulation abuses might be avoided.

At the head of the organisation there would be a real industrial council representing the industry of the country. The industrial council established in the year 1911 has never had a fair chance to show its mettle. It was established at a critical time; perhaps the Government did not feel justified in throwing a great responsibility on an untried body. Nevertheless, it exemplified a very wise policy, and one regrets that it has not been tested, for even now both employers and workpeople feel that some such council is preferable to State interference, and there is a clearly articulated distrust on both sides of official arbitration.

We do not need at the present juncture to attempt a new experiment. Our old system, whatever its failings, has been tried and proved sound. Its elasticity has been its salvation, and it is capable of still further evolution without calling for drastic changes. The improved organisation that is now suggested would contain nothing that is new or untried. It would consist of natural developments of what already exists. Employers and workpeople have organised themselves into associations and unions, some of these have developed federations of similar or even of unconnected interests; and both parties have their national congresses, or at any rate the germ of them. The demand now is that the organisations already in existence be perfected, and that those perfected organisations shall in all their agreements be loyally and honestly supported by their members. Success depends on absolute loyalty to the pledged word.

Here we have a practical policy suited to the needs of this critical stage in our history. The ideal organisation has yet to be formulated, but what is here proposed would form a definite step in advance, and the very elasticity of the system would be a good augury for the future.

A committee of this association has been investigating for the past two years into the extent to which women have recently replaced men in industry. A certain amount of exaggeration exists as to the number of women who have entered our factories or undertaken services left vacant by men who have joined the Forces. The total number is, in round figures, about 600,000, as against five million men who have joined either the Navy or the Army as a consequence of the war.

The entry of large numbers of women into industry has been viewed with a certain amount of alarm by the men; and trade unions have naturally stipulated, where possible, that these women shall receive the same rates of pay for the same work as the men, and that when the men return the women shall give place to them.

That there was little ground for alarm as to the influx of women can be realised by a consideration of a few facts and figures. The majority of men who enlisted were workpeople of one sort or another; of these, unhappily, some have been killed in battle or have been rendered incapable for work. Even so, the majority will come home requiring occupation. What opportunities will they find?

To answer this question at all satisfactorily it is necessary to consider some determining factors. Thousands of men have left indoor occupations and their accustomed town life and have been trained, drilled, and disciplined under open-air conditions. They have lived, worked, and fought in the open country in some cases for many months. The new experience has had potent effects. Physique has improved, the outlook on life has changed, in many cases new hopes for the future have been formed. Inquiry shows that there is a division of opinion as to the extent to which disbanded members of the Forces will decide on making a radical change in their mode of life. Yet the experience of what occurred after the South African War warrants us in assuming that considerable numbers will only return to indoor occupations and town life if there be no alternative. It is too soon yet to form an opinion as to what opportunities there will be for land settlement. But it is known that offers will be made, both at home and in various parts of the Empire. A moderate estimate of those accepting these offers, and of our losses of killed and permanently disabled, would be at least one million. Then we shall undoubtedly require, at any rate for some years, a much larger standing Army. Even on a peace footing this at a moderate computation may be put at a million men. These two figures, and neither of them errs on the side of exaggeration, will absorb two million men who will be permanently lost to the old occupations.

Moreover, there is good ground for anticipating that if the war concludes before our resources are unduly strained, and there is every prospect that it will, there will be a period of good trade. We have to restore our own depleted stocks of goods, our mercantile marine demands a large amount of new tonnage, railways and other transport services will require much new equipment. Turning to the Continent, parts of France, Belgium, and other of the Entente countries will need reconstruction works of considerable proportions, and in this work we shall play a great part. World markets, too, have been kept short of many manufactured goods. We shall be in a position both to finance and carry on a greatly extended system of industry and commerce, for not only is our banking system prepared to face this, but our man force has been greatly improved, and our industrial equipment to a great extent remodelled.

Reverting to the somewhat thorny question of the women who have been engaged on what were men's occupations, I see no cause for alarm. Many women came forward from motives of patriotism, and will gladly resume their former state. The question, I believe, will rather be how can we obtain the labour necessary to cope with the post-war demand.

The new equipment of our factories will place us in a position to increase very greatly our ouput, and this should enable us not only to face a possible labour shortage, but if the recommendations made by this section of the association meet with a favourable response, our labour force should enter upon a new period of prosperity consequent on a remodelling which has been rendered possible by a reorganisation of our industrial machinery. This new epoch for labour would include higher wages, shorter hours, and better working conditions. To effect these salutary advances both employers and employed need to exercise sanity of judgment, frankness in mutual discussions, and a recognition of the fact that the prosperity and material well-being of each is bound up in a common effort to maintain and develop our industrial and commercial position.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The term has opened with a greatly reduced number of undergraduates. Exact figures are not yet forthcoming, but they will certainly be small. The current issue of the *University Gazette* contains the names of 312 members of the University who have lost their lives on active service during the last three months, all but a very few having been killed in action. The usual lists of lectures, demonstrations, and laboratory work have been issued by the heads of the various science departments. The programme published by the School of Geography includes lectures by the acting director on geographical method and on the distribution and economic geography of primitive societies; by the demonstrator, on regional geography of the British Isles; and by Messrs. Spicer and Kendrew, on land forms and climate. Practical classes will also be held. The Committee for Anthropology has arranged for lectures on physical anthropology, ethnology, theories of totemism, and primitive archæology. These will be given by Prof. A. Thomson, Miss Czaplicka, Mr. H. Balfour, and Dr. Marett. Demonstrations and informal instruction on a large variety of subjects connected with anthropology are also announced.

THE widow of Prof. Gwynne Vaughan has presented to the Botanical Department of the University of Glasgow the collection of more than 2000 slides, in mahogany cabinet, belonging to her late husband, and the originals of all his published memoirs.

A SPECIAL course of short lectures is to be given by Mr. E. F. Etchells to the Junior Institution of Engineers on alternate Friday evenings, beginning on October 20. The subjects are:—"A Commonsense Notation for Engineers," "The Practical Use of Units in the Evaluation of Formulæ," "How to Memorise Formulæ," "Logic of the Differential and Integral Calculus," and "Practical and Illustrative Examples of the Application of the Newer Concepts."

THE Joint Matriculation Board of the Universities of Manchester, Liverpool, Leeds, and Sheffield conducts a matriculation examination which ensures one common standard for entrance to the separate universities. The various universities are represented on the board, and about five practical teachers are co-opted, so that the schools and universities are kept in touch with one another. According to the *Morning Post* of October 13, Birmingham University is to be included in the operations of the board, and thus another step is taken in the direction of securing a uniform standard for entrance to a university. We also learn from our contemporary that the Vice-Chancellor of Liverpool University, who is the chairman of the Joint Board, stated at a special meeting of the Liverpool University Court on October 12 that the University authorities at Bristol proposed recently that the Bristol University should be included in the scheme, but a final decision had been postponed until after the war.

An address by Sir Henry A. Miers on "The Place of Science in Education" is printed in *Education* for September 15. In outline the views expressed may be summarised as follows:—In elementary schools science can be little more than common-sense thinking about, and intelligent interest in, the ordinary events of everyday life, the main aim being to encourage a feeling of the necessity for personal trial and effort in understanding what is seen and done. In secondary schools there should be a systematic course of experiments, especially in the physics and chemistry of ordinary life, in order to encourage a habit of reasoning from what has been observed. This systematic course should be preceded by an introductory course dealing with scientific facts and ideas. All the work here outlined should precede the division of the school into "moderns" and "classics." On the modern side real scientific training is obtained from the laboratory work which becomes essential, but on the classical side science might well deal with general principles through the history of science and discovery, the whole subject being taught in language of a literary character freed from technical phraseology. Such a scheme involves the teaching of general elementary science in the preparatory schools.

In the *Fortnightly Review* for October the subject of science and the *rôle* to be assigned to it in the curriculum of the higher schools and universities is considered in a suggestive article entitled "Education To-day and To-morrow," by Mr. P. E. Matheson. Reference is made to the manifesto issued a few months ago pleading for a larger infusion of scientific knowledge into the public service, and it is suggested that whilst the critics have made good their complaints of serious defects in our war administration some of the criticisms are to be met by other means than educational reform, as, for example, the conversion of men of business to the belief that scientific research pays. Mr. Matheson admits that unless we have more science in the schools we shall perish. But it is declared that we are up against faults of character and a disbelief in the value of disciplined intelligence. Yet we cannot hope for a cure for these defects either in respect of employers or of persons in the higher service of the State unless it be through the schools and as a result of systematised training, not only in languages, history, literature, and mathematics, but also in the facts and potentialities of scientific knowledge, together with the due training of hand and eye, and accompanied by those formative agencies which promote self-reliance and sterling character. The article is a welcome indication of a more liberal attitude towards the claims of science in the schools and universities.

The annual congress of the Textile Institute, which met at Leeds on October 13, was in the main concerned with the question of scientific research in the application to the needs of the textile industry. Much has been done of late years in the encouragement of research in the great textile schools of Manchester for cotton goods, and in those of Leeds and Bradford for woollen and other animal fibres, but there is still to lament the indifference of manufacturers to the fruit of such research and to the importance and value of skilled, scientific labour. Dr. Sadler, in welcoming the delegates, pleaded for better appreciation on the part of manufacturers, and for a higher scale of remuneration for those engaged in research in our universities and in the technical colleges attached thereto. When shall we have an English example such as that of the firm of Zeiss, in Jena, which in the course of years has contributed considerably more than 100,000*l*. to the University of Jena as a mark of its appreciation of the value of the scientific assistance it has received therefrom? It is not merely in the adoption of ingenious mechanical contrivances to displace hand labour and so to increase production, the invention of which is shared by the textile-producing nations, but the question goes far deeper than this, in the closer investigation of the fibres with a view to their more successful treatment; in the discovery and scientific manipulation of new fibres, even to the production of artificial fibres; and in the skilful adaptation of material, hitherto regarded as waste, to the production of saleable goods. In the latter aspect of the question the superior chemical training and skill of our foreign competitors on the Continent have enabled them to compete most seriously with important branches of our textile trade, especially in respect of the dyeing and finishing of textile goods. The future of the coal-tar industry was the subject of an address by Prof. A. G. Perkin, who maintained that the production of synthetic dyes, in which Germany had outdistanced this country so completely, was due to the neglect of the manufacturer, the chemist, and of the technical schools. We needed, said Mr. J. H. Lester, of Manchester, a better organisation of industrial education, research and co-operative agencies of all concerned on scientific lines, in order to ensure the maintenance and progress of our industries. There was not, said another speaker, Dr. M. O. Forster, a sufficient supply here of well-educated, clear-brained, intelligent young men of sound character and real perseverance in the chemical world.

The attention which is being directed to educational topics in the public utterances of men distinguished in various forms of national activity is, it may be hoped, an indication that the importance of a sound and well-balanced system of national education in this country is beginning to be understood. On October 11 Lord Haldane delivered the first of a series of lectures on after-war problems, arranged by a joint committee of Birmingham University and the Workers' Educational Association. He said it was his wish to devote his remaining days to being a missionary on the great question of education. We remember, however, that though, when president of the British Science Guild, he was an advocate of increased attention to education and science by the State, he did little, when he possessed political power, to see that the nation was given the fullest scientific and educational equipment. In his address on October 11 he maintained that what we want is training, and it is the mental training of the future generation that is going to count. When peace comes, he continued, we shall hear no more in Germany about 16-in. guns, but a great deal about continuation schools. The Germans are training up a generation of skilled workmen with whom we cannot compete. We must take care to train the children of our working classes in at least as good a way as the Germans have been able to train theirs. Mr. L. A. Legros also referred to education in his presidential address to the Institution of Automobile Engineers on October 11. Never, he said, in the history of engineering has the ignorance of science by the politicians, the military, and other authorities been so openly displayed as in the early stages of the war, and never has it proved so costly in time, in life, and in material. How many lives and how many millions of pounds, he asked, would the country have been saved if as much study in time and thought had been expended on science as on classics by our law-makers and law-givers? He pleaded that science should be given its proper place in education, and that due care should be exercised in providing suitable training for those women who, as mothers and teachers, would have charge of the earliest training of our future men.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, September 25.—M. Camille Jordan in the chair.—E. **Belot**: The origin of the rotations and revolutions in the forward or backward sense, as well as the origin of cometary orbits.—J. **Guillaume**: Occultations of the Pleiades, observed on September 16, 1916, with the 16-cm. Brünner equatorial of Lyons Observatory.—M. **Boll** and L. **Mallet**: Determination of the practical constants of the Coolidge tube. The Coolidge tube is very stable, and the X-radiation can be maintained for a long time constant, both as regards emissive power and degree of penetration. It is easy to change from hard to soft rays and the reverse. The practical yield is of the same order as other focus tubes for soft rays. The radiation from a Coolidge tube is not appreciably more homogeneous than that of other tubes.—J. **Bougault**: The acidylsemicarbazides. A general account of their physical and chemical properties as a group.—P. **Paris**: *Sphaeromicola topsenti*, a new genus and species of Ostracod.—A. **Lumière**: The comparative action of antiseptics on pus and on pure cultures. The experiments were carried out with three disinfectants of different types—phenol, sodium mercury-phenol-disulphonate, and sodium hypochlorite. These were allowed to act under similar conditions upon the concentrated pus, culture of the pus, and a pure culture of the predominating staphylococcus from the pus, and also upon 1 per cent. dilutions of these. The albuminoid substances present in the pus attentuate slightly the bactericidal effect of phenol; this action is a little more marked with the mercury compound, and becomes very important with the hypochlorite.—R. **Wurtz** and E. **Huon**: The variolisation of heifers immunised against the vaccine.—Em. **Bourquelot** and A. **Aubry**: The biochemical synthesis of α-propyl-*d*-galactoside with the aid of a ferment contained in air-dried low yeast.

BOOKS RECEIVED.

A Census of New South Wales Plants. By J. H. Maiden and the late E. Betche. Pp. xx+216. (Sydney: W. A. Gullick.)

Vorschläge zur geobotanischen Kartographie. By Dr. E. Rübel. Pp. 14. (Leipzig: Rascher and Co.) 1.50 francs.

Catalogue of Scientific Papers. Fourth Series. 1884–1900. Compiled by the Royal Society of London. Vol. xv. Pp. vi+1012. (Cambridge: At the University Press.) 2*l*. 10*s*. net.

Joseph Pennell's Pictures of the Wonder of Work: with Impressions and Notes by the Artist. Pp. lii. (London: W. Heinemann.) 7*s*. 6*d*. net.

Transactions of the Royal Society of Edinburgh. Vol. l., part iv. Session 1913–14. (Edinburgh: R. Grant and Son.) 22*s*.

Checklist of the Recent Bivalve Mollusks (Pelecypoda) of the Northwest Coast of America from the Polar Sea to San Diego, California. By Dr. W. H. Dall. Pp. 44. (California: Southwest Museum.)

Arboreal Man. By Prof. F. Wood Jones. Pp. x+230. (London: E. Arnold.) 8*s*. 6*d*. net.

The Migrations of Fish. By Prof. A. Meek. Pp. xviii+427. (London: E. Arnold.) 16*s*. net.

DIARY OF SOCIETIES.

FRIDAY, October 20.

Institution of Mechanical Engineers, at 6.—Trials on a Diesel Engine, and Application of Energy Diagram to obtain Heat Balance: The late Lieut. Trevor Wilkins; presented by Prof. Burstall.

TUESDAY, October 24.

Zoological Society, at 5.30.—Notes on the Development of the Starfishes *Asterias glacialis* O. F. M., *Cribrella oculata* (Linck) Forbes, *Solaster endeca* (Retzius) Forbes, *Stichaster roseus* (O. F. M.) Sars: Dr. J. F. Gemmill.—Studies on the Anoplura and Mallophaga, being a Report upon a Collection from the Mammals and Birds in the Society's Gardens. Part II.: B. F. Cummings.—Two New Species of Cestodes belonging respectively to the Genera Linstowia and Cotugnia: Dr. F. E. Beddard.—Notes on a Collection of Heterocera made by Mr. W. Feather in British East Africa, 1911–13: Lt.-Col. J. M. Fawcett.—The Structure and Function of the Mouth-parts of the Palæmonid Prawns: L. A. Borradaile.—Heude's Collection of Pigs, Sika, Serows, and Gorals in the Sikawei Museum, Shanghai: A. de C. Sowerby.

Institution of Civil Engineers, at 5.30.—James Forrest Lecture: The Development of Appliances for Handling Raw Materials and Merchandise at Ports and other Large Centres of Traffic: Sir John Purser Griffith.

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

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THURSDAY, OCTOBER 26, 1916.

"METEORITICS."

Meteorites: their Structure, Composition, and Terrestrial Relations. By Dr. O. C. Farrington. Pp. x+233. (Chicago: Published by the Author, 1915.) Price 8*s.* 6*d.*

THE treatise on meteorites written by the well-known curator of geology at the Field Museum of Natural History, Chicago, will meet a difficulty that has long faced the student who, while desirous of studying this subject, has hitherto looked round in vain for a comprehensive text-book. Sir L. Fletcher's handbook and guide to the meteorite collection at South Kensington, which is now in its eleventh edition, is admirable so far as it goes; but its scope is naturally limited, since it is intended for the ordinary visitor to the museum. Meunier's "Météorites," which formed part of an "Encyclopédie Chimique," was published so far back as 1884, and is therefore out of date, and probably not now readily accessible. Cohen's "Meteoritenkunde" was excellently planned, but was unfortunately cut short at the end of the third of the five parts in which it was intended to be by the author's death in 1905; indeed, he did not live to see the third part appear.

At the outset Dr. Farrington attempts to solve the problem of finding a name for the subject, and suggests "Meteoritics," a word that seems to serve the purpose very satisfactorily, since "Meteoritology" is ruled out because of the inevitable confusion with that branch of science which is concerned with the weather. Previously "Astrolithology" had been proposed by Shepard, and "Aerolitics" by Story-Maskelyne, but neither word is suitable or suggestive.

The book consists of two parts, though it is not so divided, dealing the one with the mode in which meteorites have reached the earth's surface and their possible origin, and the other with their physical and chemical characters. But for the protection afforded by the atmosphere the fall of a meteorite would not be the comparatively rare phenomenon it is at present. Most of the erratic bodies which meet or overtake the earth are burnt up long before they reach the ground, and the velocity of those that do survive the passage through the air is so reduced by the friction that the rate of fall is only what would be due to gravity had they fallen from heights which have been variously estimated from 4 to 46 kilometres. The disruptive force generated by the heat resulting from the friction causes meteorites to burst into pieces which are often quite small. Nevertheless, some of the masses which must have fallen, though there is no recorded evidence of the fact, have been of considerable size and weight. The largest as yet known is the Ahnighito—one of those located at Cape York, West Greenland, by Admiral (then Lieut.) Peary in 1895, and now in the New York Museum; it weighs 36½ tons. The next in size is that of Bacubirito, Mexico, which, on account of its inaccessibility and the difficulty of transport, still remains where it originally fell; its estimated weight is 27 tons. Pathetic interest attaches to the photograph which is reproduced as a frontispiece. It represents the late Prof. H. A. Ward standing beside the Bacubirito meteorite. An indefatigable collector of meteorites, he was ready to start at a moment's notice to any part of the globe in search of one. He returned in safety from all his expeditions, only to be run over and killed in the street at Rochester, N.Y., where he had his home.

Meteorites are distinguished from terrestrial rocks both by their structure and by their mineral composition. All the elements present in the former are known terrestrially, but some of the common elements, such as barium, strontium, lead, and bismuth, have not been detected in meteorites, at least not in quantity or with certainty. Many of the minerals present in meteorites are peculiar to them, and have not been found terrestrially—for instance, oldhamite (calcium sulphide), schreibersite (iron-nickel-cobalt phosphide), lawrencite (iron-nickel chloride). Their presence is very significant, since they could not have been produced had solidification taken place in the presence of free oxygen. It is the last-named mineral that is largely responsible for the sweating and rusting which occur in certain irons. The metallic portion of a meteorite consists largely of an iron-nickel alloy, and is arranged in a definite manner, as is shown by the markings developed on etching a polished section. Dr. Farrington himself has established that the nature of the arrangement depends on the ratio of the iron to the nickel in the alloy; irons with about 6 per cent. of nickel have one type, which is characterised by the fine Neumann lines, those with from 7 to 15 per cent. have a second type, showing the broad Widmanstätten bands, and those still richer in nickel have a granular structure. Meteoritic stones are not unlike terrestrial rocks as regards their mineral constitution, but differ from them in their peculiar chondritic or granular structure.

One of the problems in the subject that call for solution is a satisfactory classification of meteorites. That at present in use, which is described in detail by Dr. Farrington, was devised by Gustav Rose, and amplified or modified by Tschermak and Brezina. It is cumbersome, consisting as it does of no fewer than seventy-six groups, and has no real scientific basis. The author refers the reader to a scheme on the lines of the American quantitative classification of rocks which he has himself put forward. This classification has, however, been by no means generally accepted in the case of rocks by petrologists. A promising scheme, which emphasises the relationship subsisting between meteorites, however apparently different their characters may be, was recently communicated to the Mineralogical Society by Dr. Prior. It consists of six groups, of which five may be considered as derived from the first by chemical interaction between certain of the constituent minerals.

At the close the author appends a useful table for discriminating the metallic minerals occurring in meteorites, and has added two indices, one general, and the other giving the falls mentioned in the book.

ESCAPE OF ELECTRONS FROM HOT BODIES.

The Emission of Electricity from Hot Bodies. By Prof. O. H. Richardson. Pp. vii+304. (London: Longmans, Green and Co., 1916.) Price 9*s.* net.

THIS work, which is one of the series of monographs in physics published under the editorship of Sir J. J. Thomson and Prof. Horton, deals with the emission of positive and negative electricity from hot bodies. The closely related subject of the conductivity of flames is not included. It will be remembered that a volume dealing with this part of the subject was published a few years ago by Prof. H. A. Wilson.

While it had long been known that hot bodies discharge both positive and negative electricity, the detailed investigation of this important subject was an immediate consequence of the development of the ionisation theory of gases. The author was one of the first workers in this new field of work begun at Cambridge, and with the help of numerous students he vigorously continued his investigations at Princeton University, and more recently at King's College, London. A large part of our knowledge of this subject is due to his investigations.

As a consequence, we have a first-hand account of this interesting subject, written by one who has a full appreciation of the experimental difficulties and the adequacy of the theories proposed. A large part of the volume is devoted to the study of the emission of negative electrons from heated filaments at low gas-pressures, its variation with temperature, the effect of residual gases, and the treatment of the metal surfaces. Although the electronic current is usually large and easily measured, there are in many cases wide discrepancies in the magnitude of the current obtained under similar conditions by different observers. This lack of definiteness in the data seems to result mainly from the part played in the electronic emission by the condition of the surface, and the presence of gaseous or other impurities. A general theory is advanced on the supposition that a metal contains free electrons which obey the gas laws. At high temperature some of the electrons acquire sufficient energy to escape from the metal surface. The theory of the escape of electrons from a hot metal is thus analogous to that of the evaporation of a liquid. This theory seems to explain satisfactorily the rapid variation of the electronic current with the temperature. The author has shown experimentally that energy is expended in the escape of electrons from the metal surface, and that heat is given up to the metal surface when electrons pass into it. The connection of these effects with the contact difference of potential has been carefully examined.

As is well known, there has been considerable difference of opinion in the past as to the origin of the large electronic emission from incandescent bodies. Its susceptibility to conditions, and especially to the presence of impurities, has led some to suppose that part, if not all, of the electronic emission is the result of chemical action between the heated metal and the gaseous or other impurities. The author evidently considers that there is a true electronic emission depending only on the metal, and his contention is certainly strongly supported by the observed fact that a tungsten filament in the highest possible vacuum continues its emission of electrons unchanged with time. On the other hand, the electron current from most metals is very markedly influenced by the previous history of the wire, and is extraordinarily susceptible to the presence of a minute amount of impurity. For example, Langmuir in a recent paper directs attention to the striking fact that the heating of a filament containing thorium in the neighbourhood of the tungsten wire increases the thermionic current of the latter by a million times. While great progress has been made in the last decade in extending our knowledge of this subject, there is no doubt that much work still remains to be done to clear up many outstanding difficulties.

In the last chapter the author discusses the experimental evidence of the emission of positive electricity from heated metals and salts, and describes the ingenious method developed by him to determine the mass of the carriers. The surprising fact is brought out that in the great majority of cases the carriers of positive electricity are atoms of potassium. The reason why potassium, which, even when present only in minute quantities, is an impurity, should be the active element in this emission is difficult of explanation.

In the preface the author mentions that he has not thought it desirable to include an account of the practical applications of thermionic emission, but mentions some of the more important papers in which this side has been discussed. It is to be hoped, however, that when a second edition is called for, the author will devote a chapter to the very interesting application of the thermionic emission to the rectification of alternating currents, and to the magnification of small currents in radio-telephony and radio-telegraphy. It is of great value that students should appreciate the striking way in which the pure science researches in this subject have proved of great technical value.

This book can be strongly recommended to all those who are interested in modern physics as a clear and up-to-date account of our knowledge of an important department of modern scientific research.

PHYSICS.

(1) *A Student's Heat.* By I. B. Hart. Pp. vii + 376. (London and Toronto: J. M. Dent and Sons, Ltd., 1916.) Price 4*s.* 6*d.*

(2) *Elementos de Fisica Descritiva para a 4ª e 5ª Classes dos Liceus.* Por Dr. F. J. Sousa Gomes e Alvaro R. Machado. 5ª edição, revista por Alvaro R. Machado. Pp. 528. (Braga: Livraria Escolar de Cruz y Ca., 1915.)

(1) MR. HART'S text-book of heat is intended for use in the higher forms of secondary schools, for advanced students in technical colleges, and for those taking a pass degree examination at the university. The author has included in his book descriptions of many modern methods of determining thermal constants and results of recent experimental investigations. Although the calculus is introduced in the section on thermodynamics, a knowledge of elementary algebra and geometry will suffice for the perusal of the greater part of the book. The text is furnished with a large number of clearly drawn diagrams, but the exposition in some parts is open to considerable criticism.

In the paragraphs dealing with electrical methods of measuring temperature the author assumes his reader to have no knowledge of electricity, and explains the chief points of the simple electric circuit with the aid of a diagram showing cell, ammeter, resistance, and voltmeter all connected in series. In connection with the platinum resistance thermometer, the compensating leads are not made of copper, nor is it usual to standardise the instrument in the way described by the author. The variation of resistance with temperature is represented by $R_t = R_0 \ (1 + \alpha t + \beta t^2)$. According to the author, β is neglected for approximate measurements, and $\alpha = 0{\cdot}00366$; while for more accurate work the constants α and β are determined by measuring the resistance at 0° C., 100° C., and −273° C. At the last-mentioned temperature the resistance of a pure metal is known to be zero. Again, when describing the thermocouple method of measuring temperature, on p. 23, we have "the difference in temperature at the junctions *induces* an electromotive force, and the galvanometer registers a *kick.*" The formula derived for the expansion of a liquid by the weight thermometer method, on p. 49, is wrong. On p. 86, dealing with molecular velocity and temperature of a perfect gas, it should be made clear that it is the square root of the mean square velocity of the molecules which is proportional to the absolute temperature and not their mean velocity. It is difficult to see how Charles's law for unsaturated vapours is verified by the experiment described on p. 131, since the vapour will be subjected to varying pressures. On p. 182 we have the statement that Newton's law of cooling is an approximation to Stefan's law. This is wholly erroneous, since the law of Stefan refers to loss of heat by radiation alone. Each chapter is furnished with a large number of questions selected from the papers of various examining bodies.

(2) As its title implies, this text-book is purely descriptive in character. The subjects dealt with are mechanics of solids and fluids, light, heat, sound, electricity and magnetism. The ground covered is only elementary, and upwards of 200 pages are devoted to introductory mechanics and properties of matter. No mathematical proofs of the formulæ employed are given, the idea being that the statements are to be regarded as laws to be verified experimentally. While there is nothing novel in the treatment of the subject, the text is accurate, concise, and amply illustrated.

BIRDS AND THE POET.

The Birds of Shakespeare. By Sir Archibald Geikie. Pp. x + 121. (Glasgow: James Maclehose and Sons, 1916.) Price 3*s.* 6*d.* net.

THIS volume—one of the company of books which owe their existence to the tercentenary of Shakespeare—consists of an address delivered by the distinguished author to a country natural history society, and as such it must have served its purpose admirably. Beyond this it makes no pretensions, but it is all that it claims to be, and will fill a vacant place on the shelves of those who do not possess Mr. J. E. Harting's standard work.

In his opening pages the author lays stress on the development of man's feeling towards Nature from Chaucer to Shakespeare, from the simple, unreflective delight in the sights and sounds of the open air to the dawning of a sense of "the mystery of things" and its influence on the human mind; and again, at the close of the lecture, he passes to the further development of reflectivity manifest in the poems of Wordsworth, Keats, and Shelley, where the birds are not merely talked *about,* however poetically, but actually talked *to,* as being, like ourselves, "travellers between life and death." The main body of the volume is taken up with the passages in the plays and poems relating to the several birds, linked together by pertinent observations. Some half-dozen pages are deservedly devoted to that "pleasure for high-mounting spirits"—the sport of hawking, to which the birds of prey owed such consideration as they enjoyed; for, apart from this, Shakespeare shares the depreciatory attitude towards them current in his day and long after, including even the "mousing owl"; but then, as Waterton long ago remarked, from the time of Ovid downwards this useful bird has always been in ill odour with the poets. Passing on to the game birds, we get a too brief account of the various methods of taking them, and the sportsman to whom the "Diary of Master William Silence" is still an undiscovered treasure might have welcomed a footnote sending him to that invaluable work.

Here are one or two points which might receive attention when the book is reprinted. "The Passionate Pilgrim" and "The Phœnix and the Turtle" are drawn upon without any hint that these *réchauffés* are by no means wholly the work of Shakespeare. Loon, "a diver," and loon, "a rogue," are words of distinct origin. With the very doubtful exception of the passage in "King Lear," Shakespeare's "chough" (as the present writer maintained many years ago in the *Zoologist*) is not the Cornish chough (*Pyrrhocorax graculus*), but the jackdaw (*Corvus monedula*), and, to be strictly accurate, Tereus was not the brother, but the brother-in-law, of Philomela.

The numerous illustrations require no recommendation. They are our old familiar friends from Yarrell and Howard Saunders.

OUR BOOKSHELF.

The Panjab, North-West Frontier Province, and Kashmir. By Sir James Douie. Pp. xiv + 373. (Cambridge: At the University Press, 1916.) Price 6*s*. net.

THE editor of the Cambridge series of Provincial Geographies of India made a happy selection when he entrusted the Panjab to Sir James Douie, who during thirty-five years' work as a member of the Indian Civil Service has held the posts of Chief Secretary, Financial Commissioner, and Officiating Lieutenant-Governor; what he does not know of the Province in which he served is not worth knowing. In a series of chapters packed with information he discusses the physiography, ethnology, sociology, history, archæology, and administration of an area of one quarter of a million square miles, comparable in extent, as well as in other respects, with Austria-Hungary. To summarise this amount of information within a limited space naturally prevents the elaboration of detail. The book, in fact, is an epitome of the information contained in the Imperial and Provincial Gazetteers, and in numberless other official publications.

An excellent feature of the work is the large series of photographs, maps, and diagrams. In the illustrations it is pleasant to notice that the personal element is well represented in John Lawrence, Charles Aitchison, Denzil Ibbetson, and Michael O'Dwyer—some of the able administrators for which the Province has been noted—and in those of native celebrities. In a new edition we may suggest the inclusion of some great soldiers—Pollock, Nott, Gough, Nicholson, Edwardes, Roberts, and Donald Stewart. It would also be a help to students to provide a short list of the more useful books dealing with various aspects of history, social life, travel and sport. The mistake (p. 24) of fixing Lord Roberts's march to Kabul in 1898 should be corrected. Every young officer, military and civil, posted to India should possess a copy of this useful book, and it might with advantage be introduced into the geography course in British and Indian schools.

The Student's Handbook to the University and Colleges of Cambridge. Fifteenth edition, revised to June 30, 1916. Pp. 16 + 704. (Cambridge: At the University Press, 1916.) Price 3*s*. net.

THOUGH the statements contained in this handbook are not official, the information provided has been compiled from authentic sources and may be regarded as accurate. Parents sending sons to Cambridge will find the guide invaluable, especially the sections dealing with expenses and scholarships.

In view of the recent comparative inactivity of the University there are no additions to this issue of the handbook. Some temporary emergency regulations, occasioned by the war, affecting undergraduates are summarised conveniently, and altogether the general usefulness of the volume has been well maintained.

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.]*

Scarcity of Wasps.

THE scarcity of wasps in Cheshire during the passing autumn, noted in NATURE of October 12 by Mr. H. V. Davis, has been equally remarkable in this district (Wigtownshire). Observation extending over very many seasons has convinced me that the abundance of queen wasps in spring is no indication of the number of swarms in late summer and autumn. That appears to be regulated by the character of the weather in June and July, which this year was unusually cold and wet. In the autumn of 1915 there was an extraordinary number of the nests of social wasps, both of the species that build underground and those that found arboreal colonies. In consequence I do not remember ever to have seen so many queen wasps about as there were in May of this year. Presumably each of these started building cells and laying eggs, but even if these hatched out, the cold was fatal to the larvæ (for wasps are essentially lovers of sunshine); no workers were reared to assist in forming the colony, which consequently came to naught. Last year I would have undertaken to find fifty wasps' nests within a radius of half a mile of this house; this year I did not know of one. HERBERT MAXWELL.

Monreith.

THE past summer has been so remarkable as regards these insects that a few notes from an old observer may be acceptable. The principal fact to be noticed is the extraordinary disproportion between the immense number of queens in spring (I cannot remember so many in upwards of fifty years' observations) and the scarcity of workers in the summer. It is scarcely an exaggeration to say that there were more queens to be seen in the spring than workers when these were most numerous, in September. To go back to the beginning, an entry in my diary on October 18, 1915, states that on digging out a nest poisoned with cyanide two days previously, in which all the active workers had been killed, "a lot of quite lively ones, mostly queens," was found.

There can be little doubt that the cause of the scarcity of nests and workers was the cold and *wet* weather of mid-April. This supposition is supported by the fact that of the only four nests found and taken near this house, two were in fresh (and therefore warm) manure-heaps, one in the roof of the gardeners' bothy, and one in a sheltered hedge bottom. I have no recollection of having ever seen a nest in a dunghill before.

The discrepancy between the number of queens in spring and of nests and workers in summer is so common that I am tempted to think that the more conspicuous, and therefore more often caught, queens are infertile, and the rewards for their destruction wasted. Perhaps some member of the Association of Economic Biologists will take the matter up?

ALFRED O. WALKER.

Ulcombe, Kent.

IN reference to the letter of Mr. H. V. Davis (NATURE, October 12, p. 109), I may say that in this district ordinary wasps have been decidedly scarce this year. Reports from several other localities are of the same character. Queens, however, were abudant in the spring (May and June), but I think that only a few survived the wet and cloudy weather.

I make a point of cultivating these insects, as they are extremely interesting to watch, and destroy myriads of flies every summer. There were six embryo nests in my garden in May last, but only one (*Vespa vulgaris*) managed to withstand the vicissitudes of the inclement weather. This nest was a weak one, for when I dug it out on September 20 it consisted of four layers of cells, the top one alone being for small working wasps (1000 cells), while the others were exclusively for queens and drones (1450 cells). This proportion is quite exceptional according to my own observation, for I have commonly found the smaller cells greatly in excess of the others. In a much stronger nest (*Vespa germanica*) which I took here on October 6, 1915, there were 12,900 cells, forming ten tiers, and less than a quarter of the former had been devoted to the rearing of queens and drones.

Very few persons will be inclined to attract wasps to reside in their own immediate neighbourhood, but anyone caring to study these insects should make a few little cavities in dry situations early in April. The queens begin selecting eligible positions in that month (average date, April 17). It is certain that wasps are not so aggressive and violent as commonly supposed. They display remarkable industry and activity, for at midsummer they may be observed streaming to and from their homes during a long working day of eighteen hours! In view of the justified agitation against the house-fly in recent years, it is questionable whether the usual spring campaigns against queen wasps should be encouraged. On a bright summer day in 1913 I carefully watched the entrance of a wasps' nest in my garden, and concluded that the insects brought home at least 2000 flies.

W. F. DENNING.

44 Egerton Road, Bristol, October 14.

REFERRING to Mr. H. V. Davis's letter in NATURE of October 12 on the scarcity of wasps, I have taken nests for some years over an area a little less than 1000 acres as follows:—1906, 95 nests; 1907, 61; 1908, 31; 1909, 113; 1910, one (*Vespa rufa*, Linn.); 1911, 85; 1912, 56; 1913, 189; 1914, 21; 1915, 56.

1916: I knew of three *Vespa vulgaris*, Linn., nests, and took one as it hindered ploughing, and in the early part of the season I hived three *Vespa sylvestris*, Scop., nests as there were a very large number of *V. sylvestris* queens about. My hived ones died out before hatching queens (this wasp is always earlier here, and gone before the fruit, and I have never caught it in my house), as did some unhandled nest I heard of. In 1910 the *V. rufa* nest had been scratched up before I got it, and I saw a few *V. vulgaris* workers about the Severn, indicating at least one nest, but actually saw no other nests that year.

RICHARD F. BURTON.

Longner Hall, Salop, October 17.

THE Dartford Naturalists' Field Club this season also experienced a scarcity of wasps; local papers reported the same about Gravesend on the east, and Bexley on the west.

Their nests were very plentiful last year, and so queens were exceedingly plentiful in spring—abnormally so. But later a cold spell nipped those about at the time.

Observers here speak confidently of the persistent hunting of flies by these early queen wasps, out too soon for nectar from flowers, and say the early wasps put down the flies for this summer. Flies were far more numerous last year, and, other things being equal, a beekeeper predicts many flies next summer, because of this season's scarcity of wasps. He remembers such an experience at Green St. Green (Dartford).

On May 27 I saw a note about more wasps than usual at Dudley, a district fairly free compared with the south and west. It was during May when so many early queens were observed here.

S. PRIEST

(Hon. sec., Dartford Naturalists' Field Club).

REFERRING to Mr. Davis's letter, it would be interesting to know if the same dearth of wasps has been noted in the cider counties.

I have caught only two here this season (in jars of beer and sugar placed outside), while last year I trapped hundreds.

C. CARUS-WILSON.

Strawberry Hill, Middlesex, October 13.

Glacial Nomenclature and Scott's Antarctic Expedition.

IN the review of my book, "With Scott—The Silver Lining," in NATURE of June 1, the reviewer, among many kindly remarks, takes exception to my use of the word "riegel." He prefers the English word "bar." I have briefly explained my point of view in the *Geographical Journal* (p. 571, December, 1914), but may be allowed to elaborate it a little.

Webster gives fourteen paragraphs dealing with different meanings of the word "bar." One at least of these—the bar of a river—is a geographic term. Why should the reviewer use the Scotch word "corrie" or the French "cirque" (as I use the Welsh "cwm") if not because—as in my case—there is no English word which is not ambiguous? I believe that there was a movement in Oxford to standardise geographic nomenclature. I sent in a memorandum in 1913, but have heard nothing of it lately.

May I refer briefly to further Antarctic questions raised in the review? The "catenary curves" illustrated in my book are not "ordinary denudation curves" in my opinion. They are common in the Alps (*e.g.* above Hospenthal, on the St. Gothard Road), but not in regions of normal erosion. An ordinary water-cut valley only a few hundred yards across would certainly not exhibit the smooth catenary curve of the small empty Antarctic valleys.

The small scale of the photograph of the *Discovery* Hut (p. 189) has, I feel sure, led the reviewer into a natural error. My colleague, Debenham, is emerging *viâ* the window, since the door alongside was then blocked by ice. I am certain that Prof. J. W. Gregory's hut could not have been satisfactorily erected so that the "support" shown in the figure could have been sunk in the ice. Under the latter condition the door sill would have been 3 ft. below ground-level.

The problem of the "origin of the glacier valleys" through the Royal Society Range is to a large degree answered by what I call the "palimpsest theory" (v., p. 175). In effect the outlet glaciers flow down notches cut by earlier headward (or cwm) erosion. I hope to publish shortly a mass of evidence and illustration in support of this sequence in glacial erosion.

Griffith Taylor.

Meteorological Bureau, Melbourne, July 26.

Muret Sanders's "Encyclopädisches Wörterbuch" gives "riegel," in addition to the various ordinary meanings of the word "bar," including a bar of soap, eleven other meanings. What advantage is there in the use of a German term over an English term when both have equally varied meanings? The term "riegel" is especially overloaded, as in geography, according to Grimm's "Deutsches Wörterbuch," it is used in South Germany for a "kleine Anhöhe, steiler Absatz eines Berges," and he also quotes its use for a watershed.

Ordinary water erosion would certainly produce a slope with catenary curves if it is operating on suitable rock and under suitable conditions.

The conclusion that the *Discovery* Hut was not erected as designed was not based only on Dr. Taylor's photograph, and there could have been no difficulty in managing the supports on any surface of ice which had not so steep a slope as to be otherwise unsuitable.

The more detailed information regarding the origin of the glacier valleys which Dr. Taylor obviously collected may, as was remarked in the review, explain their origin. Dr. Taylor's further publication will be awaited with interest.

The Reviewer.

ANNEALING GLASS.

Everyone who makes chemical apparatus by blowing glass practises annealing in a rude way by allowing the glass to cool slowly by gradual removal from the flame, or by the use of a smoky flame. In glass works more systematic annealing is effected by slow passage through a long chamber wherein the temperature falls from the incoming to the outgoing end. In the manufacture of optical glass of many different qualities the question of annealing is one of the first importance, as they differ so much in fusibility. Messrs. Hilger have after a careful investigation found the means of arriving at the maximum temperature necessary, and also the necessary rate of cooling, which may progressively become more rapid. Optical glasses may differ as much as 200° C. in the maximum necessary temperature, which temperature may be a long way below any visible softening point. It is desirable not to exceed the necessary temperature, as the very slow cooling at the higher temperature leads to great loss of time.

The method adopted by Messrs. Hilger for testing different specimens of glass is interesting as an example of a physical investigation made with a view to practically useful results. The principle of the method can be described very shortly. Fig. 1 shows a bar of glass supported as a cantilever, and carrying a load. Its edges are ground and polished in the form of two parallel planes. This is set up in an electrically heated muffle, with means for observing the temperature electrically. Polarised light broken up into interference bands by passage through a Babinet's compensator is passed through the glass, and when this is loaded the bands become inclined as shown in the figure, illustrating how perfectly the stress, whether of compression or extension, is proportional to the distance from the neutral axis. If the load is allowed to rest on a support in consequence of the slight yielding of the glass, the rate at which the bands change from the inclined to the straight position can be observed for any known tempera-

Fig. 1.

ture. Fig. 2 shows two specimens undergoing a change of temperature which sets up strains from the difference in temperature between the interior and the exterior. That the two specimens are very different is only too apparent.

By watching the bands in specimens of glass Messrs. Hilger are able to ascertain when the glass is hot enough to allow the internal strains to be relieved in a convenient time, and whether as the glass cools internal strains are avoided by

Fig. 2.

sufficiently slow cooling. After a point is reached at which the glass has lost all viscosity the cooling may be accelerated, and though the bands then become curved they straighten out again when ultimately the temperature is equalised. There is no hard-and-fast point at which the glass ceases to be viscous, and so there is a progressive permissible increase in the rate of cooling. Messrs. Hilger have thus shown how annealing may be effected perfectly in the minimum of time. Though the research was carried out with the object of finding how best to anneal blocks of optical glass, the apparatus is available for testing any glass, chemical or otherwise, and Messrs. Hilger, having the apparatus set up in their laboratory, are prepared to test specimens of glass for the trade, and thus provide the valuable information which they are able so easily to obtain.

C. V. BOYS.

UNIVERSITY AND HIGHER TECHNICAL INSTRUCTION IN FRANCE.

ONE of the principal articles in the *Revue générale des Sciences* for June 30 is that by Prof. Paul Janet, of the Sorbonne, director of the Higher School of Electricity, concerning the *rôle* of the universities in higher technical instruction, especially in relation to the Bill before the French Senate, at the instance of M. le Goy, to sanction the establishment of faculties of applied science in the universities. The proposed measure is exciting considerable interest, not only amongst the learned bodies in France, but also amongst those engaged in scientific industries. The question has assumed a deeper interest in view of the problems raised by the war and of the position and means of development at its close of the national industries, especially those closely dependent upon chemical and electrical science.

Incidentally the question raised by M. le Goy in his project embraces other deep considerations relating to economic problems, including the right direction and utilisation of capital, the question of tariffs and raw materials, a closer union of capital and labour, and especially the creation of a better educated industrial *personnel* in the scientific control and administration of industry, together with measures for the amelioration of industrial conditions. It is urged with considerable force that there is need of a much closer understanding between men devoted to pure science and those engaged in the higher technical industries. The former are often ignorant of the difficulties which beset the engineer and manufacturer, despite the systematic methods he employs in the actual production of commodities; whilst the latter, resenting the accusation that they lack all scientific spirit, do not hesitate to apply derisively the epithet "Sorbonnique" to the science which is incontinently thrust upon them.

Only when this antagonism is entirely removed by a closer sympathy, understanding, and appreciation, on the one hand, of the potentialities of pure science, and on the other of the difficulties which beset its translation into terms of production, can there come that union of effort upon which the successful development of industry depends. In the case of the electrical industry it is freely admitted by all concerned that it finds its solid base in electrical science; nor is it now possible to pretend that any man can hope to become a competent engineer whose technical skill is not founded upon a sound training in science.

The article goes on to consider the existing resources for the training of the expert engineer, and passes in rapid review the faculties of science existing in the universities of France and their competence to train the future technologist; the technical institutes, such as the Chemical Institute at Nancy, founded in 1890, and the Electro-Technical Institute at Grenoble, founded in 1892; the Ecole Polytechnique and the Central School of Arts and Manufactures at Paris, and other special schools in France. An unfavourable view is taken, however, as to the competence of the faculties of science, which have never shown any appreciation of the needs of industry, adequately to train the men, who in fact do not really seek them, destined for industrial pursuits. A firm distinction is drawn between the ideals and aims of the university and the functions of the schools of practical science. The former need for their realisation absolute freedom and long leisure, since their purpose is the exploration and discovery of natural laws, the attainment of exact knowledge as the grand end of their existence, and the moral rather than the material progress of humanity. Research is with them the end, and teaching only the means. The latter, to achieve their purpose, require direct contact with industrial problems, and the due and serious employment of the time of their students, with strict discipline and method and supervised work.

In order to bring the universities into closer touch with industry, it is suggested that they should, with the collaboration of practical men, establish scientific institutes preparatory to industry. It is further proposed to found a very few higher technical schools for more advanced industrial training and research, established and controlled directly by men eminent in industry, yet aided by the State and directly linked with the Ministry of Public Instruction.

PUBLIC SCHOOLS AND OTHERS.

"PUNCH" of September 27, under the title of "Public Schools," prints a poem of which the last two verses are as follows:—

Spite of the anti-classicists' arraigning,
Spite of the ink so petulantly spilt,
Not by exact laboratory training,
Not by the test-tube character is built.

Only in fields of emulous endeavour,
Fired by the teaching of the famous dead,
Public-school boys, who play the game for ever,
Grow into leaders and inspire the led.

PUBLIC SCHOOLS: AN ANSWER.

Dear *Punch*, your poet praises public schools,
Not well, nor wisely, nor by half enough.
Their modern Army Classes, "mostly fools,"
Have shed his "grand old fortifying" stuff.
Their "labs," which he accentuates so oddly,
Seem just as formative, and just as godly.

Again, those test-tubes, which his words abhor,
And cheap thermometers with paper zeroes,
All made in Germany before the war,
Were not unknown to many of their heroes.
[Just now sweet girls in improvised pavilions
Are turning English test-tubes out by millions.]

Boys from our "public schools" (including those
Provided, non-provided, and the rest of it),
When once the opportunity arose,
Quitted themselves like men, and made the best of it.
The highest praise for such a band of brothers,
Would be: "Each did his duty like the others."

Then, as to leadership, I knew a lad,
By nature quite unqualified to grapple
With Greek and Latin verses. This was bad.
Worse still, a Jew, he never went to chapel.
And yet he learnt, in spite of missing sermons,
His duty to his men, and to the Germans.

Perhaps the Duke was right in his remark,
That old, apocryphal, and hackneyed saying;
And Eton Playing-fields, and Regent's Park,
And all fair fields where British boys are playing,
Have proved of higher value to the nation
Than classical, or modern, education.

W. D. E.

NOTES.

THERE have been much overlapping and unevenness of distribution in connection with the food parcels sent to British prisoners of war; and little scientific guidance has been sought or given as to the food-values of the things included in the parcels. The first of these defects will be remedied by a scheme which is to be brought into effect on December 1. It is announced that the Central Prisoners of War Committee, recently established by the British Red Cross Society and the Order of St. John, has, with the authority of the Government, now made the necessary arrangements for co-ordinating and controlling the work of the various associations and individuals at present sending parcels to British prisoners of war in Germany and other enemy and neutral countries. These arrangements have been made with the view of securing:—(1) That every prisoner shall receive an adequate supply of the comforts in the form of food, etc.; (2) that the excellent work being done at present by associations and individuals shall be disturbed as little as possible; (3) that overlapping and consequent waste shall be reduced to a minimum. In order to attain these objects the following arrangements have been made:—(1) All parcels must be sent through the Central Committee or an association authorised by it; (2) individual senders are requested not to send food parcels, but to arrange for this to be done by a recognised association. It is hoped that individuals and organisations now collecting funds for prisoners of war will continue their efforts, and will send the money collected either to the Central Committee or to such recognised association as they prefer. Subscriptions and donations should be sent to the Right Hon. Sir Starr Jameson, Bt., C.B., 4 Thurloe Place, London, S.W. All other communications should be addressed to the Secretary, Central Prisoners of War Committee, 4 Thurloe Place, London, S.W. We suggest to the committee that guidance is needed as to the most suitable things to send from the point of view of food-values. A prisoner of war doing moderate work requires a daily ration which has an energy value of 2500 calories, and may be made up of proteins, 100 grams; carbohydrates, 400 grams; and fats, 50 grams. It is possible to combine all these constituents in a single foodstuff, or to see that the ratios are roughly supplied by the combination of several things in a parcel. The British Science Guild has appointed a committee to make suggestions relating to food parcels, and the Central Prisoners of War Committee should enlist its aid or that of other food experts in order to advise associations as to the most suitable constituents of the parcels.

THE Board of Agriculture announces that an estate of 2363 acres near Patrington, in the East Riding of Yorkshire, about fifteen miles distant from Hull, has been acquired under the provisions of the Small Holding Colonies Act, 1916, for the purpose of a land-settlement colony of ex-service men. The soil is a rich alluvium capable of producing very heavy crops. This colony, when fully developed, will consist of a central farm of about 200 acres and sixty small holdings of "mixed farming" type, averaging about 35 acres in extent. The equipment of each of the latter will include a comfortable cottage and the necessary farm buildings for carrying on the holding. The central farm will be under the management of a director, and will be equipped with machinery, implements, horses, etc., which will be let out on hire to settlers requiring them. Selected applicants will, if necessary, receive preliminary training by working on the central farm under the supervision of the director, and be paid wages until such time as they are considered capable of working a holding independently. They will then be allotted, at a reasonable rental, land near their cottages which, if of less extent than the average-sized holding above indicated, may be afterwards increased by taking land from the central farm. Co-operative methods will be adopted for the purchase of requirements and the consignment and disposal of produce. This is, we believe, the first experiment of its kind in this country, and its development will be watched with great interest. For some years there has been a great controversy as to the merits of schemes of this kind, and now arises the opportunity for the large-scale test. The experience gained is likely to be of great value, deciding whether or not such colonies can be run on an economic basis.

PROF. A. S. DONNER, director of the observatory at Helsingfors, has presented to the University, of which he was formerly rector, the sum of 8000*l.*, to ensure the continuance, and indeed the completion, of the "Catalogue photographique du Ciel, Zone de Helsingfors," begun under his direction in 1890. Hitherto the work has been paid for, partly by the University, partly by Prof. Donner out of his private means. The sum now allotted by him is intended to cover all expenses for twelve years, when, at its present rate of progress, the task should be finished.

THE Sociedad Argentina de Ciencias Naturales, Buenos Aires, has elected as corresponding members Sir Ernest Shackleton and Mr. W. H. Hudson, author of "Argentine Ornithology" and other works. Mr. Hudson is an Argentine by birth.

THE opening meeting of the Institution of Electrical Engineers for the session 1916–17 will be held on Thursday, November 9, when the eighth Kelvin lecture will be delivered by Dr. Alexander Russell, who will take as his subject "Some Aspects of Lord Kelvin's Life and Work."

THE address of the retiring president, Sir Joseph Larmor, at the anniversary meeting of the London Mathematical Society, to be held on Thursday, November 2, at 5.30, at Burlington House, will deal mainly with "The Fourier Harmonic Analysis: its Practical Scope and its Limitations."

THE Cardiff Naturalists' Society, the most influential body of its kind in Wales, attains its jubilee next year. It is hoped to signalise the event in a useful way by producing a complete fauna of Glamorgan.

A SINGULAR phenomenon excited extraordinary attention at and round Cardiff on the evening of October 16. About 6.25 a narrow bar of light appeared in the north-north-west, about 6° long and 1° broad, some 40° above the horizon, the sky being mostly overcast at the time. By 6.35 it had shifted to the north, and ten minutes later to its former situation, whilst a similar appearance was seen in the north-east, a good deal fainter than the other. The beam just mentioned was of an angry ruddy colour, and fitfully illuminated the surrounding haze. Along the northern horizon all this time there was a glow, probably of auroral origin, and the Rev. John Griffith informs the writer that the shaft of light was, in his opinion, possibly auroral also, he having witnessed a similar phenomenon some years ago.

WE notice with regret the announcement of the death on September 14, in his sixty-first year, of Prof. Josiah Royce, distinguished for his contributions to philosophy, logic, ethics, and psychology, and professor of the history of philosophy at Harvard University from 1892 until his recent retirement.

THE death is announced, in his fifty-third year, of Dr. J. H. Kastle, research professor of chemistry since 1911 at the agricultural experiment station in connection with the State University of Kentucky. He had previously been chief of the division of chemistry in the hygienic laboratory of the U.S. Health and Marine Service from 1905 to 1909, and professor of chemistry at the University of Virginia from 1909 to 1911. He was the author of treatises on the chemistry of metals and the chemistry of milk, as well as of articles in the *American Chemical Journal*.

AT a hearing before a New York official budget committee it was recently stated that the attendance at the American Museum of Natural History for the year ending June 30, 1916, was 870,000, as against 664,215 for the previous year. The increase was attributed to the larger number of visits to the museum by classes from the schools. During the same period the attendances at the Metropolitan Museum of Art, the New York Zoological Garden, and the Aquarium have considerably decreased.

THE death is announced of Dr. David Maron, a research chemist, whose work is referred to as follows in the *Times* of October 20:—"Dr. Maron was a Russian, aged fifty-two, who had been resident in England for many years. He claimed to have invented a new process by which the output of high-explosive shells could be accelerated, and he carried on his operations at a factory near London. On September 14 there was a serious explosion at the works. The Press Bureau announced that 'an explosion has occurred to-day at a factory where the manufacture of explosives on a small scale for the Government had recently been commenced. The casualties are not numerous, present reports recording five killed and fifteen injured.' Dr. Maron was seriously injured, and he died on September 17."

IN addition to the awards announced in April for papers read at the meetings, the council of the Institution of Civil Engineers has made the following awards for papers published in the Proceedings without discussion during the session 1915–16:—Telford premiums to Messrs. Hubert Mawson (Liverpool), T. W. Keele (Sydney), R. W. Holmes (Wellington, N.Z.), W. Fairley (London), J. M. Greathead (Johannesburg), T. C. Hood (Manmad, India), and J. B. Ball (London); the Manby premium to Mr. W. C. Cushing (Pittsburg, U.S.A.); and the Crampton prize to Major C. E. P. Sankey (London). The Indian premium for 1916 has been awarded to Sir John Benton (Eastbourne).

THE President of the Board of Trade has appointed a committee to consider the position after the war, especially in relation to international competition, of the lead, copper, tin, and such other of the non-ferrous metal trades as may be referred to the committee, and to report what measures, if any, are necessary or desirable in order to safeguard that position. The members of the committee are:—Sir Gerard Albert Muntz, Bt. (chairman), Mr. C. L. Budd, Mr. C. Cookson, Mr. C. W. Fielding, Lieut.-Col. A. J. Foster, Mr. A. W. Tait, and Mr. A. H. Wiggin. The secretary is Mr. J. F. Ronca, to whom all communications relating to the committee should be addressed at 7 Whitehall Gardens, S.W.

AT the statutory meeting of the Royal Society of Edinburgh, held on October 23, the following office-bearers and council were elected:—*President*, Dr. J. Horne; *Vice-Presidents*, Dr. B. N. Peach, Sir E. A. Schäfer, the Right Hon. Sir J. H. A. Macdonald, Prof. R. A. Sampson, Prof. D'Arcy Thompson, Prof. J. Walker; *General Secretary*, Dr. C. G. Knott; *Secretaries to Ordinary Meetings*, Prof. A. Robinson, Prof. E. T. Whittaker; *Treasurer*, Mr. J. Currie; *Curator of Library and Museum*, Dr. A. Crichton Mitchell; *Councillors*, Dr. W. B. Blaikie, Principal O. C. Bradley, Dr. R. S. MacDougall, Dr. W. A. Tait, Dr. J. H. Ashworth, Prof. C. G. Barkla, Prof. C. R. Marshall, Dr. J. S. Black, Sir G. A. Berry, Dr. J. S. Flett, Prof. M. Maclean, and Prof. D. Waterston.

TYPHOID inoculation was the subject of a question by Mr. Chancellor, the member for Haggerston, in the House of Commons on October 18. Mr. Forster, replying, said that up to August 25, 1916, of the total cases finally diagnosed as typhoid fever amongst the British troops in France, 903 were amongst inoculated men and 508 amongst uninoculated men. There were 166 deaths, 47 of which were amongst the inoculated and 119 amongst uninoculated. To the same date there were 2118 cases of paratyphoid fever, 1968 amongst inoculated men, and 150 amongst men who had not been inoculated. There were 29 deaths, 22 of which were amongst the inoculated and 7 amongst the uninoculated. From these figures it will be seen that the case-mortality per cent. for typhoid fever is, among the inoculated 5·0, and among the uninoculated 23·4; for paratyphoid, among the inoculated 1·12, and among the uninoculated 4·66—a striking testimony in favour of inoculation.

THE exhibition of kinematograph films of Capt. R. F. Scott's Antarctic expedition has been revived after an interval of nearly two years, and is being shown twice daily at the Philharmonic Hall by Mr. H. G. Ponting. Mr. Ponting, during the year he spent with the expedition, availed himself of every opportunity of making kinematograph records of the life and work in the Antarctic, and has a remarkable series of pictures to show. The pictures of Weddell seals and Adelie penguins are excellent records of Antarctic animal life, but cannot compare in the skill and patience required with the film of penguin chicks breaking out of their eggs or of skua gulls swooping down on a penguin rookery and stealing unguarded eggs. The film showing the bows of the *Terra Nova* breaking into the pack gives a good idea of how a polar ship forces her way among ice. The films of sledging and camping show Capt. Scott and his four companions in the first few days of their southward march. These have an interest that can never fade in any field of heroism. Mr. Ponting was happily inspired in reopening his exhibition at the present time, not only for the high educational value of the pictures themselves, but in recalling the devotion and self-sacrifice that men may show in peaceful endeavour.

WE learn from *Symons's Meteorological Magazine* that Mr. Edward Mawley died on September 15, at seventy-four years of age. The following particulars of his work in meteorology are from an obituary notice in our contemporary:—Mr. Mawley was elected a fellow of the Royal Meteorological Society in 1876, and served continuously on the council from 1881 to 1908. He was president in 1896–98, when he gave two addresses of great value. The first was on "Shade Temperature," giving the results of a lengthy series of experiments with different patterns of thermometer screen, which resulted in the adoption of the Royal Meteorological Society's modification of the Stevenson screen. The second was on "Weather Influence on Farm and Garden Crops," and may be said to have intertwined the two main branches of his life-work. After retiring from the presidency he acted as secretary at the meetings of the society from 1898 to 1901, and throughout the whole time his influence was always exercised in extending the usefulness of the society and increasing its dignity. Mr. Mawley commenced his meteorological observations at Richmond, Surrey, in 1870, and in 1873 he went to Addiscombe, near Croydon, where his meteorological observations were greatly extended. In 1883 he moved to Berkhamsted, where he soon created one of the finest private meteorological stations in the country.

THE meeting of the Gilbert Club, to which we referred in our issue of October 12, was held in the rooms of the Royal Society of Arts on Wednesday of last week. The Right Hon. Lord Moulton occupied the chair. Mr. Conrad Cooke, the hon. secretary, read his report recording the past history and present position of the club, and in it he paid a warm tribute to the memory of Prof. Silvanus Thompson, expressing the irreparable loss to the club, of which he was the life and soul, by his lamented death. Mr. Charles Benham, of Colchester, as representing the hon. treasurer, read the hon. treasurer's report. Both these reports were adopted. The members then devoted themselves to a discussion as to the disposal of the property of the club, including thirty-four copies of the translation of Gilbert's "De Magnete," issued by the Gilbert Club, and letters were read from Lord Rayleigh, Sir Joseph Larmor, Dr. Singer, of Oxford, Mr. W. M. Mordey, Mr. James Paxman, and others, in which various suggestions were made, and a general discussion followed. The general consensus of opinion, however, appeared to be that the proceeds should be devoted to forming the nucleus of a fund to establish a Gilbert scholarship for physical science in the Royal Grammar School at Colchester, in which in all probability William Gilbert was himself a scholar. Lord Moulton, in summing up the discussion, pointed out the legal aspect of the question, giving it as his opinion that the meeting was not competent to dispose of the property of the club outside its original constitution without giving notice to the members beforehand of the suggestion to be proposed. He considered it advisable that the meeting should be adjourned for three months in order that this should be done. Lord Moulton's recommendation was unanimously adopted.

IN the October issue of *Man* Mr. St. George Gray describes a remarkable chipped flint implement found in British Honduras. It is 19¾ in. in length, chipped throughout, with a straight, chopper-like edge on one side, and on the other two tapering projections. In general character it resembles other large and occasionally serrated implements found in Honduras and now in European museums. No suggestion is made about the possible use of such an implement; but the theory may be hazarded that it bears some ritualistic significance, and that it may have been used in sacrifice or for some similar religious purpose.

DR. A. C. HADDON contributes to the October issue of *Man* a useful article on "Kava Drinking in New Guinea," based partly on published materials and partly on information collected for the first time from friends who have visited the island. The question is important, because Kava drinking has been regarded as a criterion of a certain definite migration, or series of migrations, into Oceania. The root of the pepper plant (*Piper methysticum*) is chewed, not only by grown-up men, who take part in the feast, but also by boys, to whom the drink is still forbidden, and who, together with the women, are not allowed access to the feasting assembly. It is then filtered through grass in a coconut shell, and a traveller who drank it found that it possessed powerful intoxicating properties. It was apparently used to produce mental excitement during some form of tribal ritual. In British New Guinea the custom prevails among three cultures: those of the Kabiri, Mawata, and Maringara. Dr. Haddon supposes that it might readily spread from the Kabiri to the bush peoples behind the Fly delta, but we are in the dark as to the date of this possible drift. There seems to be no reason to believe that it was imported into the Fly estuary area on the south coast of Netherlands New Guinea by a migration or cultural drift by sea. His own opinion is that it has come overland, possibly from Astrolabe Bay. This must, however, remain doubtful until we know more of the races in the interior of New Guinea.

THE psychology of the organised group game is the subject of the fourth Monograph Supplement to the *British Journal of Psychology*. The author, M. J. Reaney, in her introduction, considers the problem of play in general, and summarises the various theories, both physiological and biological, which have been put forward to account for the phenomena of play. She then reviews the types of play leading up to the organised group game, which occupies such a prominent position in the life of modern England. The relation between the type of game played and the degree of racial development is brought out, showing that the organised group game appears only in races which have reached a stage of development in which co-operation is combined with division of labour and loyalty to a leader. She suggests, too, that this form of play gives an outlet to instinctive tendencies for which civilised life affords little scope. In an investigation worked on the principle of correlation she found a direct correspondence between general ability and success at games. The paper will be of particular interest at the present time, when the place of games in education is so much discussed, and when the English habit of "playing the game" is showing its value. Apart from the scientific value, antiquarians and historians will find much that is interesting.

DR. HAMLYN-HARRIS and Mr. Frank Smith contribute some valuable notes to the Memoirs of the Queensland Museum, vol. v., on "Fish Poisoning and Poisons Employed among the Aborigines of Queensland." Considering the widespread practice of fish poisoning, the authors hold that it is not unjustifiable to assume an independent origin among the Australian aborigines, and the evolution of an empirical knowledge of efficient piscicides. Having regard to the very considerable number of plants used for this purpose, the varied properties of the poisons obtained from them, and the skill and knowledge displayed in their preparation, the intelligence and reasoning powers of the preparers would seem to be of a higher standard than that generally attributed to them.

THE Rev. S. Graham Birks contributes a lengthy paper on Megalichthys to the Transactions of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, vol. iv., part 2. The fossils described belong in part to the Hancock Museum, Newcastle-upon-Tyne, and in part to the Manchester Museum, some of which have not been previously described. The result of this investigation, it is contended, seems to show that the position of Megalichthys in the family Osteolepidæ is by no means secure. There are, indeed, indications that the classification of the Rhipidistia is in an unsatisfactory state. According to the author, although Megalichthys is not itself the ancestral type of the Stegocephalian Amphibia, there can be little doubt that the study of this genus leads inevitably towards the conclusion that its affinities are with the ancestral type, and that the Stegocephalia were evolved from a similar fish, and probably from a nearly related form. A number of very beautiful photographs add much to the value of this work.

MESSRS. HERON-ALLEN AND EARLAND have issued a report (Trans. Linn. Soc., London, Zool., vol. xi., part 13, 1916), illustrated with five excellent plates, on the Foraminifera collected during the cruise of Prof. Herdman's steam-yacht *Runa* off the west of Scotland in 1913. The material examined consisted of shore-sand and dredgings from comparatively shallow waters—sixty fathoms being the greatest depth. A list is given of the twenty-five stations at which the material was obtained, the more noteworthy species from each being indicated, and following this is a systematic account of the 324 species and varieties identified in the gatherings. A new species, *Halophragmium runianum*, and a new variety of *Lagena pulchella* are described; twenty-seven species are recorded for the first time from British waters, and a considerable number make their appearance for the second time only in a British list. The richest material was a lump of mud of about 3½ lb. weight, dredged from twelve fathoms in Loch Sunart, which yielded 203 species and varieties of Foraminifera. The memoir forms an important contribution to our knowledge of the Foraminifera of the British area.

THE report on the survey operations in New Zealand for the year 1915–16 has been received. Despite the difficulties it had to contend with in shortage of surveyors and of funds, the department records that the acreage of the settlement survey is considerably in excess of the previous year, while the cost per acre has been decreased. On the other hand, little triangulation was done, and shortage of paper seems to have delayed the publication of several maps. A feature of the report is the inclusion of a map of Anzac and the Suvla Bay area on a scale of one inch to a mile, with the heights and trenches shown. Some notes on the operations accompany the map. It is fitting that the Survey Department should make this record of the gallant endeavours of the New Zealanders and Australians in Gallipoli.

IN connection with the navigability of Hudson Bay and its value as an outlet for Canadian grain, a useful list of arrivals and departures of ships at and from Moose Factory has been compiled by Mr. J. B. Tyrrell (Papers and Records of the Ontario Historical Society, vol. xiv.). The record shows that from 1751 to 1880 not a single year passed without at least one ship arriving at Moose Factory, generally in August or September, but occasionally in July or October. The ships left again in August or September. Furthermore, Mr. Tyrrell points out that for eighty years previous to 1751, and for thirty-five years after 1880, ships sailed from Britain to Moose Factory bringing supplies, and returned with furs. When it is remembered that these ships were generally old sailing vessels, and that as a rule no attempt was made to send more than the one ship a year, the record is evidence that Hudson Strait and Bay could easily be navigated by steamers for some three months at least every summer.

Two papers by Dr. L. V. King on the "Linear Hot Wire Anemometer" have been reprinted from the Journal of the Franklin Institute, January, 1916. In these papers the mathematical theory of the instrument and the uses to which it may be put are discussed by the author. The instrument consists essentially of a fine platinum wire carrying an electric current. The temperature of the wire depends on its resistance and the strength of the current, and also on the rate at which it is cooling, since the wire, being very fine, has little capacity for heat, and the energy supplied by the current must just balance the loss by radiation and convection. The loss by convection is naturally dependent on the velocity of the air current in which the wire is placed, and it is claimed that by suitable measurements of the current and the resistance the velocity of the air to which the wire is exposed can be measured with an accuracy of less than 1 per cent. There are obviously many cases where such an instrument can be usefully employed, notably in mapping out the stream lines in two-dimensional motion, where the wire can be placed perpendicularly to the plane of motion. Wires of about 1/400 in. diameter are used, so that very little interference with the flow of air is caused.

MR. MURRAY's new list of announcements includes the following forthcoming books of science in addition to those to which attention has been directed already in our columns:—"The War and the Nation: a Study in Constructive Politics," by W. C. D. Whetham—the book will deal with such topics as land, coal and railways, science and industry, and with those fundamental racial problems made acute by the great loss of life caused by the present war; "Volcanic Studies in Many Lands," by the late Dr. Tempest Anderson, second series—the volume is intended as a memorial to the author by the Yorkshire Philosophical Society, and will contain the results of further visits to the Lipari Islands, Vesuvius (after the outburst in 1906), and to Etna, together with photographs taken after the great eruptions of the Soufrière and Mont Pelée; "Horses," by R. Pocock, with a preface by Prof. J. Cossar Ewart; and "British Agriculture: The Nation's Opportunity, being the Minority Report of the Departmental Committee on the Employment of

Sailors and Soldiers on the Land, together with some Considerations by a Free Trader in Favour of the Policy therein Advocated."

THE following volumes are in preparation for appearance in the "University of Michigan Studies" (*New York: The Macmillan Company*).—Contributions to the History of Science, part ii., "The Prodromus of Nicholas Steno's Latin Dissertation on a Solid Body Enclosed by Natural Process within a Solid," translated into English by Prof. J. G. Winter, with a foreword by Prof. W. H. Hobbs, illustrated; part iii., "Vesuvius in Antiquity," passages of ancient authors, with a translation and elucidations, by F. W. Kelsey, illustrated; Scientific Series, vol. ii., "Studies on Divergent Series and Summability," by Prof. W. B. Ford.

OUR ASTRONOMICAL COLUMN.

TWO LARGE FIREBALLS.—On October 20 at 8h. 14m. and 10h. 34m. p.m. large fireballs were observed. The first was seen by Mr. J. E. Clark, of Purley, Surrey, and it was estimated as twice as bright as Venus. The path was $82^\circ+62^\circ$ to $79^\circ+35^\circ$, and its duration four to five seconds. The second was seen by Mrs. Fiammetta Wilson at Totteridge, Herts, and by Mr. Denning at Bristol. It appeared as a ball of fire streaming slowly along in a level course about 8° above the northern horizon. This fireball was at a great distance from the observers, and probably over the southern region of Scotland. It probably emanated, like Mr. Clark's fireball, seen earlier on the same night, from a radiant near Zeta Herculis low in the N.W. sky.

ENCKE'S COMET.—Further particulars of Dr. Max Wolf's recent observation of Encke's comet are given in *Astronomische Nachrichten*, No. 4861. The search for the comet was undertaken at the instigation of Dr. Kritzinger, and eight plates were taken at different times during August and September, with exposures amounting altogether to about thirteen hours. The last two exposures were made on September 22, in a very clear sky, and though the plates were on the point of being regarded as failures, the use of lower magnifying power easily revealed the comet, at a point about 20′ from the position given by the ephemeris. The comet appeared on both plates as a faint nebulous patch, with an extremely small condensation, and the displacement of the images in the interval between the exposures corresponded precisely with the ephemeris. The photographs were taken with the 71-cm. reflector, which was guided to follow the probable motion of the comet. The observation is of special interest from the fact that the comet was not far from the aphelion point of its orbit.

INTERNAL MOTION IN SPIRAL NEBULÆ.—An investigation of internal motions in the spiral nebula Messier 101 has been undertaken by A. van Maanen (Proc. Nat. Acad. Sci., vol ii., p. 386). In the first instance measures were made with the stereocomparator on two photographs taken by Ritchey in 1910 and 1915, and strong evidence of motion, even in this short interval, was obtained. Other plates, taken with the Crossley reflector of the Lick Observatory in 1899, 1908, and 1914, were afterwards included in the discussion. The resulting data depend upon measures of eighty-seven nebulous points and thirty-two comparison stars. Relatively to the mean of the comparison stars, the annual motion of translation of the nebula was found to be $+0.005''$ in R.A. and $-0.013''$ in declination. The mean rotational motion is $0.022''$ left-handed, and the mean radial motion $0.007''$ outward. The measures further indicate a small, but scarcely trustworthy, decrease of rotational motion with increasing distance from the centre. At the mean distance of 5′ from the centre, the rotational motion of $0.022''$ corresponds to a period of about 85,000 years. If the parallax were known, and if it could be assumed that the movements were in elliptical orbits, the central mass could be calculated. A comparison with the average translation of spiral nebulæ determined by Curtis suggests a parallax of $0.005''$, while a comparison of the cross-motions with the known radial velocities of some of the spiral nebulæ leads to $0.0003''$. The corresponding central masses are 30,000 and 140,000,000 times that of the sun, and the corresponding orbital motions 21 and 345 km./sec. Evidence of rotation has also been found in Messier 81.

THE ASSOCIATION OF TECHNICAL INSTITUTIONS.

A LARGELY attended general meeting of the members of the Association of Technical Institutions was held on October 20-21 at the Imperial College of Technology and Science, under the presidency of Sir Alfred Keogh, K.C.B., the president of the association, with the view of discussing educational questions bearing upon the work of technical schools and colleges. The Right Hon. A. H. Dyke-Acland, the chairman of the executive of the governors of the Imperial College, extended a welcome to the members and referred to the splendid service which Sir Alfred Keogh, the rector of the college, in his capacity of director of the Army Medical Service, was rendering to the nation.

The conference was addressed in the first instance by Lord Haldane, Chancellor of the University of Bristol, who took for his subject "Education after the War, with special reference to Technical Instruction." He made clear in his address that unless technical education was based upon large ideas and was penetrated by sound knowledge it must surely fail. He deprecated most strongly the current controversies which sought to place the teaching of the humanities and natural science in unfriendly relation. Knowledge was one and indivisible. The study of fine literature and of the thought it embodies was just as needful to the complete training of the human being as the study of mathematics or of the phenomena of Nature, since the object of all true education was a wider, a more penetrating and stimulating vision. The teaching of the higher mathematics could, if taught in the right way, be made as stimulating as the classics. There was a great awakening in the nation, induced by the events of the war, to the paramount necessity for knowledge. Education and business were not really in two compartments. Rightly considered, the successful pursuit of manufacture and commerce depended for its permanence and value upon sound methods of education and the acquisition of accurate knowledge. Many apt and clear illustrations in support of this contention were adduced from the sphere of chemical, physical, and electrical science and practice. In the domain of applied science attention was directed to the fact that London was the great centre of the world's trade in furs, but that in order to make the furs marketable to the consumer we exported them to foreign countries, notably to Saxony, where alone they could be dyed and treated with suitable effect. The aloofness between the man of business and the man of science must cease, and all classes from the workers upwards, amongst whom there was splendid raw material, must receive the benefits of scientific training. We must have a higher standard of knowledge not only for managers, but for workmen also, if the position of the nation industrially and commercially is to be maintained in face of the fierce competition of the advanced nations of the world. The nation is really entering upon the most critical period of its history. The old spirit was splendid, but it will not avail against modern science any more than we could make progress on the Somme without modern science in furnishing us with the great artillery and high explosives required for battering down the trenches before us. Undue specialisation in secondary schools was undesirable in the best interests of education.

Lord Haldane's address was followed by a valuable paper by Sir A. Trevor Dawson, of Vickers, Ltd., on "Education after the War, with special reference to Engineering Instruction," in which he strongly urged the desirability of apprenticeship beginning at an earlier age than at present, and that the most capable boys should devote a portion of each day to the workshop and the rest to the school, and that every encouragement should be given to capable and talented boys, with a view to their being sent on to the technical college or university to complete their theoretical training, serving their vacations in the works so that they may have the advantage of special courses of advanced work on experimental research. The council of the association was instructed to prepare a public statement dealing with the immediate necessity for the further development of the means of scientific and technical education, and a resolution was passed calling upon Parliament to abolish all forms of exemption from school attendance below the age of fourteen, and to require compulsory facilities for continued education up to seventeen years of age, extending to at least six hours per week within working hours, for all persons employed who have left school. A further resolution was passed to invite the governing bodies of the various agricultural schools and colleges to join the association. On Saturday, October 21, a valuable and suggestive paper was read by Major Robert Mitchell, director of the Regent Street Polytechnic on "What Can Be Done to Train Disabled Sailors and Soldiers in Technical Institutions?" The facilities existing in London for the training of such disabled men in various occupations, and the success which had followed the work, together with the necessity for its further extension throughout the country, were fully set forth.

RECENT WORK ON TSETSE-FLIES.

The tsetse-flies (Glossina) continue to occupy the attention of entomologists working in tropical Africa. Dr. W. A. Lamborn has now published (*Bull. Entom. Research*, vii., part 1) a third report of his investigations into the habits of these flies in Nyasaland (see Nature, vol. xcvii., p. 90). He believes that an abundance of the flies usually indicates the presence of "big game" in the neighbourhood; yet he doubts whether the destruction of game would be effective in reducing the numbers of the fly, because "the game, if severely harassed, will retire [to surrounding areas] during the dry season, when only it is possible to hunt, returning in the wet and probably bringing more flies with it." In the same number of the bulletin there is also a paper by Ll. Lloyd on *Glossina morsitans* in northern Rhodesia. His observations show that in districts where game is scarce tsetses are often more numerous and troublesome than where game is plentiful; he suggests that this is because the flies, in the absence or scarcity of other mammalian prey, must attack man in larger numbers and with a more violent hunger. Mr. Lloyd, like Dr. Lamborn, finds males much more abundant than females in ordinary collections of Glossina, but Dr. Lamborn points out that the proportion of females is largely increased when flies are caught beneath an umbrella or resting on trees, approaching the equality with the males which is seen in flies reared from puparia. Both writers have interesting notes on species of Mutilla (described by R. E. Turner in the same number of the bulletin), the larvæ of which are parasitic in the pupæ of the tsetses, while Dr. Lamborn has shown that a small chalcid (*Syntomosphyrum glossinae*), believed also to be a parasite of the Glossina, is really a hyperparasite on the Mutilla.

A convenient and useful summary of our knowledge of the tsetse-flies ("Notice sur les Glossines ou Tsétsés") by E. Hegh has been published in London under the auspices of the Belgian Colonial Ministry. It serves as an introduction to the structure, life-history, and classification of the insects in tropical Africa generally, but with special reference to the Belgian Congo. M. Hegh begins his historical introduction with the work of Bruce in 1895–6, and seems to ascribe to that distinguished surgeon the discovery that tsetse-flies carry disease. The deadly action of Glossina on European domestic beasts was well known to Livingstone during his early African journeys, and in his "Missionary Travels and Researches" (1857) he described the effect of the tsetse's bite on cattle and horses. With a seeming prevision of modern discoveries, he wrote of the "germ" of a poison "which enters when the proboscis is inserted to draw blood," and which "seems capable, although very minute in quantity, of reproducing itself." Bruce's contribution to the subject was the demonstration of this "germ" as a flagellate blood-parasite or Trypanosoma.

G. H. C.

ZOOLOGY AT THE BRITISH ASSOCIATION.

The papers read in Section D were devoted chiefly to the consideration of problems arising out of the war. An account has already appeared in Nature for October 19 of the papers on fisheries.

Flies.

Mr. F. M. Howlett gave a lecture dealing with the occurrence, habits, life-history, and means of prevention and destruction of the principal insects which have been troublesome during the campaign in France and Flanders. In another communication he surveyed briefly the known facts regarding the senses of insects, and gave an account of his observations, made in India, on the extraordinary attractiveness for the males of certain species of flies of *iso*valeric aldehyde, *iso*eugenol, and methyleugenol.

Miss O. C. Lodge gave an account of studies on the habits of flies in relation to means employed for their destruction. The best bait for blow-flies was found to be liver, brain, and fish which had been already attacked by maggots, and thus rendered more attractive. Baits were found to be much more attractive in the sun than in the shade. The best bait for house-flies is a mixture of casein, banana, any sweet substance, and water. Formalin in water (about 1 : 13) is apparently the best poison (excluding scheduled poisons) to use against house-flies.

Bilharzia Disease in Egypt.

Dr. R. T. Leiper gave an account of the later results obtained by the War Office Bilharzia Commission in Egypt. After sketching the conditions in a village where 91 per cent. of the schoolboys were found to be infected with Bilharzia, Dr. Leiper stated that the Commission had proved the occurrence of two species of Bilharzia, the chief characters of which he pointed out with the help of lantern illustrations. The egg of

Bilharzia haematobium is terminal-spined, and the cercariæ are found in the fresh-water molluscs, *Bullinus contortus* and *B. dybowski*. The egg of *Bilharzia mansoni* is lateral-spined, and the cercariæ occur in *Planorbis boissyi*. From these molluscs the cercariæ escape, and were proved to enter experimental animals through the skin as well as through the mucous membrane of the mouth.

Protozoa and Disease.

Dr. Helen Pixell-Goodrich gave an account of the amœbæ parasitic in man, namely, *Entamoeba histolytica*, the specific cause of amœbic dysentery, from the large intestine; *E. gingivalis*, from the mouth; and *E. coli*, a harmless species, feeding on the contents of its host's intestine. Dr. Pixell-Goodrich devoted special attention to *E. gingivalis* in relation to pyorrhœa, but although this amœba occurs so commonly in these lesions, it was not considered to be the cause of the disease. The morphological similarity of the trophozoites of *E. gingivalis* and *E. histolytica* was pointed out, and the large characteristic inclusions of the former were held to be the nuclei of lymphocytes.

Dr. T. Goodey's paper dealt with the results of observations by Mr. Wellings and himself on *E. gingivalis*, which they found in the mouths of both young and old persons wherever there was accumulation of food débris. They concluded that there is nothing to show that the organism is in any way causally connected with pyorrhœa, the food bodies being nuclear fragments of decomposed salivary corpuscles.

Dr. Annie Porter gave an account of observations by Dr. H. B. Fantham and herself on the flagellate protozoa associated with dysentery, with special reference to cases from Gallipoli. *Trichomonas hominis* has been found in cases of severe diarrhœa at Salonica; prophylaxis is directed to the prevention of contamination of food or water by infected material and by possible insect carriers and rodents (similar Trichomonads occur in rats, mice, and rabbits), and to the isolation of human "carriers." Cases of Tetramitus diarrhœa have been found among patients from Egypt, Gallipoli, and Salonica. *Giardia* (*Lamblia*) *intestinalis* was found to be the commonest flagellate in the stools (3800) of the soldiers examined, and in some cases occurred in enormous numbers; one stool was estimated to contain 14,400,000,000. Giardia derived from man is pathogenic to kittens and mice, producing erosion of the intestinal cells. Rats, mice, and cats can act as "reservoirs," and by contaminating the food and drink of man may spread the organism.

War and Eugenics.

Mr. Hugh Richardson stated the case for the institution of an inquiry into the after-effects of war on population. He pointed out the nature of the evidence available or to be sought, the statistical methods to be employed, and, after referring to the various and dubious theories held in the past, indicated some of the problems which seemed capable of solution. Subsequent speakers—Dr. Chalmers Mitchell, Dr. Doncaster, Dr. Tocher, and Prof. MacBride—were emphatic in supporting the case for an impartial inquiry and for the collection and preservation of statistical information by the Registrar-General, the Army recruiting staff, school medical services, and other agencies.

Dr. F. A. Dixey exhibited and commented upon a series of insects collected on the way to and from and in Australia in 1914. Mr. Heron-Allen exhibited lantern-slides illustrating the mussel fishery and the life of Alcide d'Orbigny at Esnandes.

The Friday afternoon was devoted to a visit to the Dove Marine Laboratory at Cullercoats, the members being taken over the laboratory and aquarium by the director, Prof. Meek.

J. H. ASHWORTH.

ENGINEERING AT THE BRITISH ASSOCIATION.

MR. GERALD STONEY devoted his presidential address to a review of some of the errors committed in the past by masters and men in the engineering industry. An abridgment of the address appears elsewhere in this issue of NATURE.

After the address a paper on "Limit Gauges" was read by Dr. R. T. Glazebrook, director of the National Physical Laboratory. This subject has been forced upon the attention of the whole engineering world by its importance in the manufacture of munitions. The greatly increased scale of manufacture necessitated the production of an enormous number of gauges, both for workshop use and for testing. The National Physical Laboratory has acted as the checking authority for the correctness of the gauges employed by the Government inspectors. Dr. Glazebrook first described the principles of limit gauging and then the various methods and apparatus evolved for dealing with the problem at the National Physical Laboratory.

A paper on "The Principle of Similitude in Engineering Design" was read by Dr T. E. Stanton, who discussed the possibilities and difficulties of obtaining accurate information for the design of structures, ships, aeroplanes, propellers, etc., from tests made on small models.

The late Mr. Leslie Robertson, who was lost on the *Hampshire*, had promised to read a paper on the work of the International Standards Committee. Mr. le Maistre, who has succeeded him as secretary of the committee, took over the task, and read an interesting paper on "Standardisation and its Influence on the Engineering Industries."

Mr. H. T. Newbigin described the *raison d'être* of the Michell type of bearing. Already in common use for thrust bearings, it is now being experimentally applied to journal bearings.

Prof. W. M. Thornton discussed "The Influence of Pressure on the Electrical Ignition of Methane," and described experiments showing that, as the pressure is gradually increased, the energy in the spark necessary to cause ignition increases in a stepped, discontinuous manner.

Prof. W. H. Watkinson described some tests showing that Diesel engines could be worked satisfactorily with compression pressures considerably lower than those usually employed.

Prof. G. W. O. Howe read a paper on "The Calculation of the Capacity of Aerials, including the Effects of Masts and Buildings." Papers on this subject were read by the author at the Sydney and Manchester meetings; in the present paper the subject is carried further, and a number of numerical examples and experimental results are given which fully confirm the method of calculation.

Mr. McLachlan described the results of some experiments on a Poulsen arc, to determine the best magnetic field strength to employ for maximum output and for maximum efficiency.

The only research committee that reported at length was that on "Complex Stress Distribution," in connection with which Dr. Stanton exhibited a model of a new machine in use at the National Physical Laboratory for subjecting a specimen to a rapidly reversing combination of bending and twisting.

The last day of the meeting was devoted to a joint discussion with the Chemical Section of the report of the Committee on Fuel Economy.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION G.

ENGINEERING.

Opening Address (Abridged) by Gerald Stoney, B.A.I. (Dub.), F.R.S., M.Inst.C.E., President of the Section.

At times such as these the mind naturally turns to problems to be considered both at the present time and after the war, and in considering such problems a review of some of the errors committed in the past is most necessary. Such a review enables methods which should be adopted both now and in the future to be considered. As this is an address to the Engineering Section of the British Association for the Advancement of Science, only such problems will be considered as affect engineering and its allied industries.

One thing which has handicapped our industries is the reluctance of firms to utilise highly educated labour or to adopt scientific methods. In looking round the industries of the district one is struck by the small number of men who have undergone a thorough scientific training at one of the universities or at one of the leading technical colleges, and who occupy a prominent place in the firms in this district.

The general complaint is that university and college men are too theoretical and not practical. It is the usual thing for a bad workman to blame his tools, and is it not because employers do not know how to make use of such labour that they utilise it to such a small and imperfect extent?

Things are very different in some other countries with which we have competed in the past, and with which there will be in all probability still fiercer competition in the future. There we find the fullest use made of highly educated scientific labour.

How many engineering firms in this district have a skilled chemist on their staff, and what percentage of these pay him a decent salary? And how many heads of firms have sufficient chemical knowledge to appreciate the work and utilise the services of such a man? because unless there is appreciation of the work done by such a man his services are useless and he becomes discouraged, generally finding himself up against the blank stone wall of there being no appreciation of his services, and yet chemical problems are continually cropping up in engineering work. There is the question of the supply of materials; as a rule the manufacturer trusts to the name of the contractor and assumes that he gets materials of the composition and purity he ordered. Every now and then something goes wrong and the question arises, Why? Without a chemist to analyse the material it is often most difficult to say. Apart from this question of the analysis of raw or partly manufactured materials received, there is the chronic question as to the mixtures of the metals in both the metal and brass foundry, and large economies can be effected by systematic analyses.

Another direction in which scientific labour is invaluable is in seeing that instruments are in proper order, and that tests are accurately carried out. Tests carried out with inaccurate instruments and without proper scientific precautions to see that they are accurate and trustworthy are worse than useless, and, in fact, most misleading and dangerous, as entirely untrustworthy inferences may be drawn from them and far-reaching troubles caused in the future. Under scientific supervision arrangements are made to avoid such troubles and get trustworthy results which can be depended on for future designs.

What is the case with pressure gauges and the measurement of pressure applies, of course, to all other instruments and measurements. In most works it may be said with sorrow that the only moderately accurate measurements that can be made are those of dimensions and weight. It is only by accurate testing of existing plant that trustworthy deductions can be drawn enabling safe progress to be made in future designs.

One of the great things which helped forward the steam turbine in the early days was accurate and full testing of each plant as soon as it was completed and before it left the works. The late Mr. Willans was probably the first, or one of the first, to recognise the importance of accurate testing of steam plant, and the success his well-known engine had was largely due to this. From the earliest days of the steam turbine Sir Charles Parsons recognised the necessity of such testing, and the test-house has always been a prominent feature of Heaton Works. And then in the higher ranks of an engineering works it requires a scientific mind to draw safe conclusions from tests carried out and to see in what directions progress can safely be made. Such methods have enabled the steam turbine during the writer's acquaintance with it, now extending over some twenty-eight years, to grow from 50 horse-power to some 45,000 or more in each unit, and the steam consumption to be reduced from 40 lb. per h.p.-hour to about $7\frac{1}{2}$ lb., or less than one-fifth.

And closely allied to such work in engineering works is the general question of scientific research, and here a trained scientific mind is of the utmost importance to see that trustworthy results are obtained and to make true logical deductions from those results. Without suitable training a man is liable to be unable to grasp all the conditions of an experiment and to make deductions from the data obtained which are totally unjustified and often lead to most disastrous results in the future.

Such research is generally carried out in four places —engineering works, private laboratories, engineering colleges, and national laboratories. The first has already been dealt with. The second is of comparatively small importance in practice.

As regards the third, a great deal of good work has been done in engineering colleges, often under great difficulties for want of plant and money, and it is greatly to the credit of our professors and others that they have succeeded in doing so much with the very inadequate appliances at their disposal, and handicapped for want of funds. How inadequate their income is can be understood when it is remembered that Leipzig University alone has an annual income from the German Government of 100,000*l.*, as against a total Government grant to *all* the universities here of about 45,000*l.*, or less than half.

Of national laboratories we have only one, the National Physical Laboratory at Teddington, and here again the support given to it is totally inadequate. The total income from all sources last year was only 40,000*l.*, and of this 23,000*l.* was charges for work done, such as testing meters and other instruments and similar commercial work; the Government grant is only 7000*l.* a year, and besides this 7500*l.* was received for experiments in connection with aeronautics, which is really war work. The balance was made up of subscriptions, grants from technical societies, and miscellaneous receipts. Compare this with the German equivalent, the Reichsanstalt of Berlin, which has an income of 70,000*l.* a year from the Government, or ten times that given to our N.P.L. The Bureau of Standards, the similar institution in the U.S.A., has a Government grant of 140,000*l.*, or twenty times ours. In the Civil Service Estimates there is an allowance of 40,000*l.* for research, an increase of 15,000*l.* over that allotted last year. The total estimates are more than 20,000,000*l*., so that less than one-fifth per cent. is allotted to research.

It is difficult to realise what benefits might be gained by investigations which could be carried on by the N.P.L. if only sufficient funds were available, and of what importance they might be to industry at large. One example may suffice. Some time ago the Reichsanstalt carried out a most complete set of tests on a certain class of machine, an investigation which must have cost several thousands of pounds sterling, apart from the time it occupied. The results of this investigation are available to German manufacturers of this machine, and just before the war preparations were being made to take advantage of this, and from figures stated a large extra economy was expected. This, of course, would enable them, provided the cost of manufacture was not too high, to have an enormous advantage over such machines manufactured without this special knowledge. The Institution of Mechanical Engineers saw the importance of this problem and appointed a Research Committee to deal with the matter, but the first question met with is that of finance. Should this be the case in a wealthy country such as this that depends on its manufactures for its very existence? And that such an investigation is required is obvious from the fact that the designs of no two independent manufacturers of this machine in this country agree among themselves. Of course, each claims his is the best, but this cannot be so.

Investigations in engineering shops do not meet such a case. The question of finance has to be carefully watched, and as soon as results sufficiently good are obtained they are generally accepted, and in any case the problem is rarely thrashed out to the bottom, an almost universal defect in commercial research work. Without the help of the National Physical Laboratory the position of the aeroplane in this country would be very different from what it is, and what has been done for the aeroplane requires to be done in many other directions.

But what firm here would do what has been done in the commercial synthesis of indigo, on which it is said that seventeen years' work and more than 1,000,000*l*. have been spent by one firm alone abroad? Here in chemical investigations and manufactures the Government refuses even to give the help of allowing cheap alcohol to be obtainable, and much of such work is impossible in this country on that account, as in many cases methylated and denatured alcohol are not suitable. Recently under pressure the restrictions have been somewhat relaxed by the Government, but many manufacturers have found that the privileges granted are so tied up with red tape that the concessions are practically useless.

I am sorry to say the employer does not look after the welfare of his workmen as he might. In a small factory the head of the firm, as a rule, knows all the leading men among the workmen, many of them having been with him for years. As the place grows he loses touch with his men, and as an actual fact knows fewer of those under him when he has 1000 or more employees than he did when he had 400 or under. This state of things gets worse when the place is turned into a limited liability company, as nearly all large places are at present. The result is that a most deplorable state of things has come to pass. The workman says, "Put not your trust in employers"; the master says, "Put not your trust in workmen"; and the official who is between the master and the workman says, "Put not your trust in either."

It is difficult to say what is to be done to remedy this state of things, but one cannot help feeling much might have been done in the past to have prevented such a regrettable state of affairs as there is at present. Much of this trouble might have been avoided if employers had shown more consideration for the welfare of their workmen.

With the growth in strength of the Trades Unions, which at first were for the legitimate object of seeing that the workman got fair play, and providing out-of-work and old-age benefits, etc., has grown up a system of Trades Union officials who live by agitation, and whose jobs would be gone if there were no supposed grievances to agitate about. These men keep the labour world in a constant state of agitation, and make the employers' and officials' existence a burden to them by constant demands of all sorts, many of them utterly impracticable and unfair. When they cannot agitate against the employer they agitate against another Trades Union, and thus endless disputes spring up on the demarcation of work. Some of the worst strikes in the past have been due to disputes between two Trades Unions.

Unless something can be done to bring master and man together and make both work for the common good, English trade must inevitably go down, and the supremacy that England has in the engineering of the world will come to an end.

Nothing ever was a truer statement than that recently made by Lord Joicey that this country, unless it produces as cheap as, or cheaper than, other countries, cannot in the long run keep her trade, and this is true in spite of any tariff walls which may be set up. And if the present state of affairs is maintained of unscientific management and obsolete machinery, combined with limitation of output and high wages, or, in other words, high cost of production, we must, sooner or later, go to the wall.

What is really wanted is common honesty and common sense on both sides, for one side is as bad as the other at present.

Apart from the considerations set out above, combinations among the firms employed in any one trade are most essential for the well-being of that trade. It is by such combination that much of the progress made of late years by our competitors has been effected. Some of these combinations have been international, and at least two such in the engineering trade were so before the war. These now, of course, are, and it is expected will be after the war, confined to the Allied and possibly to neutral countries, but such combinations, whether among all the engineering firms in one district or among firms employed in one particular trade, to be successful must be worked fairly to all members, and the larger firms must not override the smaller, as, it is regrettable to say, has been done in combinations of employers in some districts. For example, in a district where there is one firm very much larger than any of the others, it is not unknown for it to act the bully and insist on everything being done as would suit its requirements, regardless of the rights of others. And, further, such combinations are, unless directed by men with broad minds and able to take a wide view of things, liable, especially in case of emergency, to do much harm.

If the armament ring in this country had taken such a view when it was found what an enormous supply of munitions was required, it is doubtful if there would have been such a shortage as there has been. Hundreds of firms were willing and anxious to help in the production of munitions, but when they offered their services they were met in many cases with a blank refusal, and in all cases with little encouragement. And when, under pressure from the Government, the ring accepted outside help, in many cases the conditions imposed on the sub-contractors were unfair in the extreme, apparently the whole idea of the ring being to make all the profit they could out of the troubles of the Empire. It has been just as difficult to persuade the armament ring to give up what they thought was their monopoly and to bring in outside works to help in the production of munitions as it has been to persuade the Trades Unions to forgo trade customs and to enable outside sources of labour to be employed, such as women and other unskilled labour. But both have had to do it. In other words, "dilution of works" has been as difficult to effect as "dilution of labour," and the position both of the armament ring and of the workman would have been very different if they had consented freely to it when it became obviously necessary for the safety of the Empire.

The necessities of research work have already been dealt with, and by the pooling of such research work enormous advantages in any one trade could be obtained. Such pooling of information has been effected with most beneficial results, especially in the chemical trade abroad. Any workable scheme which would enable this to be done and get over the jealousies between one firm and another would be of enormous benefit to the trade in general.

Another thing that must not be lost sight of is the urgent need of improving our educational system. It is little short of a disgrace that the older universities are closed to those without a knowledge of Latin and Greek.

Languages are of the greatest importance to an engineer—not dead languages, but living ones. And these should be properly taught, so that the student should be able not only to read and write them, but also to speak and understand them when spoken. It is quite a different knowledge of a language to be able to read, write, speak, or understand it. Many people can read a language without being able to write, speak, or understand it when spoken, and conversely it is not uncommon to meet people who can speak and understand a language without being able to any large extent to read or write it. And it is only in living languages that a man is trained to speak and understand a language.

Why is it that we are so wedded to the dead languages? There is, of course, the tradition that such are necessary for a liberal education, and there is the argument that modern languages are not so good a training for the mind. Granted that they are not quite so good from the point of view of learning to read and write them, does not the fact that they can also be taught as a living language to be spoken and understood make them on the whole the best educationally for a man? This is entirely apart from the fact that modern languages are useful and ancient useless to the man in commercial work. There is, of course, bitter opposition from that most conservative man, the schoolmaster, and one great reason is that it is much easier and cheaper to get a man to teach Latin and Greek than modern languages which have to be taught orally. The teaching of Latin and Greek as they are usually taught has been standardised to the last degree, and as a result they can be taught by the "semi-skilled" man, and a "skilled" man is not necessary, to use engineers' phraseology. In fact, the teaching of Latin and Greek is a pure "repetition job." At the same time, no education is complete unless science is combined with languages, and also literature, and here lies one great danger of modern technical education.

After the boy has left school and enters the shops more facilities should be given to enable him not only to keep up but to continue his education. In the shops and drawing office too often the boy is left to pick up a knowledge of his trade as best he can. The apprentice who asks questions is often looked on as a nuisance, and requests for information are generally met by a blank refusal or worse. Often the foreman or chief draughtsman is afraid to answer questions for fear of being charged with giving away so-called "trade secrets," but an immense deal of information can be given to an apprentice without doing so.

Evening classes are all very well in their way, but more facilities should be given for the diligent apprentice to attend day classes, and this can be arranged in various ways if the employer has a will to do it. A thing that at present often prevents boys desirous of educating themselves getting on is the fact that overtime is allowed as soon as a boy is eighteen, and often he is compelled to work overtime regardless of classes that he ought to be attending.

It is important to remember that the boy of to-day is the man of to-morrow.

One complaint is that after a lot of trouble is taken about a boy he leaves after a few years and goes to another employer. The good of the trade in general must be considered, and a man who has had experience of various classes of work is generally a much more valuable man than one whose knowledge is confined to one class only. In any case, the other employer gets the benefit of what has been done by the first, and thus the trade in general benefits.

It is realised that this is a very imperfect review of things as they are at present, but if this address induces all classes engaged in engineering to consider how things can be bettered the author feels that a part, at all events, of his object has been attained.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Notice is given of the forthcoming appointment to the George Henry Lewes studentship in physiology. The object of the studentship, the annual value of which is 200*l.* and is tenable for three years, is to enable promising students to devote their whole time to physiological research. Candidates are requested to send a short statement of their qualifications to Prof. J. N. Langley, the Physiology School, Cambridge, by November 18.

London.—At a meeting of the Senate held on October 18, the Vice-Chancellor (Sir Alfred Pearce Gould) being in the chair, the following doctorates were conferred:—*D.Sc.* (*Engineering*), Mr. E. H. Salmon, an internal student, of the East London College, for a thesis entitled "Columns." *D.Sc.* (*Economics*), Mr. P. Bandyopadhyay, an internal student, of the London School of Economics, for a thesis entitled "Public Administration in Ancient India." *D.Sc.* (*Physiology*), Miss D. J. Lloyd, an external student, for a thesis entitled (*a*) "The Osmotic Balance of Skeletal Muscle," (*b*) "The Relation of Excised Muscle to Acids, Salts, and Bases."

Oxford.—The reports for the year 1915 of the curators of the Botanic Garden and of the Department of Botany have just been published. They contain long lists of contributors, both public and private, of specimens and other material for study to both institutions. To most of those who have sent donations to the garden a return has been made in kind. Many interesting plants have flowered in the garden during the past year. In the Department of Botany lectures have been given by the Sherardian professor and Messrs. A. H. Church and W. E. Hiley. Practical work in physiology has been conducted by Mr. Kempin. Considerable progress has been made with work on the herbarium. The accounts show that great economy has been practised in the matter of expenditure.

The University of Lund is founding a personal professorship in the theory of heredity for Dr. N. H. Nilsson-Ehle.

Miss G. J. Sanders, formerly principal of the Lowthorpe (Massachusetts) School of Horticulture and Landscape Architecture for Women, has been appointed principal of the Swanley Horticultural College.

A pamphlet issued by the Bradford Education Committee describing the courses in chemistry and dyeing held at the Technical College in that town is symptomatic of the altered outlook towards the various branches of the chemical profession brought about by the world-war. These college courses are, in the first place, arranged to meet the growing requirements of the local dyeing industry. Together with the study of colouring matters, practical instruction is given in the art of dyeing in a dye-house with full-sized machinery combined with a finishing plant for completing the commercial treatment of cloth. As in many other technical colleges, there is an entrance examination, in which English and mathematics are compulsory. Special stress is laid on the fact that a sound secondary education up to the age of sixteen or seventeen is a preliminary asset of the greatest importance. The combined course in chemistry, dyeing, and the allied subjects extends over a period of four years. A similar course has been devised for those taking up chemical work in other industries, such as in oil and soap works, or in metallurgy or gas engineering. Both these courses include a certain proportion of mechanics and engineering bearing specially on chemical industries. Students passing satisfactorily through either of these courses receive the college diploma, but the associateship of the college is reserved for those who have had one year's practical experience subsequent to the award of the diploma, and who have submitted a thesis on some previously approved subject. The ultimate object of the curricula of this college is to turn out practical chemists, dyers, and pharmacists, and that these qualifications are appreciated by manufacturers is seen from the encouraging list of appointments secured by the alumni.

An appeal on behalf of the Endowment Fund of the School of Oriental Studies at the London Institution has been issued by an influential committee of which Lord Curzon is chairman. The objects of this new institution are three in number:—(1) To provide a place where the Englishmen who will presently be engaged in governing or garrisoning the Oriental and African parts of the Empire may learn the languages and study the literature, the religions, and the customs of the peoples with whom they will be brought into contact; (2) to offer a training to those who are about to proceed to the same countries to take part in commercial enterprise or avocations; (3) to furnish in the capital of the Empire a meeting-ground and focus for the scholars of the East of all nationalities on their visits to this country. Evidence has been accumulating in recent years that the training of our Civil Servants and officers in the languages and modes of thought of Oriental peoples falls short of the ideal which we ought to have in view. In the new relations that will develop when the war is over there must be a higher standard of efficiency in these respects if our rule is to continue to commend itself to those with whom we are brought into relations. Information has been received that important steps are already being taken in Germany to give a higher education to Germans about to proceed to the East. Provision will be made in the new London school for all the more important languages of the Near, Middle, and Far East, and of Africa. The committee desires to raise an endowment fund of 150,000*l.*, towards which they have now as a result of a preliminary appeal about 10,000*l.* Donations and subscriptions may be paid to the head office or to any branch of the London County and Westminster Bank, or to the secretary of the executive of the appeal committee at the School of Oriental Studies, Finsbury Circus, E.C. The governing body of the school has appointed Dr. E. Denison Ross, C.I.E., to be its director, and he will take up his work almost immediately. Dr Ross has travelled extensively in the East. Among his numerous works is the "Tarikh-i-Rashidi," a history of the Moguls of Central Asia.

A series of resolutions referring to the claims of humanistic studies to scientific attention was adopted a couple of months ago by a conference representing the Classical, English, Geographical, Historical, and Modern Language Associations (see Nature, September 7, p. 23). The committee of the Association of Public School Science Masters has just expressed agreement with the principles of education stated in the resolutions; and in answer to an invitation to make a statement with regard to education in the natural sciences, it has sent the following to the chairman of the conference:—"Natural science in education should not displace the 'humanistic' studies, but should be complementary to them. In this capacity natural science meets two needs in particular:—(1) *Search for Truth*: Imaginative power indicates new fields in which further knowledge of truth may be revealed; its subsequent establishment depends on accurate observation, with constant recourse to nature for confirmation. The one aim of natural science is, in fact, the search for truth based on evidence rather than on authority. Hence the study of the subject implies accurate observation and description and fosters a love of truth. The special value of Natural Science in the training of Mind and Character lies in the fact that the history of the subject is a plain record of the search for Truth for its own sake. (2) *Utility*: There are certain facts and ideas in the world of natural science with which it is essential that every educated man should be familiar. A knowledge of these facts assists men (*a*) to understand how the forces of nature may be employed for the benefit of mankind; (*b*) to appreciate the sequence of cause and effect in governing their own lives; and (*c*) to see things as they really are, and not to distort them into what they may wish them to be. It is the business of Natural Science in education to bring this knowledge within the range of all." The statement is signed by Prof. H. H. Turner, president of the Association of Public School Science Masters, and by Mr. A. Vassall, chairman of committee. Probably arising out of the conference referred to above, a Council of Humanistic Studies has been constituted, comprising representatives of the British Academy, in addition to the five associations mentioned above. Its object is to watch educational developments in the interests of the studies represented by these bodies and to co-operate, if possible, with the representatives of natural science. The president is Lord Bryce, and the chairman Sir Frederic Kenyon, to whom communications may be sent at the British Museum.

SOCIETIES AND ACADEMIES.

London.

Geological Society, June 28.—Dr. Alfred Harker, president, in the chair. Dr. A. Smith **Woodward**: A new species of Edestus from the Upper Carboniferous of Yorkshire; with a geological appendix by J. Pringle. The fossil confirms the interpretation of Edestus as a row of symphysial teeth of an Elasmobranch fish. The row of eight bilaterally symmetrical teeth, fused together, occurs at the tapering end of a pair of calcified cartilages, which evidently represent a jaw. An imperfect detached tooth probably belongs to an opposing row. The teeth are large compared with their base, and the serrated edges have been worn during life. Small Orodont teeth of the form named Campodus are scattered in the shale near the jaw. Markings on the Edestus teeth themselves suggest that they have been derived from the Campodus type of tooth. The specimen was obtained from shale below the Rough Rock, in the upper part of the Millstone Grit, at Brockholes, near Huddersfield.—A. **Holmes**: The Tertiary volcanic rocks of Mozambique. With the exception of a coastal belt of Cretaceous and Tertiary sediments, flanked on the west by later Tertiary volcanic rocks, the territory consists of a complex of gneisses and other foliated rocks, intruded upon by granites belonging to at least two different periods. From Fernão Vellosa Harbour to Mokambo Bay the junction of the sedimentary formations with the crystalline complex is faulted, and the volcanic rocks are distributed on each side of the fault. The lavas are of post-Oligocene age, and are the result of fissure-eruptions, the feeding channels being exposed as small dykes that penetrate the underlying rocks. The prevailing lavas are amygdaloidal basalts. An andesite dyke of later date occurs near the Monapo River. In the north, near the Sanhuti River, picrite-basalt, basalt, phonolite, and sölvsbergite have been found, and related lavas occurring elsewhere in the area are tephritic pumice and ægirine-trachyte. The "alkali" series can be closely matched by the lavas of Abyssinia, British East Africa, Réunion, and Teneriffe. The amygdaloidal basalts of the "calc-alkali" series are similar to those of the Deccan, Arabia, and East Africa, and also to those (of late Karroo age) occurring in South Africa and Central Africa. Each of the series was probably evolved by a process of differentiation acting on a parent magma. From the composition of the amygdale minerals it is deduced that the parent magma of the "alkali" series was rich in carbon dioxide and under-saturated in silica; whereas that of the "calc-alkali" series was rich in water and over-saturated in silica. The radio-activity of the lavas indicates that the depth from which the parent magma came was probably between thirty-three and forty-four miles from the earth's surface.

Royal Microscopical Society, October 18.—Mr. E. Heron-Allen, president, in the chair.—Dr. Helen Pixell **Goodrich** and M. **Moseley**: Certain parasites of the mouth in cases of pyorrhœa. After a general description of the pathological changes in gum tissues resulting from pyorrhœa, illustrated by sections of normal and infected jaws, a detailed account of *Entamoeba gingivalis*, Gros, was given, followed by notes on Trichomonas and the interesting complex Leptothrix colonies, which give rise to the tartar. Of these parasitic organisms only the Leptothrix colonies were considered by the authors as likely to be the cause of the disease.

Paris.

Academy of Sciences, October 2.—M. Camille Jordan in the chair.—E. **Picard**: Functions of two complex variables remaining invariable by substitutions of a discontinuous group.—G. **Bigourdan**: The declaration of Louis XIII. relating to the first meridian. The text of the declaration, dated July 1, 1634, is given in full. The position chosen had no scientific basis.—G. **Bigourdan**: The propagation of the sound of the cannonade at the front to great distances. There is evidence that the sounds heard are not propagated through the air, but through the soil.—H. **Douvillé**: The Cretaceous and the Tertiary in the neighbourhood of Thones (Haute Savoie).—J. **Meunier**: The detection of small quantities of selenium; distinction from arsenic. Selenium may cause error in the Marsh test for arsenic when present in minute traces only. A scheme for examining the deposit is given, by means of which selenium can be detected in the presence of arsenic.—P. **Garrigou-Lagrange**: Luni-solar action and temperature.—J. **Amar**: The technique of the sense education of men without limbs or sight. Details of the methods and apparatus used in the education of the sensibility of mutilated limbs, and of the sense of touch in the blind.—L. **Camus**: Vaccinal immunity resulting from intravascular injections of vaccine.

Washington, D.C.

National Academy of Sciences (Proceedings No. 9, vol. ii., September 15).—J. **Loeb**: The mechanism of diffusion of electrolytes through animal membranes. For the diffusion of certain electrolytes through animal membranes there is required, besides the osmotic pressure, a second effect, called the "salt effect," upon the membrane. This consists probably in an ionisation of the protein molecules of the membrane.—F. G. **Pease**: The rotation and radial velocity of the spiral nebula N.G.C. 4594. The radial velocity is +1180 km., in good agreement with the values found by Slipher. The linear velocity of rotation at a point two minutes of arc from the nucleus is more than 330 km.—F. H. **Seares**: A simple method for determining the colours of the stars. The method suggested consists in determining the ratio of exposure-times which is necessary to produce photographic and photovisual, or, more briefly, blue and yellow, images of the same size.—H. **Shapley**: Studies of magnitudes in star clusters. III. The colours of the brighter stars in four globular systems. It is concluded that in all the clusters examined, and probably in all globular clusters, the volumes of the bright red stars are very great in comparison with the stars that are fainter and relatively blue.—Janet T. **Howell**: The effect of an electric field on the lines of lithium and calcium. Lithium and calcium were examined, both for longitudinal and transverse effects.—A. B. **Coble**: A proof of White's porism.—J. P. **Iddings** and E. W. **Morley**: A contribution to the petrography of the Philippine Islands. Six detailed analyses are given of rocks from Luzon, P.I.—W. O. **Fenn**: Salt antagonism in gelatine. The experiments on gelatine support the hypothesis that anions antagonise kations in their effects upon organisms. The hypothesis here developed resembles that of Clowes except that it requires that NaCl should antagonise any electrolyte which has either a strong anion or a strong kation. The point of maximum antagonism is an isoelectric point at which the amount of alcohol needed for precipitation is at a minimum, and the aggregation or amount of precipitation is at a maximum.—W. O. **Fenn**: Similarity in the behaviour of protoplasm and gelatine. A close analogy to Osterhout's experiments on the electrical resistance of Laminaria is found in gelatine (plus NaOH), if we assume that the effect of time in the Laminaria experiments is to increase the concentrations of the salts in the cells of the tissue.—W. E. **Milne**: Certain asymptotic expressions in the theory of linear differential equations. Formulas more precise than those previously obtained by Birkhoff are given.—H. B. **Fine**: Newton's method of approximation. A condition is given under which Newton's method of approximation for computing a real root of an equation, and the extension of this method used in computing a root of a system of equations, will with certainty lead to such a root or solution.

BOOKS RECEIVED.

Studies of Inheritance in Guinea-Pigs and Rats. By W. E. Castle and S. Wright. Pp. iv+192+plates 7. (Washington: Carnegie Institution.)

Plant Succession. By Prof. F. E. Clements. Pp. xiii+512. (Washington: Carnegie Institution.)

The Jukes in 1915. By A. H. Easabrook. Pp. vii+85. (Washington: Carnegie Institution.)

American Fossil Cycads. By G. R. Wieland. Vol. ii., Taxonomy. Pp. vii+277. (Washington: Carnegie Institution.)

The Vulgate Version of the Arthurian Romances. Edited from Manuscripts in the British Museum. By H. O. Sommer. Index of Names and Places to vols. i.–vii. Pp. 85. (Washington: Carnegie Institution.)

Fecundity versus Civilization. By A. More. Pp. 52. (London: G. Allen and Unwin, Ltd.) 6*d.* net.

Air-Screws. By M. A. S. Riach. Pp. viii+128. (London: Crosby Lockwood and Son.) 10*s.* 6*d.* net.

Eclipse or Empire? By H. B. Gray and S. Turner. Pp. x+316. (London: Nisbet and Co., Ltd.) 2*s.* net.

Economics in the Light of War. By Prof. R. A. Lehfeldt. Pp. 56. (Johannesburg: South African School of Mines and Technology; London: W. Wesley and Son.) 1*s.*

Annals of the South African Museum. Vol. v., part iv. (London: Adlard and Son.) 25*s.*

Form and Function: a Contribution to the History of Animal Morphology. By E. S. Russell. Pp. ix+383. (London: J. Murray.) 10*s.* 6*d.* net.

Annual Report of the Board of Regents of the Smithsonian Institution for the Year ending June 30, 1915. Pp. xii+544. (Washington: Government Printing Office.)

The Indo-Aryan Races: a Study of the Origin of Indo-Aryan People and Institutions. By Ramāprasād Chanda. Part i. Pp. xiii+274. (Rajshahi, Bengal: The Varendra Research Society.)

The Cambridge Pocket Diary, 1916–17. Pp. xv+265. (Cambridge: At the University Press.) 1*s.* net.

Robert of Chester's Latin Translation of the Algebra of Al-Khowarizma. With an Introduction, Critical Notes, and an English Version, by L. C. Karpinski. Pp. vii+164. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 2 dollars.

Memoirs of the Boston Society of Natural History. Vol. viii., No. 2. Monographs on the Natural History of New England:—The Whalebone Whales of New England. By G. M. Allen. Pp. 107–322. (Boston, Mass: The Society.)

The Origin of Finger-Printing. By Sir W. J. Herschel. Pp. 41. (Oxford: At the University Press, H. Milford.) Paper covers, 1*s.* net.

A Portfolio of Reproductions of Finger Prints. (Oxford: At the University Press, H. Milford.) Not sold.

William Oughtred: a Great Seventeenth-century Teacher of Mathematics. By Prof. F. Cajori. Pp. vi+100. (Chicago and London: Open Court Company.) 4*s.* net.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 27.

PHYSICAL SOCIETY, at 5.—The Determination of the Saturation Values for Magnetism of Ferromagnetic Metals, Compounds, and Alloys by means of the Kerr Effect: Dr. S. G. Barker.—The Influence of the Time Element on the Resistance of a Solid Rectifying Contact: D. Owen.—Diffusion in Liquids: B. W. Clack.

TUESDAY, OCTOBER 31.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—The Gurkhas and their Country: Aubyn-Trevor-Battye.

WEDNESDAY, NOVEMBER 1.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Quantitative Microscopy: T. E. Wallis.—Formula for Converting Zeiss Butyro-Refractometer Readings into Refractive Indices: C. C. Roberts.—Criticism of Vaubel's Bromine Values: Cecil Revis and H. R. Burnett.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 2.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Waves in an Elastic Plate: Prof. H. Lamb.—(1) Multiple Integrals; (2) The Order of Magnitude of the Coefficients of a Fourier Series: Prof. W. H. Young.—A Determination of the Heat of Vaporisation of Water at 100° C. and 1 Atmosphere Pressure in Terms of the Mean Calorie: T. C. Sutton.—The Mechanical Relations of the Energy of Magnetisation: G. H. Livens.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—Address of Retiring President: The Fourier Harmonic Analysis; its Practical Scope and its Limitations: Sir Joseph Larmor.

CHEMICAL SOCIETY, at 8.—Overvoltage Tables. Part IV. The Theories of Overvoltage and Passivity: E. Newbery.—Studies of the Carbonates. Part II. Hydrolysis of Sodium Carbonate and Bicarbonate, and the Ionisation Constants of Carbonic Acid: C. A. Seyler and P. V. Lloyd.—The Synthesis of Hydroxyquercetin: M. Nierenstein.—(1) The Reaction between Methyl Iodide and some Metallic Cyanides; (2) Some Reactions produced by Mercuric Iodide: E. G. J. Hartley.—The Dual Theory of Acid Catalysis. A Comparison of the Activities of Certain Strong Acids: H. M. Dawson and T. W. Crann.

FRIDAY, NOVEMBER 3.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Thomas Hawksley Lecture: The Gas Engineer of the Last Century: H. E. Jones.

SATURDAY, NOVEMBER 4.

GEOLOGISTS ASSOCIATION, at 3.—Followed by Annual Conversazione.

MONDAY, NOVEMBER 6.

SOCIETY OF ENGINEERS, at 5.30.—Heating and Ventilating Private Dwelling-Houses: C. T. A. Hanssen.

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

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THURSDAY, NOVEMBER 2, 1916.

THE SCHOOL OF PYTHAGORAS.

Le Scuole Ionica, Pythagorica ed Eleata (*I Pre-aristotelici, I.*) By Dr. Aldo Mieli. Pp. xvi + 503. (Firenze: Libreria della Voce, 1916.) Price lire 12.

THAT the study of history maketh a man wise was the saying of a great Elizabethan, but it was one of the great Victorians who preferred a copy of the *Times* to "all the writings of Thucydides"; the great days of Elizabeth would not seem so spacious had one or two such sayings as the last come down to us from them! An historic sense was somewhat far to seek in the Victorian age. The nineteenth century had all but forgotten its own past. Lyell and Darwin, Schwann and Virchow, Lister, Faraday and Joule had a way of making their immediate predecessors look old-fashioned, as the post-chaise looked when the railway came. In short, so great a revolution had taken place in things mental as well as in things practical that it seemed (so Judge Stallo said) as though Bacon's demand had at last been thoroughly complied with, *ut opus mentis universum de integro resumatur.*

I never heard a lesson in my school- or college-days on the historical aspect of any science, though some few of our teachers were by no means unacquainted with history. One was on intimate terms with Ray and Willughby, and all the older English naturalists; another got no small part of his large wisdom from Boerhaave and Haller, and even Ambroise Paré. There was yet another who led his pupils (his better pupils) to Newton, while his neighbours were perfectly satisfied with Frost. When one thinks how deep was the reading, how wide the learning, of men like Sharpey and Rolleston, Alfred Newton and Michael Foster, it is all the more striking that even by them the historical method was very seldom employed and the love of history very little instilled. The fact is, we were all dazzled and obsessed, young and old, by "the great press of novelty at hand." Linnæus and Cuvier, even Johannes Müller himself, had read their Aristotle to learn of him, just as they read their Swammerdam and their Réaumur. But we had come to think of the old books as so much bric-à-brac, as material for a hobby but of no more use in the world. The tide has turned since those days, one scarce knows how or why; and a world that is as busy as ever finds more time for the study of history than it did. The long series of Ostwald's "Wissenschaftliche Klassiker" is proof of a widespread desire to consult the sources of knowledge; and Mach's "Science of Mechanics" is perhaps the best but not the only example of the historic method, rigorously and critically applied to the teaching of a science.

Dr. Aldo Mieli, the writer of the book before us, is already known by a number of historical articles in *Scientia,* that admirable journal of our Italian allies; we may welcome him accordingly as a member of the little company of historical students, of which Prof. Gino Loria is the distinguished head. He all but takes our breath away, in his very preface, by the vastness of his conceptions and his projects, while he relates with ingenuous sincerity the recent history of his own mental development. He had a thirst for universal knowledge in his schooldays, and essayed to comprehend, "con l'aiuto di poche premisse, tutti i fenomeni fisici e sociali, artistici e filosofici." He presently sought in mathematics, but sought in vain, for the inner meaning, "la spiegazione," of things. When he failed there, he betook himself in haste to chemistry; "a corpo perduto mi gettai allora (1902) nello studio della chimica!" He was baffled again; he had striven as the old alchemists strove, and his longings, like theirs, were unfulfilled. At last, under the influence of Mach and Ostwald, he turned to history and to philosophy; renouncing the search after a "rational and experimental explanation of the world," he resolved to study the creations of the spirit, and to trace in particular the development of scientific thought.

While charmed by these naïve confessions of the young Italian scholar, the reader is startled to discover that the present bulky book is but the first part of a universal history, on a scale vaster than Gibbon's or Hallam's, of the whole circle of the sciences. It is to be divided into some seven portions, dealing with the great ancient pre-Hellenic empires, next with Hellenic, Arabic, and Far-Eastern science; again, with the Middle Ages and with the Renaissance to Galileo's day; and lastly, with the seventeenth and eighteenth centuries. The story of Hellenic learning will be divided into four parts, of which one must end where Aristotle's work begins; and this pre-Aristotelian treatise will be in three volumes, of which one is the book before us, and the other two will deal in due time with the Atomists and with Plato and the Sophists.

The reader may be a trifle prejudiced, he might be dismayed or even dumfounded, by so vast an ambition. But the fact is that the book is marvellously well done—so far as the present writer is capable of judging. Big as it is, it is compact and full; it leads us smoothly and easily, with but brief and impartial discussion, through the subjects on which we expect and desire to be informed. We hear the legendary history of Pythagoras and his confraternity; we are introduced to the philosophy, the science, and the mystical mathematics of the school. We learn in successive chapters, for instance, of the mystical theory of number; of figurate and other curious numbers, and of the *proportio divina*; of the great Pythagorean theorem, and of the gnomon; of the concepts of application and of excess and defect; of the principles of acoustics and of the musical scale, and of the astronomic and other theories of Archytas and Philolaus and the rest. The subjects are those with which any book or encyclopædia article on Pythagoras is bound to deal, and there is little here but what we can get from others. But here it is, well and clearly ordered and expressed, and abundantly furnished with all sorts of guide-posts for those in quest of still more information or discussion.

The bibliographical lists are astonishingly good, without pretending to "completeness." The one, for instance, which is appended to the first section of our volume is of a general kind, and covers some seventy pages; it pilots the student to the texts of Diels, Mullach, and others; to works on the history of philosophy, Greek and other, from the days of Ritter and Preller to Zeller and Burnet and Diels; and ends with a capital account of the historians of mathematical, astronomical, and physical science, from Bailly, Montucla, and Delambre, to Allman and Zeuthen, and Moritz Cantor and Paul Tannery and Sir Thomas Heath. There may be mistakes, for aught I know, in this learned and compendious book, but I have neither found them nor sought for them. It was one of Pythagoras's sayings (or Dr. Johnson tells us so) that a friend should not be chidden for little faults.

Pythagoras is one of the great figures of the world, and many and many a scholar has had a predilection for him. Sir Thomas Browne loved him; Plato was steeped in his doctrine; and whole books of Euclid are ascribed to his teaching. Those who knew least of him could always quote him, as Shakespeare did, and Dr. Johnson, and as Goldsmith quoted Ocellus Lucanus. But the more we read about Pythagoras the less we know of him for sure and certain; and it is just herein that his peculiar fascination lies. For he is one of those shadowy figures who stand on the borderland between history and fable, between fairyland and reality: like King Arthur and Thomas of Erceldoune and King Solomon and Caliph Haroun al Raschid. We know that one of his legs was of gold, that Apollo was his father, that heavenly messengers flew down to him on golden arrows, and that his face shone like the faces of the Shining Ones. In more sober statement he seems to represent the continuity, unbroken but dwindled to a thread (a thin but indispensable thread), between one civilisation and another, between the beginning of Greek thought and the decline of learning in a remote but erudite antiquity. To the student trying to prefigure so strange and so elusive a personality there is a choice of ways. If he keep to sober and critical consideration of the meagre facts at hand, he will probably arrive at the conclusion that there is no evidence for Pythagoras having learned anything worth speaking of upon his travels or having inherited any load of learning from pre-Hellenic science and philosophy. So it is commonly held by many men of the soundest classical learning that no foreign influence can be traced in the school of Pythagoras, and that his "philosophy and institutions contain nothing but what might easily have been developed by a Greek mind exposed to the ordinary influences of the age." Dr. Allman held, with all due caution, that we must be "struck with the Egyptian character of the geometrical work attributed to Pythagoras"; but Prof. Burnet asserts that all the mathematics of the Egyptians consisted of a few rules of thumb by which to measure the area of a field or the height of a pyramid, and denies that Egypt had anything to teach Pythagoras that was worth the learning or the borrowing.

On the other hand, there is ample room for others, of a more imaginative disposition, to grope among the ruins and the misty darkness of pre-Hellenic civilisation, to put two and two together wheresoever they can, and to apply themselves (for a while at least) to the ingenious art of fanciful reconstruction. Dr. Naber's curious book, "Das Theorem des Pythagoras," is of the latter kind. The ground on which he leads us is sometimes dangerous, as when he depends on Piazzi Smyth for his facts as well as his theories of the pyramid; but for all that he weaves a fascinating and instructive story. He brings together a prodigious mass of curious lore about the triangle and the pentagon, and the Sacred Letter, and the Symbol of Health, and Abracadabra, and the sacred lotus and mallow-flower; he touches on a hundred things which the early students of the triangle must (in all likelihood) have observed and discovered by the way; and he suggests with no less ingenuity the lines of tradition along which such knowledge ran, from far-away antiquity even to the artists and cathedral-builders of the Middle Ages.

If we be inclined to see in Pythagorean mathematics not the discoveries of a single lifetime but fragments of the learning of a preceding age, so also in his philosophy may we be inclined to recognise parts of a great edifice the scattered stones of which confront us in unexpected places, built into the fabric of old but less ancient walls. We have often heard that there is a curious link or bond between the Cabbalists and the Pythagoreans; and now again, in a recent *Hibbert Journal*, an article by the Chief Rabbi on "Jewish Mysticism" suggests, though it does not assert, this view. The "opinion of Pythagoras" regarding metempsychosis, wholly absent from Bible and from Talmud, is fundamental to the teaching of the Cabbala. In Cabbalistic as in Pythagorean philosophy the ten numerals, or Sefiroth, contain the possibilities of all things, and, with the help of language, represent the Spirit of God; the mystical number Ten is the material universe, God's kingdom made visible; wisdom and understanding, mercy and justice and harmony are among the concepts which other numbers represent or embody; and the mystical One is the mystery of mysteries, which in the beginning filled all space and was all space. Then "En Sof contracted Himself in order to leave an empty space for creatures'"; just as, according to Pythagoras, *ἐπεισάγεσθαι δ' ἐκ τοῦ ἀπείρου χρόνον τε καὶ πνόην καὶ τὸ κενόν.* The Pythagorean, or Platonic, or Jewish concept of Number is a hard saying to the unpoetic, non-mystical modern and Western world; and many a way is found to show that Plato and Pythagoras meant something prosy and commonplace after all. But to some it is still as plain as ever that Number is the clue to the greatest of earthly mysteries, and that what we call beauty, whether of sound or form, is but its resultant and expression. It was in the very spirit of Pythagorean mysticism and wisdom that that great naturalist, Henri Fabre, wrote his great ode to number; as in a kindred spirit the old carpenter in Verhaeren's poem:

> "Fait des cercles et des carrés,
> Tenacement pour démontrer
> Comment l'âme doit concevoir
> Les lois indubitables et fécondes
> Qui sont la règle et la clarté du monde."

We must never forget that the secrets of the mystic, whether Gnostic, Cabbalist or Pythagorean, lie very deep indeed, and that a twin alternative between esoteric and exoteric statement, or between literal and allegoric interpretation, by no means exhausts the various meanings which the mystical philosopher can wrap up in his words. In the end, as we come slowly to a better, though still a clouded, understanding of what lies within and behind the Golden Verses and all the rest of the husk of Pythagorean tradition, we feel the truth and force of William James's saying (aptly quoted in the article to which I have just referred), that the "mystical classics have neither birthday nor native land; their speech antedates language, and they do not grow old."

D'ARCY W. THOMPSON.

PHYSIOLOGICAL CHEMISTRY.

Physiological Chemistry: A Text-book and Manual for Students. By Prof. A. P. Mathews. Pp. vii+1040. (London: Baillière, Tindall and Cox, 1916.) Price 21s. net.

PROF. MATHEWS is well known as a worker in the field of physiological chemistry, more especially on its physical side. His present volume is one of an ambitious character, and has the merit of being distinctly original. The chapters on the chemistry of the fats, carbohydrates, and proteins are fuller than is usual in such books, and the subject-matter is not only clearly explained, but is fully up to date. Much of it is pure chemistry, but it will not be less valuable for that reason to the biologist. The section on physical chemistry is also treated at considerable length, as might have been anticipated by those who know the author's bent. The whole subject is confessedly treated unequally, for, as the preface puts it: "Of so large a subject one can be personally familiar with but a small part." The portions that strike one as susceptible of more expansion are those dealing with muscle and the ductless glands; for the latter group of organs Prof. Mathews coins yet another name: he dubs them the Cryptorhetic Organs—*i.e.* organs with a hidden flow. One small feature of the book—viz. the explanation and derivation of technical terms—might well be imitated in more elementary manuals than the present. While on the question of words, one may add that the nomenclature adopted for the fats and fat-like substances is one not likely to commend itself to all physiologists.

Each chapter is followed by a short selected list of papers bearing on the subject dealt with in that chapter. There is no attempt at a complete bibliography, but the selections appear to have been judiciously made, though in the present state of the political atmosphere German writers figure rather too largely for English taste. The papers mentioned for reading and study are mostly recent ones, because they approach the subject from the modern point of view, and in them the older literature is cited. The choice does not imply that the author does not value the work of the early pioneers; indeed, he presents evidence that he takes the opposite point of view, and the full consideration which he gives to their work forms one of the most interesting features of his book. He, for instance, gives a very extensive account of the researches of Lavoisier, whom he perhaps rightly regards as the founder of bio-chemistry, of Beaumont, of Claude Bernard, and many others.

Prof. Mathews, who is here the exponent of a vast but nevertheless comparatively young branch of science which every day is becoming more and more exact, is not devoid of a sense of imagination, the most valuable asset of both a teacher and a researcher. His excursions into the regions of speculation will be read with keen interest, even although, like so many hypotheses in the past, they may ultimately be forgotten. Such theories as those which he advances in his comparison of the animal body to a magnet, or in his conception of the "conservation of psychism," or in his attempts to explain memory on a chemical basis, will certainly stimulate thought and future investigation. To quote once more from the preface: "It is hoped that this book will raise in the mind of those who read it more questions than it answers."

The last 160 pages of the book are devoted to a description of the laboratory work in physiological chemistry as carried out in the University of Chicago, and practical teachers will obtain many useful wrinkles by studying these.

W. D. H.

OUR BOOKSHELF.

Cambridge Geological Series. Agricultural Geology. By R. H. Rastall. Pp. ix+331. (Cambridge: At the University Press, 1916.) Price 10s. 6d. net.

MR. RASTALL'S well-written and excellently printed book is a treatise on geology for agricultural students rather than on agricultural geology. To say this is no disparagement, since it is obviously intended for the stage in an agricultural curriculum when natural history subjects are predominant, and not for the later years when preliminary scientific conceptions are applied to the study of the soil. A knowledge of chemistry and elementary mineralogy is presupposed, but unnecessary technical terms are carefully excluded. The final chapter, on "The Geological History of the Domestic Animals," will appeal especially to those whose work is on the farm. The history of life on the globe is, indeed, far more appreciated by agricultural scholars than our text-books would commonly lead us to suppose. The details of British strata, such as the Ashgill Shale and the inevitable Oldhaven Beds, are still reverenced by examining boards, but are far less important than a philosophic outlook on the great romance leading up to man, the tiller of the soil. Mr. Rastall, however, makes good use of his opportunity, and gives us attractive descriptions of the types of country met with on various strata throughout England.

The chapter on soils, occupying twenty-eight pages, is a good example of the author's method. It contains a large amount of information without any appearance of compression; the details given fit into a continuous and pleasing essay. We unfortunately get no conception of the variations in the "fine earth" of soils, on which their fundamental characters depend, such matters being left (p. 144) to more purely agricultural teaching. Phosphatic deposits (p. 100), however, come within the geologist's province, and here we think that more analyses might have been inserted and a description given of materials, such as the beds of Florida and Gafsa, which are being worked commercially at the present day.

G. A. J. C.

British Rainfall, 1915. By Dr. H. R. Mill and Carle Salter. The fifty-fifth annual volume. Pp. 288. (London: Edward Stanford, Ltd., 1916.) Price 10*s*.

Dr. Mill has been able, with the assistance of Mr. Carle Salter and Mr. R. C. Mossman, to prepare his annual account of British rainfall with almost the usual pre-war promptitude. The special feature of the volume lies in an account of the method of construction of a rainfall map, which is illustrated by a map of the Forth Valley above Queensferry, including an area of almost 1000 square miles. The fundamental rainfall facts are closely related to the elevation of the land and to the prevailing winds, and this relationship makes it possible to draw isohyets across districts where rain gauges are infrequent, with the result that as the years go by these rainfall lines approximate more and more closely to the final form which they will eventually take.

In May–June, 1915, practically the whole of Great Britain experienced absolute drought for twenty days. This was an unusual occurrence for Scotland. On the other hand, the west coast of Ireland and the north-west corner of Scotland had a rain spell which lasted from sixty to more than 100 "rain-days" consecutively. Remarkable rain splashes occurred at Abergavenny on July 4, when 2·2 in. fell in thirty minutes, and at Mildenhall, Suffolk, on June 30, when 2·63 in. fell in fifty minutes. The heavy thunderstorm of May 6 over the centre of London is specially mapped. On the whole, 1915 was a year of mean rainfall, since the areas of both heavy and light rains are smaller than usual; this circumstance is related to the fact that the dry east was wetter, and the wet west was drier, than on the average.

LETTERS TO THE EDITOR.

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

The Germans and Scientific Discovery.

A good deal is being written on the terms of peace and on our attitude towards the Germans after the war in the spheres of pure science, applied science, and industry generally. While these and similar topics are in the melting-pot of controversy, this might be the suitable time to bring up the subject of the attitude of Germans towards the history of science in general, and towards the part played in scientific discoveries by English-speaking people in particular.

Those familiar with German utterances during the last twenty years or so know well that German men of science, in giving the historical *résumé* of a subject, scarcely ever mention the names of British workers in that field. There is virtually a conspiracy of silence, especially as regards recent and contemporary workers. One would think, to read some German accounts of a subject, that it had been begun, continued, and ended in Germany.

To make our enemies realise to what an extent they are indebted to British thinkers would be one most excellent result of this dreadful war. Of course they know it; but they systematically conceal it; it should be a valuable part of their chastisement to be made now to confess it. They have concealed the successful part played in scientific discovery by English-speaking people as systematically as they have concealed the successes of the Allies in the present international conflict. They should be cast down from their self-assumed pride of place in the matter of scientific discovery, and made to confess who were the real pioneers in the painful fields of scientific work. It is well known that many truly epoch-making discoveries, things of the very first magnitude, were made by Britons, and that afterwards the Germans came in and adopted and utilised these discoveries in the interests, for the most part, of the expansion of their trade.

As one of the conditions of their being granted peace by those who shall conquer them on their own selected arena of brute force backed by perverted machinery and prostituted chemistry, they should be made publicly to acknowledge the enormous benefits to science made initially, not by themselves, but by those whom they forced to become their enemies, the Italians, the British, and the French.

It would be a salutary humbling of their scientific pride to be made to confess that it was the Englishman, Newton, who discovered the law of universal gravitation; the Englishman, William Harvey, who discovered the circulation of the blood; the Englishman, Priestley, who first isolated oxygen; the Scotsman, Joseph Black, who discovered the chemical relations of carbon dioxide; and the Scotsman, Rutherford, who discovered nitrogen gas. They must be made to know that the Englishman, Stephen Hales, was the first to perceive the necessity of a mechanical system of ventilation, to estimate the magnitude of the blood pressure *in vivo* by an instrument which he had devised for estimating the pressure of sap in plants, and that he was the first to invent an apparatus for artificial respiration. Chemistry as a science was created by the Englishman, Dalton. They should be made to confess that the steam-engine was a British invention, as was also the steamboat; that the electric telegraph, the telephone, and the phonograph were all inventions of English-speaking people. The bicycle and the aeroplane were devised on the soil of Britain.

It was Faraday, they should be made to confess, who laid the basis of electromagnetics, and therefore the foundations of that amazing industrial application of electricity as a mode of motion. It was Davy who showed the elemental character of the alkaline metals —a discovery of the greatest moment. They must be made to realise that Boyle, Cavendish, Watt, Stephenson, Leslie, Hutton, and Lyell, as well as John Hunter, Jenner, Simpson, and Lister, were Britons who made discoveries of the first importance. They must be forced to confess the supreme character of the work of Napier, the Herschels, Adams, Clerk-Maxwell, and Kelvin. We, on our part, always acknowledge the indebtedness of science to such Germans as Mayer, Helmholtz, and Ehrlich; whereas our enemies systematically conceal their immense indebtedness for the enunciation of first principles to men of the English-speaking race.

In regard to the splendid contributions to science of every kind made by the Italians and the French, the representatives of those nations must draw up their own lists, and they will not be short ones. The names they must contain suggest cardinal discoveries in every field of natural knowledge. It would be tedious to revert to the Italian Renaissance, because the names of the men of that epoch have become well known to anyone who knows anything at all of the story of the progress of science.

Eustachius, Malpighius, Borelli, Spallanzani, Galvani, Volta, and Avogadro in Italy; Lavoisier, Laplace, Lagrange, Montgolfier, Cuvier, Lamarck, Claude Bernard, Chevreul, and Pasteur in France, are names writ large in letters of gold across the azure of the firmament of European science. Not one of the following is German: Vesalius, Van't Hoff, Arrhenius, Helmont, Boerhaave, Mendeléeff, the Curies, Metchnikoff, and Pavlov.

Are the Germans grateful to us for what we have done in science? Do they realise, when they use railroads and steamers, dynamos and telephones, that they are all of British origination? They realise nothing of the kind. Not only are they not grateful for the benefits conferred on them by British science, but they have entered into a conspiracy of silence with regard to them.

Let us never forget that it was a German professor of physics who deliberately declared that German aircraft must destroy the tombs of Newton and of Faraday. He also included the tomb of Shakespeare, which was highly inconsistent with the widespread academic delusion that our and the world's greatest poet was a German.

D. FRASER HARRIS.

Halifax, Nova Scotia, September 30.

The Spectrum of Hydrogen.

THE writer has examined the four-line spectrum of hydrogen as produced in Geissler tubes with a 1 mm. capillary by alternating current of 15 milliamperes without inductance or capacity. The light was analysed by a glass prism monochromator, and the intensities measured by a photo-electric cell of quartz containing rubidium in an atmosphere of helium. The cell was calibrated in absolute units by a carbon filament lamp the energy distribution of which in different wave-lengths is that of a grey body in the visible spectrum.

The energy ratios of H_α, H_β, H_γ, H_δ were found to remain constant when the pressure exceeded three or four millimetres of mercury. At lower pressures the relative intensities of the lines of shorter wave-lengths increased. The effect is visually obvious in water-vapour which suppresses the many-line spectrum; this spectrum masks the effect when pure dry hydrogen is used.

The results lead to the conclusions that the four-line spectrum is due to the recombination of a $+H$ ion with an electron; that the method of ionisation of the H atom has no effect on the distribution of intensities, but that the mean free path of the luminous atom and the nature of the atoms with which it collides give a sufficient explanation of the intensity changes observed.

According to Bohr's theory, the mean free path of a luminous hydrogen atom should be shorter as the emitted wave-length decreases. The distance travelled by the atom while luminous may be called the length of the luminous streak, and at high pressures this exceeds the mean free path of the luminous atom for all wave-lengths, so that a change in pressure affects all lines in the same proportion. As the pressure is lowered, however, the mean free path will eventually exceed the length of the luminous streak for H_α, while remaining less for H_β, and so the ratio $H_\beta \div H_\alpha$ may be expected to increase, as is actually observed. At still lower pressures the intensity ratios should approach a constant value when all the mean free paths are greater than the corresponding luminous streaks.

Observation of such ratios will give the relative energies in different wave-lengths emitted by the hydrogen atom when undisturbed by collisions, and experiments of this kind are in progress.

A full account of this work will be published shortly.

R. T. BEATTY.

Queen's University, Belfast, October 18.

Origin of the Word "Blizzard."

THERE have been a number of communications on the earliest use of the word "blizzard," but thus far there has been no suggestion as to its origin. At first sight perhaps it might seem unlikely that the name of some objectionable person was adopted to describe the extremely disagreeable features of the north-westerly snowstorm of the States. We have, however, "boycott" and other words added to our vocabulary with just as much justification as the old settlers in the West would have had for introducing "blizzard."

In Amersham churchyard there is a tomb (now collapsing into the grave) of the Blizard family (Otto Bajer), and to this day, at the neighbouring village of Chalfont St. Giles, there resides a Blizard family. We are here in the heart of the Penn country, the Home of America. It seems highly probable that one or more members of the Blizard family of Buckinghamshire emigrated with the earliest settlers, and it needs no great stretch of the imagination to realise how the name could have been adopted in the slightly altered form "blizzard." I offer the suggestion to the world-wide readers of NATURE.

HY. HARRIES.

Meteorological Office, South Kensington, October 24.

"PREPAREDNESS": THE AMERICAN WAY.

THE problem of organising a nation for war has had to be faced and partially solved by this country during the act of war. The war has led the Americans to tackle the same problem, with the advantage that they are at peace and at leisure to study it scientifically, with all our mistakes and their own difficulties in the supply of munitions before their eyes. It should be instructive to see what conclusions have been reached by a people with a genius for reducing everything to machinery, from the production of motor-cars to education.

The first step, in a democracy, was to bring home to every citizen the importance of the problem. Some of us may have smiled at the picture of the President of the United States, clad in a straw hat, a navy-blue jacket, and cream-coloured duck trousers, marching at the head of a great "Preparedness" procession, and waving a flag with the best of them. But Mr. Wilson knew what he was about. The Americans are incomparable advertisers. No other device could have so instantly focussed the attention of the whole mass of heterogeneous populations between the two coasts. This having been effected, the plan evolved by the Naval Consulting Board's Committee on "Preparedness" was set out in a series of articles written by leading Government officials and business experts, and introduced by an open letter from the President himself. Which of the great political journals was entrusted with this weighty national publication? The shocking truth cannot be concealed that it was not to the editor of anything analogous to our *Times* that the President wrote his letter with full confidence that it would reach the people. It was to the *Scientific American*—as it might be our own *Engineering*—and there the articles appeared during the late spring of the present year.

They start with what seems to them an axiom, though it is still so difficult for many of our fire-eaters to realise it: "The one great lesson of the European conflict is that defence is not obtained to-day by fighting *men* alone, but by fighting *industries*. Behind every man in the firing line in Europe, from three to five persons are employed to supply him with food, ammunition, and other needs." Their experience of the first year of the war convinced them that the people will never reach the right point of view till they realise "what a mess we have made of our attempts to supply munitions to the Allies." So an article is devoted to the initial difficulties. A large firm in the West is instanced, which cheerfully took on a contract for 250,000 3-in. high-explosive shells.

It seemed a simple and profitable job. But the firm soon realised that by turning their plant—a first-class machine shop—on to it they might hope to accomplish it in eight months, and then it would only be one day's supply for *one* of the Allies. But so many difficulties intervened that after eighteen months they had only 130,000 shells accepted, which still had to be fitted with fuses and loaded and put through other processes. None had yet reached the battlefield.

Before production can be started an enormous number of measuring tools and gauges must be provided. The three famous firms engaged in this manufacture—the Brown and Sharp, the Pratt and Whitney, and the Greenfield concerns—found, on comparing estimates, that to produce 200,000 shells a day, the amount under contract for the Allies, would require in gauges and measuring tools alone an investment of from seventeen to twenty million dollars. Many of the best-known firms in the U.S. had been at work a year on the provision of this preliminary outfit without turning out sufficient finished product to be worth inspection. They have "made up their minds that if they are ever to be called on for the service of the nation they have to learn a great deal more about this business of making munitions, or in the event of war they would prove to be liabilities to the nation and not assets."

The plan worked out by the Naval Consulting Board is then expounded. It involves three steps:—

The first step consists in the taking of a complete census of the producing resources of the country, to be tabulated on a card index. This is to include an inventory of industrial manufacturing establishments which, it is thought, will cover eighty thousand firms.

The index will show the ground area, floor space, number of stories, housing accommodation, and possibility of increase in emergency; sources of heat, light, water, power; tool equipment idle in slack season; limits of precision in machine work, principal materials used and where purchased, and principal products manufactured; number of men, skilled and unskilled, number of toolmakers, of women, and of men who could be replaced by women; percentage of employees who are not American citizens; means of transport, trucking distance, and quality of street service to shipping point, trucks owned and hired, and shipping facilities by water.

The census is to cover the resources of the country in minerals and materials, with special stress on petroleum supplies and the utilisation of water-powers. To prepare it President Wilson invoked the aid of the five great engineering societies—civil, mechanical, mining, electrical, and chemical. In every State a member of each of the five societies has given his services gratuitously to form a board of five directors for the State, and under the supervision of these boards the 30,000 members of the societies have been at work. The Chambers of Commerce have given their aid, private firms have provided offices and furniture free of cost, and the newspapers have given advertisements and articles to boom the movement. It was expected that the bulk of the work would be completed by the end of May, 1916.

The second stage of the plan will consist in placing small educational orders for munitions with large numbers of selected firms annually in time of peace.

It is felt that while the Government must have its own factories distributed throughout the country to act as educational centres and clearing-houses, they would in any important war have to rely on privately owned plants. Everything connected with these orders will be done exactly as it would be were the order a war order of one hundred times the magnitude. The work will be educational. The purchasing department of the company will learn where to buy materials; the manufacturing department how to handle them and make the necessary jigs and tools; the inspection department will become familiar with Governmental inspection; the engineering department with Government blue-prints and specifications; the firm with Governmental methods of business; and the shipping department will know how to crate and ship the finished article.

The terms on which these contracts are to be made are significant. They are to be on a basis of cost plus a reasonable profit, or at a fixed dividend. There are to be no excess profits for anybody arising out of the national need, but the stockholders are to have a living wage, "since it is economically undesirable that the stockholders cease to have any dividend from their investment"! In this way will be prevented any suggestion of a profit-interest in war, of a munition lobby, of a section of the community having an interest in forcing the nation into war. If there is a war every person in the nation must accept his share of the national sacrifice and turn in and work in whatever place his ability can be best applied.

The third and final step in the programme is the enrolment of skilled labour in an "Industrial Reserve" in time of peace. Skilled mechanics in all lines of production must be kept from enrolment in the Army. Rather must bankers, clerks, shopkeepers, and professional men be sent. The skilled workers must be badged, and the only restriction imposed on them by the badge will be prevention of enlistment. Enrolment in the Industrial Reserve will be considered to carry with it honours equal to enrolment in the fighting forces.

It is claimed that this plan is a most democratic and American way of doing the job. It is cheap; it lays the ghost ot a munitions trust, with its dangerous interest in provoking war; it safeguards labour from exploitation for excess profits; it educates the manufacturers; and it is not only an insurance against war, but it has great advantages in peace.

Direct organisation for peaceful competition is dealt with in another series of articles. The survey of national resources and their conservation includes significantly "our 22,000,000 children." These must be trained, not only in the schools, but in the vital years between fourteen and eighteen, the waste of which has recently been pointed out by Mr. Galsworthy in the Press and Lord Haldane in the House of Lords. The methods of intensive industrial efficiency which were coming into notice before the war must be continued and developed.

Other articles deal with the disposal of the finished products—the careful preparation of the ground in foreign markets by personal inquiries; by correspondence with consular agencies, chambers of commerce, and universities; by improved methods of packing and dispatch; and by cultivating the "human side of salesmanship." Some of the devices described under this last head would not commend themselves to British ideas, and are not perhaps very seriously urged. There is a thoroughgoing materialism in some of the utterances quoted which we could not accept. "Real immorality," says Prof. Carver, of the Economics Department of Harvard University, in a paper on the Conservation of Human Energy, "is nothing in the world except waste or dissipation of human energy. Real morality is nothing in the world except the economy and utilisation of human energy. The reason why it is better to tell the truth than to lie is because a community in which truth prevails will waste less energy than a community where lying prevails. . . . Honesty is one of the greatest labour-saving inventions ever devised. This may be said of any other form of morality which is genuine and not merely conventional."

There are things in our British life which we should not sell for all the markets in the world. But the treasuring of these ideals is not inconsistent with sane preparation to meet the tremendous competition we shall have to encounter in the material sphere at the conclusion of the war. What this preparation should be, in the opinion of President Wilson, is indicated in the letter addressed by him to the editor of the *Scientific American*, directing attention to the articles which have since appeared in that journal. We think it worth quoting in full:—

It will be a signal service to our country to arouse it to a knowledge of the great possibilities that are open to it in the markets of the world. The door of opportunity swings wide before us. Through it we may, if we will, enter into rich fields of endeavour and success. In order to do this we must show an effectiveness in industrial practice which measures up to our best standards. We must avail ourselves of all that *science* can tell us in aid of industry, and must use all that *education* can contribute to train the artisan in the principles and practice of his work. Our industries must be self-reliant and courageous, because based upon certain knowledge of their task, and because supported by the efforts of citizens in the mills. If scientific research and the educated worker go hand in hand with *broad vision in finance* and with that keen *self-criticism* which is the manufacturer's first duty to himself, the fields will be few indeed in which American commerce may not hold, if it chooses, a primary place.

The significant thing about this letter is that there is in it no allusion to Protection. The President is for open operations by an industry relying on its own efficiency, not for trench warfare behind tariffs. Science, education, broad vision in finance, self-criticism—that is the programme. A nation which has imagination, courage, and honesty enough to depend on these can look forward without fear to whatever the future may have in store for it.

J. C.

RHODODENDRONS AND LIME.

IN a note in Nature of February 17, 1916 (vol. xcvi., p. 684), reference was made to Mr. Forrest's discovery of rhododendrons growing on limestone rocks in N.W. Yunnan. In this connection Lady Wheeler-Cuffe, writing from Maymyo, Upper Burma, informs the Editor that she found "a beautiful blush-white rhododendron growing actually wedged into a bare limestone crag on the very summit of Sindaung (6022 ft.), in the southern Shan States, a few years ago." Mr.

Forrest also states definitely that he found rhododendrons with their roots actually spreading in the crevices of the limestone rock.

From the evidence of Mr. Forrest and Lady Wheeler-Cuffe it would appear that these particular rhododendrons must come in contact with a large quantity of lime, but, unfortunately, we have no definite information as to the particular character of the limestone rocks on which they have been found.

In the European Alps the two endemic species of rhododendron, *R. ferrugineum* and *R. hirsutum*, are recognised as being chalk-avoiding and chalk-loving respectively. *R. ferrugineum* is found in damp, deep-layered soil rich in humus, and it will only grow in a limestone region when there is an overlying layer of humus. *R. hirsutum*, on the other hand, is a limestone rock plant, found in dry, open situations, and when the two species are found in the same locality, *R. hirsutum* grows only on the rocks, while *R. ferrugineum* occurs in the pockets of humus. The hybrids which have been raised in gardens with *R. hirsutum* as one of the parents are also lime-loving, like that species.

Several of the new Chinese rhododendrons which were collected on limestone are now being experimentally cultivated in this country on various lime-containing soils. Some of the species (see Grove in *Gardeners' Chronicle*, January 29, 1916, p. 65) appear to thrive under these conditions very well, while to others the lime has proved fatal, but the experiments have not been in progress for a sufficiently long time for a definite verdict as to the behaviour of these limestone rhododendrons under cultivation to be given.

The abhorrence of lime by the humus-loving rhododendrons appears to be intimately connected with the mycorrhiza, the symbiotic fungus which lives in association with the roots of the rhododendron and heath family (Ericaceæ), and performs the functions of the root-hairs in absorbing water from the soil; and it may be that the mycorrhizal fungi associated with the humus-loving forms of rhododendron are physiologically, if not specifically, distinct from those of the lime-loving species.

It has recently been shown by Rayner, Jones, and Tayleur (*New Phytologist*, vol. x., 1911, pp. 227–240) that the common ling, *Calluna vulgaris*, though it is sometimes found on chalk downs, is really growing in pockets of loamy soil rich in mineral constituents but poor in lime. It is also worthy of note that in the "limestone pavement" district of Westmorland ling grows vigorously in the very thin layers of earth which lie directly on the limestone rock. An analysis of the surface soil, however, reveals an almost complete absence of lime, and so lime-free is this layer that it is actually necessary to add lime thereto in the course of ordinary agricultural operations.

Cultures made by C. A. Weber and Graebner (see Graebner, "Lehrbuch der Allgemeinen Pflanzenphysiographie," 1910, p. 236) have shown that the lime-avoiding Ericaceæ and other plants they examined suffer from lime only when this is associated with a large amount of soluble salts, and that root-formation fails when nutritive salts are in abundance in the presence of lime. Rhododendrons, however, do not appear to have been among the plants examined.

In connection with their behaviour towards lime-containing soils, plants may be roughly divided into two groups: of those which avoid lime, the heath family affords one of the most striking examples, but, contrary to expectation, certain members of the family, as, for instance, *R. hirsutum*, are characteristic plants of limestone districts.

It seems probable from the evidence now before us that some of Forrest's newly discovered Chinese rhododendrons, as also the one found by Lady Wheeler-Cuffe, must be reckoned as lime-loving species, but in all these cases the interesting question as to the quantity of lime absorbed by the plants growing on limestone rock still awaits an answer. Under natural conditions these lime-loving rhododendrons are flourishing on what we should consider a very sterile medium, and it may be that the poor growth which such plants exhibit when grown in lime-containing soil in our gardens is due to the superabundance of soluble nutritive salts, which may cause the lime to react unfavourably on the mycorrhiza of the roots, and that, under certain chemical conditions, the lime may have a definitely toxic influence. A. W. H.

NOTES.

At a meeting of the council of the National Museum of Wales held at Cardiff on October 28, it was announced that a sum of 10,000*l*. had been received in War Loan Scrip from Capt. W. R. Smith, senior partner of the firm of W. R. Smith and Son, Cardiff, and Mrs. Smith towards the building fund of the new museum. The generous donors had made this gift in the belief that the National Museum would be one of the first educational influences in the Principality. There were other donors, who wished to remain anonymous for the present, and it is expected that when the present contract has been paid there will be a balance of about 16,000*l*. towards the 50,000*l*. which is needed to complete the furnishing and equipment of the portion of the building at present in course of erection.

Dealing with the fine collection of statues of eminent Welshmen at Cardiff unveiled by Mr. Lloyd George, a correspondent, writing in the *Western Mail*, points out with regret that no man of science figures in the series. He says that Robert Record, of Tenby, who flourished in the first half of the sixteenth century, might well have been included. Record was a man of cyclopædic knowledge, and was most eminent in his time, though little known to modern Welshmen. The use of the sign = to denote equality was introduced by him in 1557. He was "the first mathematician who wrote on arithmetic in English; the first who wrote on geometry in English; the first who introduced algebra into England; the first who wrote on astronomy and the doctrine of the sphere in English; and, finally, the first Briton (in all probability) who adopted the system of Copernicus." As a statue or two are still to be added, perhaps science may yet be represented in the Welsh Valhalla.

LORD RAYLEIGH presided at a meeting held at University College, London, on Tuesday, October 31, to take steps to establish a memorial to the late Sir William Ramsay. Mr. J. A. Pease, M.P., Postmaster-General, in moving that a memorial fund should be raised, to be utilised in promoting chemical teaching and research, under a scheme to be approved hereafter, said he was glad on behalf of the Government to pay a tribute to the memory of Sir William Ramsay and to take part in the great object of the meeting. The memorial should be not merely national, but international. Sir J. J. Thomson seconded the motion, which was supported by the Belgian Minister, who wished to convey the respectful homage of Brussels University, and by Mr. W. H. Buckler, who testified to the interest of the American Ambassador and his countrymen in the movement. The resolution was carried. It was also agreed that the meeting should resolve itself into a general committee, with Lord Rayleigh as chairman, to raise the necessary fund, and an executive committee was appointed to circulate an appeal.

A NEW departure in the study of Indian phonetics and linguistics is marked by the presentation before the Royal Asiatic Society, by Sir G. Grierson, head of the Linguistic Survey of India, of a series of gramophone records of four languages of the Munda group, prepared under the orders of the Government of Behar and Orissa. These comprise the Kharia, Mundari, Ho, and Santali, and one of the Dravidian group, Kurukk. In each case a version of the tale of "The Prodigal Son" has been reproduced, with some marriage songs and items of folklore. The work is important because the Munda tongues are a widespread group, extending through India proper to Assam, Burma, thence to Indo-China and the Malay Peninsula, and eastward to Easter Island. A copy of these records will be deposited at the India Office Library, a second in the British Museum, and a third in the rooms of the Asiatic Society. It is significant that this new record of phonetics is produced just as the first director of the School of Oriental Studies has been appointed. It may be hoped that similar records for other Indian languages may be prepared, and the scheme might be extended to other languages taught in our schools.

THE Chinese Government is becoming alive to the need for a proper geological investigation of the mineral resources of the country, and the lead in this task has been entrusted to Swedes. As the head of the survey, Dr. J. G. Andersson, formerly chief of the Swedish Geological Survey, has been appointed, and with him already are Dr. Tegengren and Prof. U. Nyström. We now learn that Dr. T. G. Halle, assistant in the palæobotanical department of the Riksmuseum at Stockholm, is to travel in China for one year, mainly in the interests of his own department, for which he will collect Palæozoic plants, but partly for the Chinese Government, to which he will report on the age and character of the coal-seams inspected, and for which a duplicate series of fossils will be provided after their determination. A young Chinese geologist will accompany Dr. Halle, and will be trained by him as a palæobotanist. The spring and summer will be devoted to the northern provinces, especially Shansi, with its enormous deposits of anthracite and ordinary coal. The coal-field of greatest scientific interest lies round and south of the Yangtse river, but how far this can be visited must depend on political conditions, now considerably disturbed. The expenses are borne by friends of the Swedish museum, but naturally every assistance will be given by the Central Government at Pekin.

A PAPER on food economics, by Prof. G. Lusk, in the Journal of the Washington Academy of Sciences for June 19, is worthy of study by everyone, and especially by those sending parcels of foodstuffs to prisoners in Germany. Prof. Lusk describes briefly how Germany tackled the all-important question of foodstuffs at the outbreak of the war. In order to maintain the protein portion of the nation's food the committee of investigation recommended that considerable increase should be made in the bean crop in Germany. Modifications were put forward in connection with the production of cereals, cheese, and skim milk, and it was finally concluded that the German people, through the co-operation of millions of inhabitants, would be able to obtain a ration of 3000 calories per adult per day, and so escape suffering from lack of food. A prisoner of war, doing moderate work, could get along on a ration of 2500 calories, composed as follows:—Proteins, 100 grams; carbohydrates, 400 grams; fats, 50 grams. On the assumption that a gram (roughly $15\frac{1}{2}$ grains) of protein yields 4·1 calories, and that the corresponding values for carbohydrates and fats are 4·1 and 9·3 respectively, it is obvious that the total caloric value of this ration is about 2500. Prof. Lusk points out that true food reform demands the sale of food by calories and not by pounds, and he gives an instructive table of various articles of food, showing the weight and price of each necessary to produce 2500 calories. The following are some of the foodstuffs mentioned, and their costs in New York:—Oatmeal, 1 lb. $5\frac{1}{2}$ oz., $2\frac{3}{4}$*d.*; wheat flour, 1 lb. 8 oz., 3*d.*; sugar, 1 lb. $5\frac{1}{2}$ oz., $3\frac{1}{2}$*d.*; rice, 1 lb. $8\frac{1}{2}$ oz., $3\frac{3}{4}$*d.*; bread, 2 lb. 1 oz., 4*d.*; lard, $9\frac{1}{2}$ oz., $4\frac{1}{4}$*d.*; potatoes, 8 lb. 1 oz., 8*d.*; raisins, 1 lb. 12 oz., $10\frac{1}{2}$*d.*; cheese, 1 lb. 3 oz., $11\frac{3}{4}$*d.*; butter, 11 oz., 12*d.*; cocoa, 1 lb. 1 oz., $14\frac{1}{2}$*d.*; lentils (dried), 1 lb. 8 oz., 15*d.*; salt cod, 6 lb., 45*d.*

OFFICERS of the Royal Artillery and the Royal Engineers, besides a large circle of friends in the teaching profession, will learn with deep regret of the sudden death, on October 18, of Mr. C. S. Jackson, Instructor of Mathematics and Mechanics at the Royal Military Academy, Woolwich. Before entering as a scholar of Trinity College, Cambridge, Mr. Jackson was head of Bedford School. He was eighth Wrangler in 1889, in the following year took the premier place in Part II. of the Law Tripos, and was called to the Bar shortly afterwards. In 1891 he joined the staff of the R.M. Academy, and for the past twenty-five years worked there with rare distinction and single-hearted devotion. He was a member of the council of the Mathematical Association, and took a prominent part on the various committees of that body, the reports of which have done so much to improve the mathematical teaching of our schools. He was also the first president of the London branch of this association. His great knowledge of the educational requirements of the country was recognised by the Board of Education when, in connection with the International Congress of Mathematicians, which met at Cambridge in 1912, it was determined to issue a series of reports dealing with the teaching of mathematics in secondary schools. The organisation of the work in connection with these reports was put into the hands of Mr. Jackson, and they form a lasting tribute to his far-sighted outlook on mathematical education. His work at Woolwich brought him into contact with the applications of mathematics to the problems of gunnery and military engineering. Working on these lines, he became a pioneer in breaking down the barrier that so long existed between so-called rational mechanics, as taught in our schools, and mechanics as applied to the problems of civil and military engineering.

THE *Nieuwe Courant* reports the death, at sixty-three years of age, of Prof. A. Torp, of the University of Christiania, the most famous of Norwegian philologists.

ACCORDING to the *Chemisch Weekblad*, the Bakhuis Roozeboom medal has been awarded to Prof. Schreinemakers, professor of inorganic and physical chemistry in the University of Leyden.

WE notice with much regret, in the *Times* of October 30, the announcement of the death, at seventy-seven years of age, of Prof. Cleveland Abbe, the well-known meteorologist of the U.S. Weather Bureau, Washington, D.C

THE Horace Dobell lecture of the Royal College of Physicians of London will be delivered by Dr. H. R. Dean on November 7. The subject will be "The Mechanism of the Serum Reactions." On November 14 and 16 Dr. W. H. R. Rivers will give the Fitz-Patrick lectures on "Medicine, Magic, and Religion" (part 2).

DR. E. D. VAN OORT's report on the activities of the State Museum of Natural History at Leyden for the year ended September 1, 1916, records the transference of the collections to the new building in the Van der Werf Park, but laments that even now the collections are totally inaccessible to the public at large, owing to the lack of any exhibition galleries. The retirement, after forty-five years' service, of Dr. C. Ritsema Czn, keeper of the entomological collections, is a great loss to the museum. He is succeeded by R. van Eecke.

OWING to the pressure of his duties at Columbia University, Prof. M. H. Whitaker has resigned the editorship of the *Journal of Industrial and Engineering Chemistry*, one of the official organs of the American Chemical Society. He will be succeeded in that post by the president of the society, Prof. C. H. Herty, who will relinquish at the end of the year his duties as head of the department of chemistry at the University of North Carolina in order to devote his whole time to editorial work.

THE death is announced, in his seventy-fifth year, of Dr. Albert J. Cook, professor of zoology and entomology at the Michigan Agricultural College from 1866 to 1893, and afterwards professor of biology at Pomona College, California. From 1894 to 1905 he superintended the university extension work in agriculture in connection with the University of California. Prof. Cook is said to have been the first to make kerosene emulsion (in 1877), and to demonstrate and advocate the use of the arsenites as a specific against the codling moth (in 1880). He was the author of a manual of the apiary, and also of publications on "Injurious Insects of Michigan," "Silo and Silage," "Maple Sugar and the Sugar Bush," and "Birds of Michigan."

CAPT. J. O. WAKELIN BARRATT, who is serving with the British Expeditionary Force in France, writes:—"On October 17, at 9 p.m., an exceptionally fine lunar rainbow was visible in the west at Etaples (the moon had risen in the east). The width of the rainbow was fully equal to that of a solar rainbow, but no colour was recognisable, the rainbow being of a uniform light grey appearance." Full moon was on October 11—six days earlier—so that the atmospheric conditions must have been very favourable for a lunar rainbow to be distinctly visible. Such rainbows are usually faint, and their colours are not easily distinguished on this account. They generally have the appearance of a whitish or yellowish arch, except when the moon is full and other conditions are good, in which case colours may be seen, as in a solar rainbow.

THE sixth war course of Chadwick public lectures began on October 27 with a lecture on the physiological basis of fatigue by Prof. W. Stirling at the Royal Society of Arts. Prof. Stirling will give two other lectures on the effects of fatigue on industry and efficiency on November 3 and 10 at the same place at 5.15 p.m. Dr. C. Porter will deliver three lectures at Norwich Museum during November on the health of the future citizen. Dr. J. T. C. Nash will lecture at the Hampstead Central Library on November 20 on baby-saving for the nation; and Mr. P. Waterhouse will give three weekly lectures at the Surveyors' Institution, London, on architecture in relation to health and welfare, beginning on November 30. The lectures are free, and particulars concerning them can be obtained from the offices of the Chadwick Trust, 40 (6th) Queen Anne's Chambers, Westminster.

WE regret to note that *Engineering* for October 27 records the death, on October 7, of Col. T. Turrettini. Col. Turrettini was born in 1845, and his experience in hydraulic and electric machinery led to his election as one of the experts for the harnessing of the Niagara Falls in 1891. He was president of the Swiss National Exhibition held in Geneva in 1896. In the same number of *Engineering* is also recorded the death of Sir Henry Benbow, a prominent naval engineer officer of the past generation. In the Nile expedition of 1885 Sir Henry Benbow's name appears in the official despatch for his brilliant feat of repairing the boilers of the rescuing steamer under heavy fire, thus saving Sir Charles Wilson and his shipwrecked comrades. He was promoted to chief inspector of machinery in 1888, and was placed on the retired list at his own request in 1893.

SEVERAL further letters have reached us upon the subject of the scarcity of wasps during the past summer. The abundance of queen wasps referred to by correspondents last week seems to have been noticed in many districts. Mr. C. F. Butterworth, writing from Poynton, Cheshire, seven miles from Stockport, says:—"The queen wasps were much more numerous this year than I have known them during quite ten well-observed years, when I have kept honey bees and regarded these things with interest." Mr. K. Evershed, Kenley, Surrey, noticed a number of queen wasps in the spring, but adds, as to wasps in general:—"I do not recollect so marked a scarcity during the last thirty-five years in this county." Mr. A. E. Murray says that in the Reading district also their numbers have been considerably below the average. He adds:—"In July I observed early wasps on the flowers of Scrophularia (which they fertilise), and during the autumn, while engaged on a study of ivy, particularly as regards its fertilisation (in which they also take part), I have noticed a sprinkling of these insects obtaining honey from the discs of the flowers, this being the only occasion on which I have seen even a moderate number assembled. It was interesting to observe these wasps now and again preying on the numerous flies also attracted by the honey, bearing their victims to the ground and killing them after a short, fierce struggle. In one case when a wasp had finished feeding on a fly the head of the latter was found to have been severed from the trunk, and in another instance, when I disturbed a wasp killing a fair-sized fly, it flew off, carrying its prize bodily away!"

THE Harveian oration was delivered by Sir Thomas Barlow, at the Royal College of Physicians, on October 18. The story of Harvey's life and of his great discovery of the circulation of the blood have often been told, and Sir Thomas Barlow dwelt on certain minor, but none the less important, details of Harvey's life before proceeding to consider Harvey as physician and as Court physician to Charles I., his Oxford life, his great discovery and work on generation, and his relations with the College of Physicians. Harvey was a pupil at King's School, Canterbury, and gained there a scholarship which enabled him to proceed to Caius College, Cambridge. The regulations for this scholarship, founded in 1571 by Matthew Parker, Archbishop of Canterbury, are probably unique for the period, and enjoined that the scholar should be educated first in subjects that pertain, or are serviceable, to medicine, and then in subjects which actually constitute medicine itself. In 1600 Harvey entered the University of Padua, and studied anatomy under the learned Fabricius, returning home in 1602, became a fellow of the College of Physicians in 1607 and attached to St. Bartholomew's Hospital, with which he was connected for thirty-six years. Sir Thomas Barlow's estimate of this side of Harvey's life is that, besides being a great anatomist and naturalist, he was an experienced pathologist, a learned physician, and had the qualifications of a good, all-round practitioner. The College of Physicians was the chief interest of his old age, and he enriched it with many benefactions. The last exhortation of the great master was "ever to search out and study the secrets of Nature by way of experiment, and for the honour of our profession to continue in mutual love and affection among ourselves."

SOME weeks ago there was considerable speculation as to the truth of the reports concerning Germany's new super-Zeppelins, and the matter was referred to in these columns. Since that date two Zeppelins of the very latest type have been brought down in England, and one in such a state of preservation that detailed information has been readily obtained from it. Excellent descriptions of this airship have appeared in the daily papers, and a particularly correct account in the *Times* for October 19. All the main particulars of the early reports are justified. The capacity of the L33 has been estimated at 2,000,000 cub. ft., its length at 680 ft., and the total horse-power at about 1500, which entirely confirms the figures previously given in these columns. More information is now available concerning the minor details of the new design. A point worthy of particular notice is the centralisation of the controls, the whole airship being under the control of the men in the forward gondola. Bombs and petrol tanks are carried in a passage-way along the keel of the ship, which also serves for communication between the various gondolas. The extent of the development of small details is illustrated by the fact that provision has even been made for dropping the petrol tanks in case of emergency, to save all possible lifting power. The bomb-releasing arrangements are exceedingly neat and trustworthy, and an armament of nine machine-guns has been provided. The construction of the main framework is very ingenious, the strength being enormous for the weight of metal used. In view of the great improvements in the design of these latest Zeppelins, it is comforting to think that our defensive measures have proved so successful against them, and that the raiders no longer enjoy the comparative immunity from loss which characterised the earlier raids.

WE have received the report of the Director-General of Public Health, New South Wales, for the year ended December 31, 1914. It contains a summary by the Director-General, Dr. Paton, of the general public health administration, reports of the work of the various departments and of the State hospitals, and the report of investigation and research work of the microbiological laboratory. The routine examination of rats and mice for plague infections forms a part of the work of this laboratory, and it is of interest that no plague infection has been found since 1910 among these rodents, although some 60,000 animals have been examined during the years 1911–14 inclusive.

PHYSICIANS and psychologists will find a critical discussion of the value and limitations of the intelligence tests in diagnosing the mind of a child, in the *Psychological Review* (vol. xxiii., No. 5). The writer, Mr. J. V. Haberman, finds the Binet method entirely inadequate to furnish an accurate or truthful equation of the general intellectual ability of an individual, and, further, insists that even if general ability were so tested it would be of no diagnostic value to the psychopathologist, since in mental pathology the processes involved are not always of the nature of general ability, but of mental functioning. He suggests a method of testing which shall serve in diagnosis, prognosis, and prophylaxis, and that shall give a clue to therapy and remediable pedagogic processes. He also points out that this testing should not be in the hands of the psychologist only, but of a physician with a psychological training. The increasing importance now being attached to tests renders the criticism of an expert pertinent and valuable.

IN the numbers of *Scientia* for September and October, 1916, Prof. Eugenio Rignano writes the two parts of an elaborate and interesting psychological study of what he calls "intentional" reasoning. In *Scientia* during last year he published several articles concerned with the psychological analysis of reasoning, and the present contributions complete this analysis. In the reasoning previously considered, the reasoner, at least at the moment when he begins his reasoning, has no intention to support certain theses at the expense of certain others, but only that of discovering the truth. On the other hand, the "intentional" reasoner sets about reasoning for the purpose of proving the correctness of definite assertions which he has at heart. Prof. Rignano's work is divided into two main parts, which deal with the two chief varieties of "intentional" reasoning: dialectical reasoning and metaphysical reasoning. The latter part is subdivided into sections on metaphysical theology; metaphysics properly speaking; finalism, animism, and vitalism; the function of language in metaphysical reasoning; and positivism and metaphysics. These researches are particularly interesting at the present time, when the attention of many philosophers and men of science is fixed on scientific method in philosophy, and some philosophers are gradually coming to recognise in their work that in philosophy, just as in what is usually called science, only an unbiassed search for truth is really legitimate and can lead to permanent results. Of course, this seems a truism when stated thus as a maxim of method, but it is none the less a fact that philosophers have not, as a rule, hitherto worked in accordance with it.

DR. W. D. MATTHEW, in the Bulletin of the American Museum of Natural History (vol. xxxv.), describes in great detail "A Marsupial from the Belly River Cretaceous." The remains forming the subject of this communication comprise no more than the left ramus of the mandible, the symphysis of the right mandible, and fragments of the cranium, but they constitute the most complete remains of fossil mammals yet discovered in the Cretaceous. These remains are assigned the rank of a new genus and species—*Eodelphis Browni*—of the family Cimolestidæ, which is not clearly separable from the Didelphidæ. The specimen was discovered during the work of under-mining a Ceratopsian skull, beneath which it lay. Being thus accidentally found during work with a heavy pick, it was badly shattered, but it is believed that all the fragments originally preserved have been recovered.

Mr. E. C. Chubb, the curator of the Durban Museum, is to be congratulated on the admirable "General Guide" which he has prepared for the aid of visitors, a copy of which has just reached us. Mr. Chubb has evidently made the most of the collections under his charge, though it would seem that great gaps have to be filled, even in so far as African mammals are concerned. If we may judge from this guide, neither the elephant nor the giraffe is yet represented here. When a new edition of this guide is issued we would suggest that the statement that the "lamp-shells," or Brachiopods, are possibly related to the starfishes should be corrected, while in regard to the information concerning flexible sandstone the fact might be added that it is found in India and Brazil. At the present time the Durban Museum occupies no more than the first floor of the south block of an imposing pile of buildings serving also as an art gallery and public library, and apparently yet other functions. In the course of time it is to be hoped the Natural History Department will either oust its rivals or find new and more commodious quarters elsewhere; as matters stand, the space allotted to it is inadequate.

Mr. E. P. Meinecke, in U.S. Dept. Agric. Bulletin, No. 275, entitled "Forest Pathology in Forest Regulation," gives the results of an investigation, as regards the incidence of wounds and disease, of 160 felled trees of *Abies concolor*, varying in age from 60 to 258 years. These trees were representative of the ordinary condition of the species under natural forest conditions in Oregon. Only one-fourth of the trees were found to be free from wounds. The rest had all been injured at one time or another by lightning, fire, frost-crack, etc., or by a combination of these, and as the wounds permitted infection by fungi, decay had set in. After the trees had reached eighty or ninety years of age, 70 per cent. were more or less badly wounded; and at 106 years, 80 per cent.; but serious decay of the timber rarely set in until about the age of 130 years. Fire, usually caused by lightning, is the greatest enemy. The management of the forest should be modified by the pathological conditions, as it is evident that much may be done to avert decay and destruction of valuable timber by timely removal of wounded and badly suppressed trees, and by fixing the felling rotation at 130 to 150 years.

The richness of Sweden in water-power, and Denmark's natural poverty in any sources of power, has led to Sweden exporting electric power across the Sound. The works are established in the small river Låga, in Smaland, and the current is carried by overhead wires to Helsingborg, and thence by three submarine cables under the waters of the Sound to Marienlyet, north of Elsinore, on the island of Seeland. According to *La Géographie* (vol. xxxi., No. 2), the Swedish power station sends 500 h.p. to Denmark, but the company undertakes to increase this to 5000 h.p. Precautions have been taken so far as possible to prevent the cables being fouled by the anchors of ships.

The Royal Italian Geographical Society has issued as one of its special memoirs a handbook and index to the names which appear on the Austrian Staff map (1 : 75,000) of the Alto Adige, the new province of Italy lying north of the Trentino ("Prontuario dei nomi locali dell' alto Adige"). The index itself, apart from the introduction, runs to more than one hundred pages, and contains all the names on the fourteen sheets of the map, with their Italian equivalents. Pending the preparation of a new map, this index should be of great value, as many of the places are difficult to identify from the German versions of their names, which often bear no relation to the Italian. The work has been done under the direction of Signor E. Tolomei.

With the view of increasing the commercial utility of cobalt, Dr. H. T. Kalmus, of Queen's University, Kingston, Ontario, has carried out a number of investigations of the physical properties of the metal and its alloys for the Mines Branch of the Department of Mines of Canada. The fifth of these investigations deals with the magnetic properties of pure cobalt and of the alloy Fe_2Co, and has been conducted by Dr. Kalmus and Mr. K. B. Blake. The B, H curves of both materials have been obtained by the Burrows method in use at the American Bureau of Standards. For pure cobalt the value of B for $H=100$ is only about 5000, while older observations had given 8000. At $H=150$ B has risen to 6300, and shows no sign of the material being magnetically saturated. The Fe_2Co alloy, when cast, is very liable to fine cracks, but after forging is more than twice as strong as pure iron. At low fields its magnetic permeability is less than that of pure iron, but at fields exceeding 8 it is greater, and for fields of the order 50 to 200 is approximately 25 per cent. greater. The hysteresis loss is considerably less than that of transformer steel, and its electrical resistance about the same as that of pure iron.

A paper by the late Lieut. F. Trevor Wilkins (Northumberland Fusiliers), read at the Institution of Mechanical Engineers on October 20, gives an account of some trials of a small Diesel engine at the University of Birmingham. The manner of conducting these trials and reducing the results enabled figures to be presented additional to those usually given in such investigations. The indicator diagrams have been re-drawn upon a heat-energy chart, and by this means any differences between the theoretical and practical cycles are clearly exhibited. The amounts of heat passing to the cylinder walls and to the exhaust were determined accurately. The heat flow during the compression and expansion strokes was estimated separately, and the period during which this heat flow takes place was indicated definitely. At full load the thermal efficiency, heat to jackets, and heat to exhaust are respectively 42·1, 29·6, and 28·3 per cent., these being the results of the test. The corresponding figures from the energy diagrams are 42·5, 25·3, and 32·2 per cent.

OUR ASTRONOMICAL COLUMN.

The Fireball of October 20.—Mr. Denning writes that forty-six observations of this brilliant object have reached him. It was seen from widely distant stations, the most northerly being Rothes (Elgin), and the most southerly Totteridge (Herts) and Bristol. The fireball was a splendid one, and it traversed a long flight of about 252 miles, from over a place 60 miles N.W. of Edinburgh to 50 miles E. of Whitby, Yorks. Its elevation decreased from 68 to 25 miles, and its velocity was about 17 miles per second. The radiant point was near ζ Herculis, situated low in the N.W. by W. sky at the time of the apparition. There is no well-known meteor shower from this region in the autumn, but bright meteors have sometimes been observed from the same astronomical point at various times of the year, and this point near ζ Herculis forms the chief focus of a well-defined meteoric shower visible during the last half of May.

The Orionid Shower of 1916.—These October meteors were fairly well seen this year between October 20 and 25 at Bristol. There were two showers, one at $92^\circ+15^\circ$, the true Orionids, and a richer one at $98^\circ+14^\circ$, near γ Geminorum. These results appear to substantiate observations made in 1900 and 1903 at Bristol, when the Geminids exhibited greater activity than the Orionids. The two showers, lying so near together, are very liable to be confused; in fact, in some cases it is impossible to say to which radiant the meteors are conformable.

Of the other showers belonging to this usually prolific meteoric epoch, only a few of well-pronounced character were visible this year. There were, however, some slow meteors from a sharply defined radiant at $72^\circ+66^\circ$, and some very swift, streaking meteors from a point at $121^\circ+43^\circ$. Several of the true Orionids, observed on October 20, were recorded at two stations, and their real paths have been computed.

Ultra-violet Radiation from the Sun.—Prof. Birkeland has recently given an account of some observations of the zodiacal light, and of the registration of the ultra-violet radiation of the sun (*Cairo Sci. Journ.*, vol. viii., p. 287). The most effective rays of the zodiacal light appear to have a wave-length of about 3200 A.U. and under, so that, in attempts to obtain photographs, lenses of quartz, or mirrors of Mach's metal (67 Al + 33 Mg) or of nickel, should be employed. Regarding the zodiacal light as a manifestation of the general electrical activity of the sun, Prof. Birkeland was led to investigate the ultra-violet radiation of the sun itself by the use of a filter consisting of a silver film which was opaque to visible light. Sunbeams transmitted through such a film were received by a photo-cell and registered in the usual manner. Variations of intensity were observed, and there was some slight evidence of a relation to changes in horizontal magnetic intensity. While allowing that some of the observed variations of the ultra-violet intensity were probably due to atmospheric differences, Prof. Birkeland finds reason to believe that variations also arise through real changes in the electrical state of the sun. The possibility of extending such observations to stars and planets by the use of large concave mirrors, say 4 metres in diameter, is suggested. A new analysis of celestial bodies giving information as to their general electrical states, might thus be founded.

THE SOIL SURVEY OF WISCONSIN.[1]

FOLLOWING the lead set by the American Bureau of Soils, the State of Wisconsin has arranged for a soil survey, and is publishing the results in a series of attractive booklets, well provided with maps, diagrams, and illustrations. First of all, there was issued in 1911 the so-called "Reconnaissance Soil Survey of Part of North-West Wisconsin," in which a general account was given of the geology, climate, soil, and agriculture of the area. This has now been followed by more detailed accounts of the various counties. It is proposed to complete the work by issuing a series of bulletins dealing with the management of the different types of soil, and on the 1-in. maps issued with these reports the various soil types are so clearly defined that the farmer would have no difficulty in locating his land, and so discerning which particular bulletin would give him advice as to cropping and management.

The region lies wholly within the great Mississippi valley, and its main topographical feature is the relatively level or gently sloping surface of the land. Like other parts of the valley, it is an undulating plain into which lesser valleys have been cut by the rivers and streams.

The underlying rocks belong to the Cambrian or pre-Cambrian systems, and include crystalline rocks, sandstone, and limestone (mainly magnesian limestone). But on the whole the soils are not derived from the rocks immediately below them. Upon the broad uplands are extensive deposits of Glacial drift which in many cases retain the general forms left by the great ice-sheets that invaded this region. The lakes are here intimately related in origin to the Glacial deposits. There are also extensive wind deposits of loess over large portions of the uplands. In many of the valleys are thick deposits of loose sand and gravel, which assume the form of terraces.

The climate is not influenced by the Great Lakes, but it is by the storms that move eastward along the Canadian border and those that drift up the Mississippi valley from the south-west. As in other parts of the northern Mississippi valley, extremes of temperature prevail, the summer being warm, with abundant rainfall, and the winter cool and relatively dry. The mean temperature of the summer months is about 65°–70° F.; in January and February about 10° F.; the extremes range from about 105° F. in the summer to -48° F. in winter.

Originally the land was covered with hardwood and pine, the latter being especially abundant on the sandy lands along the rivers. Much of this still remains, and there is considerable land available for agricultural settlement. Only in the west of the area do the thinly wooded and prairie lands occur.

The first settlers after the explorers and fur-traders were lumbermen, and their way into the country was by boat on the Chippewa River. But fifty or sixty years ago the agricultural settlement began, and now all the ordinary crops are raised in quantity, oats being the most important cereal, followed by maize, barley, and wheat. Among the special crops cultivated in certain districts are potatoes, sugar-beets, tobacco, peas, and maize for canning. Dairying is a particularly important industry; and it has further given rise to the well-known researches of Woll on feeding problems, and of Babcock and Russell on the composition of milk and the estimation of fat.

Typical analyses are given of the various soil types; as usual in the States, they are almost wholly mechanical analyses, only very few chemical data being given. In studying the results it must be remembered that the terms have very different meanings from those assigned to them in this country. The substances indicated by the analysis owe their properties to their sizes, and therefore the names given to them are intended simply to define the diameters of the particles, but unfortunately no international agreement has yet been reached, and hence the same name is used in different countries for wholly different-sized particles. Thus the terms have the following meanings in American and British surveys respectively:—

Mean diameter of particles, mm.

	United States	Great Britain
Fine gravel ...	2 –1	... Above 1
Coarse sand ...	1 –0·5	... 1 –0·2
Medium sand ...	0·5 –0·25	... Not used
Fine sand... ...	0·25–0·10	... 0·2 –0·4
Very fine sand...	0·10–0·05	... Not used
Silt	0·05–0·005	... 0·04–0·01
Fine silt	Not used	... 0·01–0·002
Clay	Below 0·005 ...	Below 0·002

Direct comparison with British soils is therefore impossible, a circumstance much to be regretted, as in

[1] Wisconsin Geological and Natural History Survey: Bulletins 28–32 Soil Series, Nos. 2–6), and Bulletins 37–40 (Soil Series, Nos. 7–10).

many cases the comparison would undoubtedly prove interesting. But fortunately the descriptions are so good that the student loses less than might be expected, and the results are very valuable, not only to the farmers for whom they were intended, but also to the student of soil problems all over the world.

E. J. R.

THE SCIENTIFIC WORK OF A SCHOOL OF TECHNOLOGY.

THE eighth volume of the Record of Investigations undertaken by members of the Manchester Municipal School of Technology, covering technological researches carried out during the year 1914, has just been issued. It is a highly interesting record of work accomplished, and is comprised in 258 quarto pages replete with explanatory diagrams and photographs illustrative of the text. This attempt to put upon permanent record the investigations conducted by members of the staff and by advanced students was begun in 1905, and has now extended to 2346 pages, and in its eight volumes covers researches carried out since the year 1900 in all departments of the school, including pure and applied mathematics, mechanical engineering, physics and electrical engineering, pure and applied chemistry and metallurgy, the science and practice of sanitation and building, textile manufacture, and the photographic and printing industries.

For investigations in all these important departments of industrial enterprise the school is exceptionally well equipped, and it has, moreover, had the assistance of many enlightened manufacturers, and in this connection many considerable extensions are in contemplation, only awaiting the conclusion of the war to give them full effect. Meanwhile new laboratories for advanced training and research in the subject of coal-tar chemistry in its bearing upon the dye-stuff industry have been opened under the charge of Prof. A. G. Green, of the University of Leeds, with the help and advice of Dr. E. Knecht, the professor of chemical technology, thus giving full opportunity, not only for the efficient training of chemists for the growing demands of the organic chemical industries, but for the establishment of a school of research for the chemistry of dyes and allied substances employed in industrial chemistry.

Many of the articles and researches published in these journals have also appeared in the scientific and technical Press. Lists are also given of important papers read in connection with the various technical societies connected with the school, including the Engineering Society, the Day Students' Chemical Society, the Textile Society, which itself publishes an important journal, the Printing Crafts Guild, and the Bakery and Brewing Students' Societies, together with the titles of fifty-four theses prepared by graduate students in technology for the degree of M.Sc.Tech. in the University of Manchester. Lists also appear of the titles of nearly fifty volumes of technical works issued by members of the staff since 1900.

The eighth volume of the journal under review contains, among other articles of value, interesting papers concerned with the applications of chemical science, such as those on vulcanising, industrial gas-burning, the action of strong nitric acid upon cotton cellulose and of sulphuretted hydrogen upon sodium hydrosulphite, together with papers on the dilution limit of inflammability of gaseous mixtures and on the ignition of gaseous mixtures by the electric discharge. Not the least valuable paper is one entitled "A Contribution to the History of Dyeing in Scotland," being a sequel to one in vol. vii. of the journal on the history of dyeing suggested by a remark of the late Prof. Meldola in his presidential address of 1910 to the Society of Dyers and Colourists on "The Antiquity of Tinctorial Art": "I have in mind the desirability of technical societies such as ours including in their work the antiquarian side of their subject. This is, as a rule, neglected. Nevertheless, it is desirable to secure records of the past with respect to ancient industries, and the experts in any particular subject are assuredly the right people to undertake such work." Other important articles in the current number deal with researches on the ultimate endurance of steel and of the results of experiments with lathe-finishing tools, a continuation of valuable experiments and investigations begun in the school so far back as 1903 on high-speed tool steels and cutting tools, which are even now under investigation; on modern boiler-room practice and the prevention or abatement of smoke; on the effect of structure on the strength and wearing qualities of cloth, copiously illustrated; on a null method of testing vibration galvanometers; and on the commutation of large continuous-current generators and rotary converters under heavy-load conditions.

The school is thus "an excellent example of the kind of work which the engineering colleges and the higher technical schools in this country ought to undertake, and must be prepared to perform, if they are to occupy the place of similar institutions abroad in the very important matter of practical research, not merely as teaching young men the elements of technical science, but also as establishments where industrial experiments can be carried out on a practical scale." It only remains to say, as exhibiting the great resources of this school, that the journal has been admirably printed and its illustrations prepared at the school press.

J. H. R.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THE attendance of physiologists at the Newcastle meeting was comparatively small, but there was a good programme, and several of the papers elicited considerable discussion. Prof. Cushny, the president of the section, took a pharmacological subject for his address. Reports of research committees were then presented, and Prof. Waller exhibited a simple apparatus for the administration of known percentages of chloroform. The recent modifications suggested by the extensive use of the instrument were described.

A series of lantern-slides illustrating the action of pituitary extract on the secretion of cerebro-spinal fluid was shown by Prof. Halliburton. The increased secretion is claimed by him to be an indirect result of the extract, the immediate cause being ascribed to stimulation of the cells of the choroid plexus by an increased quantity of CO_2 in the blood.

Prof. W. H. Thompson detailed the results of further investigations into the formation of arginine and creatine. An interesting paper by Prof. Cushny on the secretion of urea and sugar by the kidney was the outcome of a repetition of Heidenhain's experiments, with this difference, that urea in some experiments, and sugar in others, were injected instead of a dye into the blood of an animal after transection of its spinal cord. Analysis of the kidneys after a suitable interval showed no increase of urea or sugar in them above the normal, and there was therefore no accumulation of these substances in the cells of the convoluted tubules.

Prof. Herring gave the results of several series of experiments in which white rats had been fed on small doses of fresh thyroid for various periods of time. The administration of 0·2 gram of fresh ox thyroid in the food daily for one month led to a 75 per cent. increase in the weight of the suprarenals, and a 50 per cent. increase in their adrenalin content. Further, there was great hypertrophy of the heart, especially of the ventricles, the weight of the heart being double, and in some nearly treble, the weight of the heart of control animals. The kidneys were also enlarged, though not to the same extent. Prof. Herring directed attention to the similarity in the condition produced in white rats by small amounts of thyroid to the condition sometimes found in "soldier's, or trench, heart" in man, and suggested that cardiac hypertrophy, associated with excessive production of adrenalin and changes in other organs, might sometimes be caused in man by over-action of the thyroid glands. A paper by Dr. Kojima followed, in which changes in the pancreas induced by thyroid-feeding were illustrated by lantern-slides. The pancreas of thyroid-fed animals showed numerous karyokinetic figures, and alterations in the amount of secretory granules in the cells.

In the discussion which followed these two papers Sir William Osler, Sir Edward Schäfer, Prof. Drummond, and Prof. Moore took part.

On Friday morning, September 8, Dr. Itagaki described the action of ovarian extracts, more especially of luteal tissue, on preparations of uterine and intestinal muscle.

A paper by Prof. Bayliss on "The Properties Required in Solutions for Intravenous Injection" was read, in which the author recommended the use of a 7 per cent. solution of gum acacia. Such a transfusion fluid has a viscosity, and exerts an osmotic force, more nearly resembling blood plasma than normal saline, and when used in cases of hæmorrhage gives better results.

Prof. Moore and Mr. Barnard gave a paper on the nutrition of living organisms by simple organic compounds.

The meeting closed with a discussion upon "Food Standards and Man Power," introduced by Prof. Waller. The object of the discussion was to prepare the way for the formation of a committee to formulate definite figures for the value of work done by man, woman, and child.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION H.

ANTHROPOLOGY.

Opening Address (Abridged) by R. R. Marett, M.A., D.Sc., President of the Section.

The question to which I beg to direct attention on the present occasion is: What function ought anthropology to fulfil among the higher studies of a modern university? The subject may be commonplace, but it is certainly not untimely. At the present moment those of us who are university teachers in any of the warring countries are feeling like fish out of water. Our occupation is to a large extent suspended; and already it seems a lifetime since we were assisting, each after his own fashion, in the normal development of science.

"Usus abit vitæ: bellis consumpsimus ævum."

Can the hiatus be bridged, the broken highway mended? Never, if memories are to prevail with us; but if hopes, then it goes equally without saying that we shall somehow manage to carry on more actively and successfully than ever. So the only problem for brave and hopeful men is, How? Ignoring our present troubles, we are all thinking about the future of university education, and reform is in the air.

Of course, every university has difficulties of its own to meet; and my own University of Oxford, with eight centuries of growth to look back on, is likely to be more deeply affected by the sundering of traditions due to the war than such of its sister-institutions as are of more recent stamp. Now, when I discuss university matters, the case of Oxford is bound to weigh with me predominantly; and, indeed, no man of science could wish me to neglect what, after all, is bound to be my nearest and richest source of experience. But various kind friends and colleagues hailing from other universities in Great Britain, France, and the United States have furnished me with copious information concerning their home conditions, so that I shall not altogether lack authority if I venture to frame conclusions of a general nature. Besides, it is not on behalf of any university, but rather as representing the interests of the science of anthropology, that I am entitled to speak in my present capacity. I do indeed firmly hold that anthropological teaching and research can be admitted to the most ample status in the curriculum of any modern university without injury to established industries and activities. But, even if this were not so—even if it needed a sort of surgical operation to engraft the new in the old—we anthropologists must, I think, insist on the fullest recognition of our science among university studies, realising, as we are especially able to do, its immense educational value as a humanising discipline. Let me not, however, rouse prejudice at the outset by seeming to adopt an aggressive tone. "Live and let live" is the safest motto for the university reformer; and I have no doubt that the peaceful penetration whereby anthropology has of late been almost imperceptibly coming to its own in the leading universities of the world will continue to accomplish itself if we, who make anthropology our chief concern, continue to put forth good work in abundance. For, like any other science, the science of man must be justified of its children.

Now, it is customary to contrast what are known as technical studies with university studies proper; and such a distinction may prove helpful in the present context, if it be not unduly pressed. Thus, in particular, it will afford me an excuse for not attempting to travel afresh over the ground covered by Sir Richard Temple in his admirable presidential address of three years ago. What he then demanded was, as he termed it, a school of applied anthropology, in which men of affairs could learn how to regulate their practical relations with so-called "natives" for the benefit of all concerned. Let me say at once that I am in complete agreement with him as to the need for the establishment or further development of not one school only, but many such schools in this country, if the British Empire is to make good a moral claim to exist. Indeed, I have for a number of years at Oxford taken a hand in the anthropological instruction of probationers and officers belonging to the public services, and can bear witness to the great interest which students of this class took at the time, and after leaving Oxford have continued to take, in studies bearing so directly on their life-work.

What I have to say to-day, however, must be regarded as complementary rather than as immediately subsidiary to Sir Richard Temple's wise and politic contention. The point I wish to make is that, unless anthropology be given its due place among university studies proper, there is little or no chance that technical applications of anthropological knowledge will prove of the slightest avail, whether attempted within our universities or outside them. Anthropology must be studied in a scientific spirit—that is, for its own sake—and then the practical results will follow in due course. Light first, fruit afterwards, as Bacon says. So it has always been, and must always be, as regards the association of science with the arts of life. That Sir Richard Temple will heartily subscribe to such a principle I have no doubt at all. As a man of affairs, however, whose long and wide experience of administration and of the problems of empire had convinced him of the utility of the anthropological habit of mind to the official who has to deal with "all sorts and conditions of men," he naturally insisted on the value of anthropology in its applied character. On the other hand, it is equally natural that one whose career has been wholly academic should lay emphasis on the other side of the educational question, maintaining as an eminently practical proposition—for what can be more practical than to educate the nation on sound lines?—the necessity of establishing anthropology among the leading studies of our universities.

How, then, is this end to be attained? The all-important condition of success, in my belief, is that all branches of anthropological study and research should be concentrated within a single school. For it is conceivable that a university may seek to satisfy its conscience in regard to the teaching of anthropology by trusting to the scattered efforts of a number of faculties and institutions, each of which is designed in the first instance to fulfil some other purpose Thus tor physical anthropology a would-be student must resort to the medical school, for social anthropology to the faculty of arts, for linguistics to the department of philology, for prehistorics to the archæological museum, and so on. Such a policy, to my mind, is a downright insult to our science. Is the anthropologist no better than a tramp that he should be expected to hang about academic back-doors in search of broken victuals? Fed on a farrago of heterogeneous by-products, how can the student ever be taught to envisage his subject as a whole? How, for instance, is he ever to acquire the comprehensive outlook of the competent field-worker? Such a makeshift arrangement can at the most but produce certain specialists of the narrower sort. In "The Hunting of the Snark" they engaged a baker who could only bake bride-cake. Anthropological expeditions have, perhaps, been entrusted before now to experts of this type; but they have not proved an entire success. I am not ashamed to declare that the anthropologist, be he field-worker or study-worker—and, ideally, he should be both in one—must be something of a Jack-of-all-trades. This statement, of course, needs qualification, inasmuch as I would have him know everything about something, as well as something about everything. But the pure specialist, however useful he may be to society in his own way, is not as a rule a man of wide sympathies; whereas the student of mankind in the concrete must bring to his task, before all else, an intelligence steeped in sympathy and imagination. His soul, in fact, must be as many-sided as that complex soul-life of humanity which it is his ultimate business to understand. . . .

It has sometimes been objected that, however much we strive by means of organisation to invest anthropology with an external semblance of unity, the subject is essentially wanting in any sort of inner cohesion. Nor does such criticism come merely from the ignorant outsider; for I remember how, when the programme for our diploma course at Oxford was first announced to the world, Father Schmidt found fault with it in the columns of *Anthropos* on the ground that it was not the part of one and the same man to combine the diverse special studies to which we had assigned a common anthropological bearing. In the face of such strictures, however—and they were likewise levelled at us from quarters nearer home—we persisted in our design of training anthropologists who should be what I may call "all-round men." Let them, we thought, by all means devote themselves later on to whatever branch of the subject might attract them most; but let them in the first instance learn as students of human life to "see it steadily and see it whole." Since this resolve was taken, a considerable number of students has passed through our hands, and we are convinced that the composite curriculum provided in our diploma course works perfectly in practice, and, in fact, well-nigh amounts to a liberal education in itself. It is true that it cuts across certain established lines of demarcation, such as, notably, the traditional frontier that divides the faculty of arts from the faculty of natural science. But what of that? Indeed, at the present moment, when the popular demand is for more science in education—and I am personally convinced that there is sound reason behind it—I am inclined to claim for our system of combined anthropological studies that it affords a crucial instance of the way in which natural science and the humanities, the interest in material things and the interest in the great civilising ideas, can be imparted conjointly, and with a due appreciation of their mutual relations.

Now, there is tolerable agreement, to judge from the university syllabuses which I have been able to examine, as to the main constituents of a full course of anthropological studies. In the first place, physical anthropology must form part of such a training. I need not here go into the nature of the topics comprised under this head, the more so as I am no authority on this side of the subject. Suffice it to say that this kind of work involves the constant use of a well-equipped anatomical laboratory, with occasional excursions into the psychological laboratory which every university ought likewise to possess. It is notably this branch of anthropology which some would hand over entirely to the specialist, allowing him no part or lot in the complementary subjects of which I am about to speak. I can only say, with a due sense, I trust, of the want of expert knowledge on my part, that the results of the purely somatological study of man, at any rate apart from what has been done in the way of human palæontology, have so far proved rather disappointing; and I would venture to suggest that the reason for this comparative sterility may lie not so much in the intrinsic difficulties of the subject as in a want of constructive imagination, such as must at once be stimulated by a fuller grasp of the possibilities of anthropological science as a whole.

In the next place, cultural, as distinct from physical, anthropology must be represented in our ideal course by at least two distinct departments. The first of these, the department of prehistoric archæology and technology, involves the use of a museum capable of illustrating the material culture of mankind in all its rich variety. Here instruction will necessarily take the form of demonstration-lectures held in the presence of the objects themselves. To a limited extent it should even be possible to enable the student to acquire practical experience of the more elementary technological processes, as, for instance, flint-knapping, fire-making, weaving, the manufacture of pottery, and so on. May I repeat that, to serve such educational purposes, a special kind of museum organisation is required? Moreover, it will be necessary to include in the museum staff such persons as have had a comprehensive training in anthropology, and are consequently competent to teach in a broad and humanising way.

The other department of cultural anthropology is one that embraces a considerable complex of studies. At Oxford we term this branch of the subject social anthropology, and I do not think that there is much amiss with such a title. Among the chief topics that it comprises are kinship- and marriage-organisation, religion, government, law, and morals. Further, economic and æsthetic developments have to be examined in their reference to the social life, as apart from their bearing on technology. In one aspect all these subjects lend themselves to a sociological method of treatment; and, though no one is more concerned than myself to insist on the paramount importance of psychology in the equipment of the perfect anthropologist, I would concede that the sociological aspect ought so far as possible to be considered first, as lending itself more readily to direct observation. To reveal the inner workings of the social movement, however, nothing short of psychological insight will suffice. Indeed, all, I hope, will agree that the anthropologist ought to be so trained as to be able to fulfil the functions of sociologist and psychologist at once and together.

It remains to add that no training in social anthropology can be regarded as complete that does not include the study of the development of language. On the theoretical side of his work the student should acquire a general acquaintance with the principles of comparative philology, and, in particular, should pay attention to the relations between speech and thought. On the practical side he should be instructed in phonetics as a preparation for linguistic researches in the field. But detailed instruction in particular languages, more especially if these are not embodied in a literature, is scarcely the business of a school of anthropology such as every university may aspire to possess. . . .

So much, then, for the multiplicity which an anthropological curriculum must involve if it consist, as has been suggested, of physical anthropology, technology with prehistoric archæology, and social anthropology with linguistics. And now what of its unity? How best can these diverse studies be directed to a common end? I would submit that there are two ways in which the student may most readily be made to realise the scope of anthropology as a whole, the one way having reference to theory and the other to practice.

The theoretical way of making it plain that the special studies among which the student divides his time can, and must, serve a single scientific purpose is to make his work culminate in the determination of problems concerning the movement of peoples and the diffusion of culture—in a word, of ethnological problems (if, as is most convenient, the term "ethnology" be taken to signify the theory of the development of the various ethnic groups or "peoples" of the world). A great impetus was given to the investigation of such matters by Dr. Rivers in a now famous presidential address to this section, followed up, as it was shortly afterwards, by a monumental work on the ethnology of the Pacific region. But it would be quite a mistake to suppose that anthropologists were not previously alive to the importance of the ethnological point of view as a unifying interest in anthropological theory. So far back as 1891, when the second Folklore Congress met in London, under the presidency of the late Andrew Lang, the burning question was how far a theory of diffusion and how far a theory of independent origins would take us in the explanation of the facts with which the science of folklore is more particularly concerned. It is true that there has been in the past a tendency to describe the theory of independent origins as the "anthropological" argument; but such a misnomer is much to be regretted. Anthropology stands not for this line of explanation, or for that, but for the truth, by whatever way it is reached; and ethnology, in the sense that I have given to the term, is so far from constituting the antithesis of anthropology that it is rather, as I have tried to show, its final outcome and consummation. Recognising this, the Oxford School of Anthropology from the first insisted that candidates for the diploma should face an examination paper in ethnology, in which they must bring the various kinds of evidence derived from physical type, from arts, from customs, and from language to bear at once on the problem how the various ethnic individualities have been formed. The result, I think, has been that our students have all along recognised, even when most deeply immersed in one or other of their special studies, a centripetal tendency, an orientation towards a common scientific purpose, that has saved them from one-sidedness, and kept them loyal to the interests of anthropology as a whole. Let me add that, as our anthropological course ends in ethnology, so it begins in ethnography, by which I mean the descriptive account of the various peoples considered mainly in their relation to their geographical environment. Thus, from the beginning to the end of his work, the student of anthropology is reminded that he is trying to deal with the varieties of human life in the concrete. He must first make acquaintance with the peoples of the world in their unanalysed diversity, must next proceed to the separate consideration of the universal constituent aspects of their life, and then, finally, must return to a concrete study of these peoples in order to explain, as well as he can, from every abstract point of view at once how they have come to be what they are. If this theoretical path be pursued, I have little fear lest anthropology appear to the man who has really given his mind to it a thing of rags and tatters.

The second way in which the unity of anthropology may be made manifest is, as I have said, practical. The ideal university course in anthropology should aim directly and even primarily at producing the field-worker. I cannot go here into the question whether better work is done in the field by large expeditions or by small. For educational purposes, however, I would have every student imagine that he is about to proceed on an anthropological expedition by himself. Every part of his work will gain in actuality if he thinks of it as something likely to be of practical service hereafter; and, to judge from my own experience as a teacher, the presence in a class of even a few ardent spirits who are about to enter the field, or, better still, have already had field-experience and are equipping themselves for further efforts, proves infinitely inspiring alike to the class and to the teacher himself. Once the future campaigner realises that he must prepare himself so as to be able to collect and interpret any kind of evidence of anthropological value that he comes across, he is bound to acquire in a practical way, and, as it were, instinctively, a comprehensive grasp of the subject, such as cannot fail to reinforce the demand for correlation and unification that comes from the side of theory. . . .

The conclusion, then, of the whole matter is that, for practical and scientific reasons alike, our universities must endow schools of anthropology on a liberal scale, providing funds not only for the needs of teaching, but likewise for the needs of research. Money may be hard to get, but nevertheless it can be got. We must not hesitate, as organisers of education, to cultivate the predatory instincts. For the rest, it is simply a question of rousing public opinion in respect to a matter of truly national importance. If anything that I have said to-day can help in any way to improve the position of anthropology among university studies, I shall be satisfied that, trite as my subject may have seemed to be, I have not misused the great opportunity afforded to every holder of my present office.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LIVERPOOL.—Mr. C. Sydney Jones has given the University the sum of 800*l.* for the endowment of the chair of classical archæology, in memory of his father, the late Mr. C. W. Jones, who was one of the founders of the chair in 1906.

LONDON.—The several faculties have elected their respective deans for the period 1916–18; among these are:—*Medicine*, Sir Bertrand E. Dawson, London Hospital Medical College; *Science*, Prof. Herbert Jackson, King's College; *Engineering*, Dr. H. C. H. Carpenter, Imperial College of Science and Technology; *Economics*, the Hon. W. Pember Reeves, London School of Economics.

OXFORD.—Much interest has been aroused in Oxford by the debate in the House of Commons on the second reading of the Rhodes Estate Bill. The Bill proposes to establish twelve scholarships of 300*l.* a year each in lieu of the fifteen scholarships of 250*l.* tenable by German students nominated by the Kaiser. The scheme in its present form contemplates the distribution of the twelve new scholarships among colonists of the British Empire, but it is felt in some quarters that it might be advantageous, and not out of accordance with Mr. Rhodes's intention, to extend the benefit to a wider sphere. The adoption of Lord H. Cecil's proposal to give the committee power to grant discretion to the trustees to make the substituted scholarships available for students whether within or without the British Empire has accordingly been received by many with approval. It remains to be seen what form the Bill will ultimately take in its passage through Parliament.

SIR DOUGLAS HAIG, Commander-in-Chief of the British Forces in France, has been elected rector of St. Andrews University, in succession to Lord Aberdeen.

ACCORDING to the *Nieuwe Courant*, the number of women students in the German universities during the last summer semester was 5460, or double the number of 1911. The women now represent 10·5 per cent. of matriculated students, as against 4·8 per cent. in 1911. Of the students actually present in the universities (*i.e.* outside the Army), the women now form one-third. The number of women medical students is now 1394, as against 582 in 1911. In this way the losses caused by the war will to some extent be repaired, for the first 600 German casualty lists contain 1500 names of medical men.

THE Institution scholarship of the North-East Coast Institution of Engineers and Shipbuilders for the present year has been awarded to E. V. Telfer. The council of the institution, believing that the time has arrived for making the subjects of the scholarship examination of the institution more comprehensive than hitherto, has decided that the syllabus of future examinations shall be:—(1) English; (2) English history and geography; (3) Latin, Greek, French, or German (one of the four); (4) extra mathematics; (5) and (6) either experimental science and mechanics, or any two of the following:—Chemistry, physics, mechanics.

A COMMITTEE was appointed at the Newcastle meeting of the British Association to report upon the method and substance of science teaching in secondary schools, with particular reference to the place of such instruction in general education. The following resolution was adopted by the committee at a meeting held on October 18:—"That in order to secure freedom of action for teachers of science in schools, and to prevent the instruction from becoming stereotyped, it is undesirable for any external authority to prescribe a detailed syllabus in science for use in schools, whether intended as the basis of examinations or otherwise."

IN his recent presidential address to the Institution of Automobile Engineers Mr. L. A. Legros dealt, among other topics, with the part science might with advantage take in the education of our governing classes. He spoke of the deplorable ignorance of technical and scientific matters among those on whom the responsibilities for running the war have fallen. Never, he said, in the history of engineering has the ignorance of science by the politicians, the military, and the other authorities been so openly displayed as in the early stages of the war, and never has it proved so costly in time, in life, and in substance. The views of teachers brought up on classical lines are, he maintained, devoid of that perspective which would enable them to realise that for the majority of their pupils the dead languages are useless except as a discipline or gymnastic which can be provided as efficiently in the course of work which is really useful to them. A knowledge of the classics is undoubtedly of value to men of the clerical, legal, literary, and even of the medical professions, but, Mr. Legros urged, how much greater would have been the value, in this war, of that small section which deals with politics had it been as well grounded in the sciences as in the dead languages?

MR. M. S. PEASE has sent us from Ruhleben a copy of the prospectus of work for the autumn term at the Ruhleben Camp School. It would be difficult to provide more convincing proof of the hope for the future which inspires our countrymen at Ruhleben and of the courage and initiative of these prisoners there than the arrangements they have made for study and self-improvement. The camp school is in charge of a businesslike general committee, which has discovered in the camp teachers of nearly every conceivable subject, means for arranging and equipping laboratories for practical work, for starting a good library, and for holding examinations in connection with the home examining authorities. The prospectus is able to print the proud boast that "in most subjects the tuition provided by the school ranges from that required by absolute beginners to that required by advanced university students." We can refer here only to some of the numerous departments, and mention may be made of those for biological sciences, mathematics and physics, chemistry, engineering, and nautical subjects. In zoology, for example, courses are being given in vertebrate embryology, and in the study of the Echinodermata; in botany the Gymnospermæ are being studied, with laboratory work; all branches of pure mathematics, including, for instance, infinitesimal calculus and differential equations, are being taught; lectures and laboratory work are available in all branches of chemistry; and every branch of engineering is catered for. No saner way of relieving the awful tedium of prison camp life could be found than the classes and circles for study which have been provided by the Ruhleben Camp Committee.

IN Scotland for some time it has been possible for young men to obtain engineering training by attending during the winter classes in the universities, and by getting works experience in the summer. This plan suits Scotland, where the university session is condensed and there is a long interval between the closing of the university and its reopening. In England the university session is distributed more evenly throughout the year, and Dr. Wertheimer, the dean of the faculty of engineering of the University of Bristol, has, therefore, proposed a modified "sandwich" system of training. A student on leaving school will enter the university and will spend a session there, passing the intermediate examination for the B.Sc. degree in engineering at the end; if his record is good, and he is a promising student, he will be recommended to a firm which will allow him to enter its works for a period of fourteen months. This will enable the student to judge to what extent he is fitted for an engineering career, and will also enable the manufacturers to form an impression as to his suitability. He will then return to the university and continue his studies for a further period of two years, in some cases spending the long vacation in the works; after that he will return to the same works, if he has given satisfaction, for another period of fourteen months. A number of firms have already agreed to take part in the experiment, so that a satisfactory trial is assured. The "sandwich" scheme, besides providing an improved method of engineering training, will also, it is hoped, bring the important firms which are taking part in it into closer touch with the University, and thus lead to more co-operation in research and other matters.

SOCIETIES AND ACADEMIES.

MANCHESTER.

Literary and Philosophical Society, October 3.—Prof. S. J. Hickson, president, in the chair.—Prof. F. E. **Weiss**, Sir E. **Rutherford**, W. **Thomson**, and Dr. G. **Hickling**: The discussions at the Newcastle meeting of the British Association.

October 17.—Prof. S. J. Hickson, president, in the chair.—Prof. W. H. **Lang**: *Rhynia Gwynne-Vaughani*, Kidston and Lang, a new type of vascular cryptogam from the Old Red Sandstone of Rhynie, Aberdeenshire. The chert in which the plant occurs was discovered by Dr. Mackie, of Elgin, and the plant remains are being studied by Dr. R. Kidston and Prof. W. H. Lang, the results being published by the Royal Society of Edinburgh. Photographic slides showed the underground rhizomes attached to the peaty soil by rhizoids, the branched cylindrical aerial stems, which were leafless, and the large cylindrical sporangia. The internal structure is well preserved, so that our knowledge of this ancient land plant is pretty complete. Rhynia differs so much from other vascular cryptogams that a new class, the Psilophytales, has been founded to contain it.

PARIS.

Academy of Sciences, October 9.—M. Camille Jordan in the chair.—P. **Puiseux**: The physical libration of the moon, studied on forty photographs obtained at the Paris Observatory between the years 1894 and 1909. The method of measurement and calculation employed is fully described, and the conclusion is drawn that the theory of the movement of the moon round its centre of gravity, established by considering the satellite as an indeformable body, does not correspond with the facts.—D. **Eydoux**: The transmission of strokes of a hydraulic ram in pipes with bifurcations.—F. **Houssay**: The sound of distant cannonades. The complexity of the question. A description of observations made at Sceaux. Heavy cannonades can be heard at distances at which single cannon-shots cannot be detected; there would appear to be a summation effect. —M. **de Broglie**: On a system of absorption bands corresponding to the L-rays of X-ray spectra of the elements, and on the importance of the phenomena of selective absorption in radiography. Commenting on a recent communication by M. Böll and L. Mallet, the author agrees that the radiations emitted by a Coolidge tube are as heterogeneous as those given by other bulbs, and give a relatively complex spectrum. Filtration through a non-selective screen, such as aluminium, may be made to give a roughly monochromatic beam. From a discussion of the action on a silver bromide emulsion, it is shown that a practically monochromatic radiation can be obtained by interposing a selective screen containing a substance (cadmium, antimony) with an atomic weight slightly higher than that of silver.—P. **Nicolardot**: The action of reagents upon French, Bohemian, and German glassware. Glassware for chemical purposes is now made by several firms in France. Some of these glasses have been submitted to the attack of various chemical reagents (water, solutions of hydrochloric acid, ammonia, ammonium chloride, sodium carbonate), comparative tests being carried out under the same conditions with Jena glass, two Bohemian and two Thuringian glasses. The French glasses proved to be equal to the best German glasses. Comparative tests were also carried out on the resistance of the glasses to sudden changes of temperature and to the action of water at temperatures up to 160° C. Complete analyses of the French, Jena, and Bohemian glasses used are given.—A. **Pictet**, L. **Ramseyer**, and O. **Kaiser**: Some hydrocarbons contained in coal. A soft Sarre coal was extracted on the large scale (five and a half tons) with benzene. From the extraction product (0·25 per cent. of the coal) seven unsaturated and seven saturated hydrocarbons were isolated. These have been compared with the hydrocarbons obtained by the distillation of coal at 450° C. in a vacuum, and it is shown that a part, at least, of the hydrocarbons of the vacuum tar exist as such in the coal. The extracted material proved to be optically active, although no fraction from the vacuum tar possessed this property. Hence it would appear that a temperature of 450° is sufficient to racemise the volatile active substances contained in coal. This furnishes a proof that the materials from which the coal has been formed have never been carried to that temperature.—R. **Masse** and H. **Leroux**: The estimation of phenol in crude tar phenols. The process suggested consists of a preliminary fractional distillation, followed by a determination of the melting point.—J. **Bougault**: The semicarbazones of α-ketonic acids. The α-iodocinnamic acids.—G. **Barthelat**: The structure of the floral pedicel of Mesembryanthemum. —M. **Mirande**: The cytological formation of anthocyanin in the living plant.—M. **Molliard**: The disengagement of oxygen arising from the reduction of nitrates by green plants.—Em. **Bourquelot**: Remarks on the rotatory powers of the α- and β-alcohol-*d*-glucosides and alcohol-*d*-galactosides.—J. **Legendre**: The destruction of mosquitoes by fish. It has been proved that the Chinese carp (*Carassius auratus*) flourishes when introduced into the rice plantations of Madagascar, devouring the larvæ of the mosquito in large numbers, thus helping to reduce malaria.—A. **Lumière**: The presence of the tetanus bacillus at the surface of projectiles buried in cicatrised wounds.

BOOKS RECEIVED.

Dyeing in Germany and America, with Notes on Colour Production. By S. H. Higgins. Second edition. Pp. viii+143. (Manchester: University Press; London: Longmans and Co.) 5s. net.

Philips' Planisphere showing the Principal Stars Visible for Every Hour in the Year. (London: G. Philip and Son, Ltd.) 1s. 6d. net.

A Text-Book of Quantitative Chemical Analysis. By Drs. A. C. Cumming and S. A. Kay. Second edition. Pp. xv+402. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd.) 9s. net.

The Camera as Historian. By H. D. Gower, L. S. Jast, and W. W. Topley. Pp. xv+259. (London: Sampson Low and Co., Ltd.) 6s. net.

The Biology of Tumours. By Dr. C. M. Moullin. Pp. 55. (London: H. K. Lewis and Co., Ltd.) 2s. 6d. net.

Insect Enemies. By C. A. Ealand. Pp. 223+plates. (London: Grant Richards, Ltd.) 6s. net.

Memoirs of the Geological Survey. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for 1915. (London: H.M.S.O.; E. Stanford, Ltd.) 1s.

Dynamics. By R. C. Fawdry. Part i. Pp. viii+177+ix. (London: G. Bell and Sons, Ltd.) 3s.

Chronicles of Man. By Dr. C. F. Coxwell. Pp. xiv+654. (London: Watts and Co.) 6s. net.

Elements of Military Education. By W. A. Brockington. Pp. xvi+363. (London: Longmans and Co.) 4s. 6d. net.

Crowley's Hygiene of School Life. New edition. By Dr. C. W. Hutt. Pp. xv+428. (London: Methuen and Co., Ltd.) 3s. 6d. net.

A Hausa Botanical Vocabulary. By J. M. Dalziel. Pp. 119. (London: T. Fisher Unwin, Ltd.) 6s. 6d. net.

The World's Wonder Stories for Boys and Girls. By A. G. Whyte. Pp. xiv+272. (London: Watts and Co.) 6s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 2.

ROYAL SOCIETY, at 4.30.—Waves in an Elastic Plate: Prof. H. Lamb.—(1) Multiple Integrals; (2) The Order of Magnitude of the Coefficients of a Fourier Series: Prof. W. H. Young.—A Determination of the Heat of Vaporisation of Water at 100° C. and 1 Atmosphere Pressure in Terms of the Mean Calorie: T. C. Sutton.—The Mechanical Relations of the Energy of Magnetisation: G. H. Livens.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—Address of Retiring President: The Fourier Harmonic Analysis; its Practical Scope and its Limitations: Sir Joseph Larmor.—Multiple Integration by Parts and the Second Theorem of the Mean: Prof. W. H. Young.—Moving Axes and their Uses in the Differential Geometry of Euclidean Space: E. H. Neville.—Areas and Conformal Representation: I. Hodginson.

CHEMICAL SOCIETY, at 8.—Overvoltage Tables. Part IV. The Theories of Overvoltage and Passivity: E. Newbery.—Studies of the Carbonates. Part II. Hydrolysis of Sodium Carbonate and Bicarbonate, and the Ionisation Constants of Carbonic Acid: C. A. Seyler and P. V. Lloyd.—The Synthesis of Hydroxyquercetin: M. Nierenstein.—(1) The Reaction between Methyl Iodide and some Metallic Cyanides; (2) Some Reactions produced by Mercuric Iodide: E. G. J. Hartley.—The Dual Theory of Acid Catalysis. A Comparison of the Activities of Certain Strong Acids: H. M. Dawson and T. W. Crann.

EUGENICS EDUCATION SOCIETY, at 5.15.—Mental Differences in Children: C. Burt.

FRIDAY, NOVEMBER 3.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Thomas Hawksley Lecture: The Gas Engineer of the Last Century: H. E. Jones.

SATURDAY, NOVEMBER 4.

GEOLOGISTS' ASSOCIATION, at 3.—Followed by Annual Conversazione.

MONDAY, NOVEMBER 6.

SOCIETY OF ENGINEERS, at 5.30.—Heating and Ventilating Private Dwelling-Houses: C. T. A. Hanssen.

ARISTOTELIAN SOCIETY, at 8.—Presidential Address: The Problem of Recognition: Dr. H. Wildon Carr.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Great Passes of the Western and Central Alps: The President.

TUESDAY, NOVEMBER 7.

ZOOLOGICAL SOCIETY, at 5.30.—Two New Species of Cestodes belonging respectively to the Genera Linstowia and Cotugnia: Dr. F. E. Beddard.—Notes on the Development of the Starfishes *Asterias glacialis*, O.F.M., *Cribrella oculata* (Linck). Forbes, *Solaster endeca* (Retzius), Forbes, *Stichaster roseus* (O.F.M.), Sars: Dr. J. F. Gemmill.—Studies on the Anoplura and Mallophaga, being a Report upon a Collection from the Mammals and Birds in the Society's Gardens. II.: B. F. Cummings.—Notes on a Collection of Heterocera made by Mr. W. Feather in British East Africa, 1911–13: Lt.-Col. J. M. Fawcett.—The Structure and Function of the Mouth-parts of the Palæmonid Prawns: L. A. Borradaile.—Heude's Collection of Pigs, Sika, Serows, and Gorals in the Sikawei Museum, Shanghai: A. de C. Sowerby.—The Classification of the Tineinæ, a Subfamily of Moths of the Family Pyralidæ: Sir G. F. Hampson.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Address by the President, Sir Maurice Fitzmaurice, and Presentation of Medals awarded by the Council.

MINERALOGICAL SOCIETY, at 5.30.—Humite: Prof. W. J. Lewis.—(1) The Combination of Twin Operations; (2) Modification of the Kohlrausch Method of Determining Refractive Indices: Dr. J. W. Evans.—The Basalts of Hare Island, West Greenland: A. Holmes.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address; Capt. C. Thurstan Holland.

WEDNESDAY, NOVEMBER 8.

FARADAY SOCIETY, at 5.30–7 and 8.30–10.30.—General Discussion on Refractory Materials.—Introductory Address: Sir R. Hadfield.—The Texture of Refractories: Dr. J. W. Mellor.—The Application of Petrographic Methods to the Study of Refractory Materials: Prof. W. G. Fearnsides.—Silica as a Refractory Material: Cosmo Jones.—The Transmission of Heat through Materials Employed in Furnace Construction: Ezer Griffiths.

GEOLOGICAL SOCIETY, at 5.30.

THURSDAY, NOVEMBER 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Methods of Raising a Low Arterial Pressure: Prof. W. M. Bayliss.—Selective Permeability; the Absorption of Phenol and other Solutions by the Seeds of *Hordeum vulgare*: A. J. Brown and F. Tinker.—The Toxic Action of Dilute Pure Sodium Chloride Solutions on the Meningococcus: C. Shearer.—The *Rôle* of the Phagocyte in Cerebro-spinal Meningitis: C. Shearer and H. W. Crowe.—Investigation dealing with the Phenomena of "Clot" Formations. IV. The Diphasic Erosive Action of Salts on the Cholate Gel: S. B. Schryver and Mary Hewlett.—Some Photochemical Experiments with Pure Chlorophyll and their Bearing on Theories of Carbon Assimilation: Ingvar Jorgensen and F. Kidd.

OPTICAL SOCIETY, at 8.—Some Notes on Glass Grinding and Polishing: J. W. French.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Natural Divisions of England: C. B. Fawcett.

FRIDAY, NOVEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 7.—Has Lymnæa an Auriculoid Ancestry? C. Hedley.—(1) *Anodonta cygnaea*, L., and *A. anatina*, L.; (2) *Pseudanodonta rothomagensis*, Locard: H. H. Bloomer and H. Overton.—Sexual Characters in the Shell and Radula of *Cyclostoma elegans*: Prof. A. E. Boycott.

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CHEMICAL SOCIETY RESEARCH FUND.

A meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the ASSISTANT SECRETARY, Chemical Society, Burlington House, W., must be received on, or before, Friday, December 8, 1916.

All persons who received grants in December, 1915, or in December of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be returned by Friday, December 1.

The Council wish to draw attention to the fact that the income arising from the donation of the Worshipful Company of Goldsmiths is to be more or less especially devoted to the encouragement of research in inorganic and metallurgical chemistry. Furthermore, that the income due to the sum accruing from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the coal-tar and allied industries.

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THURSDAY, NOVEMBER 9, 1916.

THE EMPIRE AT THE CROSS-ROADS.

Eclipse or Empire? By Dr. H. B. Gray and S. Turner. Pp. x+316. (London: Nisbet and Co., Ltd., 1916.) Price 2s. net.

THIS book will serve the useful purpose of directing popular attention afresh to the important questions of education and scientific research in relation to national prosperity, on which so many eminent scientific men have given emphatic warnings. It is the joint production of a scholar and of a man of business, and although primarily addressed to the man in the street, deserves attention from everyone concerned with education or with commercial manufacture. Its principal aim is to show that Great Britain, which forty years ago was the workshop of the world, is so no longer. It supports this statement by an inquiry into the reason for this decadence and by useful statistics.

The book is divided into three parts. The first is concerned with the development of the main thesis of the book and an analysis of the causes of this falling off in British productiveness, and then with a discussion of the defects of British education in its several stages of primary, secondary, technical, and university rank. The second part of the book deals more particularly with industry in its relation to pure science and to the State, and the third part is a glossary, or detailed examination, of various trades and industries, with the object of supporting the contention that in the last twenty to forty years most of the new ideas, inventions, and developments have been given to the world by other countries than our own.

The second chapter, on "The Englishman at Home," contains a short but searching analysis of our national character, its love of sport and recreation, restiveness under discipline, and dislike of State organisation. The third chapter, on "The Slackening of Momentum," shows by telling figures and statistics how serious has become our competition with better organised or more hard-working nations. Fifty years ago Great Britain produced per annum, according to the authors, nearly 5 million tons of iron and 225,000 tons of steel. Germany produced barely 1 million tons of iron and 100,000 tons of steel. Yet in 1913 German production of both iron and steel had risen to 19 million tons of each, whilst English production had only increased to 10½ million tons of iron and 7½ million tons of steel.

We find the same deficiency in whichever direction we look. British production has increased at a far less rate than that in Germany or in the United States. As regards home-grown wheat it has fallen by 20 per cent. in the last thirty years in England, and increased in Germany by 50 per cent. Only 5 per cent. of the cultivated land of Great Britain is devoted to-day to wheat production. In the last thirty years the cost of raising coal to the pit's mouth has nearly doubled in England, but has slightly decreased in the United States. The value of the annual output per man in ten different trades reveals not a single case in which it is not much greater in the United States than in the United Kingdom.

In the third part of this book these facts and figures are extended, and it is shown how fatal in its results has been the cherished conviction of the manual labourer and trade-unions that restriction of output operates to the benefit of the working classes. The direct opposite is, in fact, the truth, that high wages and high rate of production go together. Tracing, then, the causes of these erroneous ideas in the minds of manual workers, and the neglect of science in its applications by the manufacturer, our authors find it primarily in our defective systems of primary, secondary, and university education. They sketch out in detail the reforms that are required, and with their main suggestions most scientific men will be in sympathy. Science, they say, should be the first wheel of the educational coach and not the fifth. For our primary and public-school education they demand a more rational and useful syllabus, and a reduction in the time spent over the grammar of dead languages. We think, however, that the authors do not lay sufficient stress on the necessity for ethical and civic training. The man in the street regards the Germans, as seen in the light of the present war, as a nation of moral decadents, to whom cold-blooded murder, lies, cruelty, and treaty-breaking are only the natural expression of character. He says, though very illogically, if this be the result of a widely diffused scientific education, then the less we have of it the better. On the other hand he sees that our inefficient systems of education have at any rate produced a nation of young heroes, and he draws the conclusion that they cannot be so bad after all. The point which needs pressing is that the German character is the result, not of an over-cultivation of science, but of a disastrous perversion and deficiency in moral and ethical training. We have nothing to fear from educational programmes which give predominance to science, provided only that they give the right position to character training as well.

The second part of this book deals with the relation of science to industry and to the State. The authors do not, however, sufficiently distinguish between pure and technical research. The former will always be chiefly conducted in the universities and technical colleges, and in public or private research laboratories. The technical research must be conducted by voluntary associations of the trades concerned. The authors have not given sufficient attention to the opinions of those who have practical experience in this side of the subject. What is required from the State is a proper support for the existing institutions. The authors call for State endowed and provided laboratories, but the real difficulty is to find the right men and not the apparatus.

One lamentable result of the war is the loss to the country of many brilliant and promising members of the younger research workers, who cannot be quickly replaced.

The glossary contains a large amount of interesting information. Some sections are contributed by experts, but we think that in many cases British work is unduly depreciated or neglected. In the section on "Telephones" the name of David E. Hughes, the inventor of the microphone, is not even mentioned, nor that of Oliver Heaviside, whose mathematical work led to the invention of the loaded cable.

The section on "Wireless Telegraphy" is very inadequate as a sketch of the subject. The writer seems to think that the coherer is still used as a receiver, whereas it has long since been abandoned. Two out of three of the actually used modern detectors are British inventions. Marconi's work, all carried out in England, is not sufficiently appreciated.

British invention in connection with submarine cable work, almost entirely a British industry, is ignored. The initiative quality of British scientific research is not sufficiently acknowledged. Nevertheless there remains sufficient to justify the main contentions of the book. We have all to turn over a new leaf, to reform educational methods, to work much harder, play much less, and bring the scientific method to bear on everything, or else the eclipse the authors foresee most certainly awaits us in the post-war struggle for commercial empire. J. A. FLEMING.

VINEGAR.

Vinegar: its Manufacture and Examination. By C. Ainsworth Mitchell. Pp. xvi+201. (London: Charles Griffin and Co., Ltd., 1916.) Price 8*s*. 6*d*. net.

THIS book seeks to fill an admitted void in the technology of an important fermentation industry. Works on the subject are to be met with in French and German literature, but their bearing on English procedure is only indirect, since the methods and conditions of acetification in this country are fundamentally different from those prevailing on the Continent.

Strictly speaking, the manufacture of vinegar—that is, the commercial preparation of a dilute acid from wine, capable of being used as a condiment or preservative, is not, and never has been, a British industry, since wine is not one of our native products. A similar, but by no means identical substance, was made in this country, even in very early times, by the souring of beer, and was known as "alegar"—a term practically now obsolete, or only to be met with in certain local glossaries. Formerly a clear distinction was drawn between the Continental and the native commodity. Thus Boorde's "Dyetary" (1542) speaks of "Soure and Tarte Thynges as Venegre and Aleger," and for many years the term vinegar was restricted to the imported variety derived from wine. So little was known in this country concerning the manufacture of this special article that the Royal Society, in one of the early volumes of its Transactions, published "The Way of making Vinegar in France: Communicated to the Publisher by an Ingenious Physician of that Nation, living at a Place where much of it is Made."

With us the manufacture of vinegar—using that term in its generic sense—still bears the impress of how it originated in this country—that is, from beer. Formerly the only useful way of disposing of sour beer, whether in the brewery or the household, was to turn it into vinegar. But as the demand for vinegar increased some more regular supply than "sick" or badly brewed beer was needed, and the manufacture was gradually placed upon a systematic and independent basis. Still this connection between the brewer and the vinegar maker long persisted. The fiscal authorities at least swept them into a common net—the fermented malt-product, no matter whether it was sweet or sour, coming within the purview of the gauger—although "Vinegar-Beer," as a Revenue Act of Charles II. termed the product, was let off with a lighter impost. "Vinegar-yards," as distinguished from the "common brew-houses," seem to have been first established in this country about the middle of the seventeenth century.

In the book under review Mr. Ainsworth Mitchell, who acts as chemist to the well-known firm of Messrs. Beaufoy and Co., one of the oldest and largest vinegar manufacturers in this country, has brought together a body of valuable information concerning the history of vinegar in general, its different varieties, and various modes of production, with special reference to English procedure; and this information he has presented in an interesting and eminently readable form. In his historical retrospect he begins his account at the period when vinegar received a certain amount of scientific attention from the early alchemists, and their immediate followers, the iatro-chemists, who speculated upon its nature and physiological action. It is interesting to note that certain of their crude theories still persist in old wives' fables, and in the practice of quacks. The author touches lightly upon the early theories of acetification, but of course he deals with the suppositions of Liebig and the far sounder views of Pasteur, Nägeli's mechanical theory, and the more modern Enzymic theories. This is followed by a description of the acetic bacteria, their various species, zooglæal condition, and involution forms, and the effect of light and oxygen upon them. These chapters are fully illustrated, showing the morphological changes of the bacteria due to age, and the character of the medium. They do not pretend to be exhaustive, as they are intended rather for the general reader than for the specialist, but so far as it goes the account is sound, and no important point is omitted. The chemical reactions in acetification are next dealt with, including the production of aldehyde, acetal, and the various esters which confer upon the different vinegars their characteristic aroma and other peculiarities. Next follows a description of acetic acid, its chemical and physical properties, and its preparation from verdigris, from spirit vinegar, and from pyroligneous acid, and there is a short reference to a few of the processes which have been described (and patented) for the synthetic production of acetic acid by inorganic methods.

But perhaps the most interesting section of the book to the lay reader is the description of the modern methods of making vinegar from an infusion of malt or malt and grain, as practised in England, and it is here that the author's technical knowledge and experience give his work a special value. The processes are described in detail, and are well illustrated, showing the most approved forms of mash-tuns, mashing machines, sparges, refrigerators, fermenting tuns, acetifiers, sterilisers, etc. The remaining chapters deal with the chemical methods of examining vinegar, and with the characteristics of different vinegars.

The author as a chemist concerned with the manufacture of vinegar has naturally something to say on the relations of that substance to the Food and Drugs Acts, and on what is known as the malt vinegar question. At present both the law and the practice are admittedly in a somewhat chaotic condition. What is held to be legitimate trading in one county renders a dealer liable to a criminal prosecution in another. The Local Government Board has no power to fix legal definitions of food substances, but in response to the appeal of the Association of Vinegar Brewers it has suggested certain definitions. These definitions have not been universally accepted by public analysts, nor, when accepted, have they been regarded as obligatory by certain stipendiaries who are more concerned to dispense law than justice. The consequence is there is a considerable amount of confusion in administration, and malpractices tend to be perpetuated which might readily be put an end to by the exercise of a little common sense on the part of judicial authorities.

INVARIANT THEORY.

A Treatise on the Theory of Invariants. By Prof. O. E. Glenn. Pp. x+245. (London: Ginn and Co., 1915.) Price 10*s.* 6*d.* net.

LIKE many other branches of mathematics, the theory of invariants has gone through stages similar to those of gold-mining. We may reckon Gauss, Lagrange, and Eisenstein among the pioneers; Boole, Cayley, Sylvester, and Salmon found the first big nuggets; and Aronhold's symbolic method may be compared to the rocker which extracted gold-dust from alluvial deposits. Finally, the refractory problem of finding complete systems led Gordan to invent his transvectant formulæ, corresponding to the stamps and cyanide tanks now used in South Africa.

The present book illustrates very well the state of the subject at present. The author gives all the important methods, both for binary and ternary forms, including annihilators of sources, polar theory, Aronhold's symbolic method, and Gordan's series. Complete systems are given for binary forms up to the quintic inclusive, and for certain pairs of forms; tables are also given for two ternary quadratics, and for the ternary cubic. Gordan's theorem is proved with the help of Hilbert's theorem and a lemma by Jordan, which simplifies the analysis. In the ternary theory an account is given of Clebsch's translation (*Uebertragung*) principle; nothing is said, however, about connexes.

The main novelty of the work is the account of modular invariants, the invention of Prof. Dickson. This remarkable theory illustrates once more the striking difference there is between umbral and arithmetical analysis. Fundamental problems, such as finding a complete system, assume an entirely new aspect, and lead to quite different results. Whether this new theory will have wide applications is uncertain; but there is no doubt of its theoretical interest and of the new turn it has given to a somewhat stereotyped part of analysis.

In connection with Gordan's theorem and the use made of Hilbert's theorem we may add a few remarks. To us, at any rate, there is some vagueness both in the statement and the proof of Hilbert's theorem; fortunately, however, so much of it as is wanted for the proof of Gordan's theorem practically amounts to the fact that linear diophantine equations of a certain type must have solutions that form what Dedekind calls a finite modulus. Hilbert's theorem is that any definite set of polynomials forms the whole or part of what Kronecker calls a modulus $(F_1, F_2, \ldots F_m)$, *i.e.* the aggregate of all expressions

$$\sum_1^m G_s F_s$$

where $G_1, G_2, \ldots G_m$ are arbitrary polynomials. The difficulty we feel may be illustrated by taking the case of four homogeneous variables and considering those polynomials which, equated to zero, represent all surfaces of given "deficiency" p; do these all belong to a finite modulus of the Kronecker type? To speak, as Prof. Glenn does, of polynomials as "formed according to any definite laws" is so very indefinite as to make us fear some tacit and illegitimate assumption in the proof. Very likely our difficulty is owing to our stupidity, but there it is; of course there is no great trouble in showing that the theorem does apply in a large number of important cases.

The present work is in many ways similar to that of Messrs. Grace and Young; it is rather more analytical in character, though there are a fair number of articles on geometrical applications and interpretations. We sometimes wish for another Clebsch to appear and give geometrical embodiment to these immaterial formulæ. The trouble is that the simplest analytical concomitants do not, as a rule, correspond to the simplest geometrical derivatives. For instance, a binary quintic has four linear covariants; suppose we represent the quintic by five points on a conic, each of the linear covariants must give a point on the conic derivable by projective construction from the original five; but it is not by any means obvious what these constructions should be. On the other hand, we can easily get covariant sets of points by construction, but it is then troublesome to find their analytical equivalents. The results for the cubic and quartic are so simple and elegant that one would like to have some development, if possible.

It should be noted that Prof. Glenn has given, as an appendix, forty-eight very good and instructive exercises; and we may add that, in spite of its conciseness, the book seems as easy to read as the subject will permit. G. B. M.

THE GROWTH OF TELEPHONY.

The Telephone and Telephone Exchanges: their Invention and Development. By J. E. Kingsbury. Pp. x+558. (London: Longmans, Green and Co., 1915.) Price 12s. 6d. net.

THIS book covers most of the ground relating to telephony from its earliest stages to the present time. It may, indeed, be regarded as a "Short History" of telephony, and, as a matter of fact, the author's original intention was to write a history, but circumstances were not favourable to the project. However, the future historian will find in Mr. Kingsbury's volume much useful historical matter and many finger-posts indicating different avenues of development which merit much fuller treatment than has been possible in this work.

A marked and valuable feature of the book is the numerous extracts from circulars of early telephone companies and from unpublished reports of experts and of telephone conferences, held principally in the United States. Only a person very intimately connected with the industry from its infancy could have obtained this exclusive information and made such judicious selection of material. Telephone engineers interested in the growth and development of their instruments and systems will feel indebted to Mr. Kingsbury for the masterly way in which the subject is dealt with in the work under review. If ever "scissors and paste" can be justified, this is a case in point; for here one gets the views of inventors and pioneers in their own words, "hot from the anvil" as it were, and free from any form of distortion due to narration by a second party. The work is not of the text-book order; persons desiring technical details of the latest instruments and appliances should consult other treatises, but those who wish to study early telephonic devices and the way they developed into present-day models will find in the volume much that they require presented in a very readable form.

The book is conveniently divided into thirty-three chapters and two appendices, one of the latter giving telephone statistics of the world, and the other relating to the increased telephone rates in Great Britain. In the first six chapters—headed, respectively, i., Introductory; ii., The Spoken Word; iii., The Growth of an Idea; iv., The Undulating Current; v., The Solution of the Problem; and vi., Development and Demonstration—the author traces the early uses of the word "telephone" for speaking-trumpets and speaking-tubes, for instruments depending on the transmission of sound through rods of glass, wood, etc., as in the "enchanted lyre," to the electrical transmission and reproduction of musical sounds, and eventually of human speech, by currents of varying strengths.

Subsequent chapters relate how the beautiful scientific instrument patented by Alexander Graham Bell in 1876 was, by the prevision and business acuity of the inventor and his American associates, made the basis of a new branch of electrical industry of enormous benefit to the public, and in a few decades permeated all parts of the civilised world and utilised capital amounting to some 400 millions sterling. The headings of these chapters are as follows:—vii., The Production of a Commercial Instrument; viii., The Application to Commercial Uses; ix., The Telephone Exchange; x., The Battery or Variable Resistance Transmitter; xi., The Microphone; xii., Philipp Reis and his Work; xiii., Call Bells; xiv., The Telephone Switchboard; xv., The Organisation of the Industry in the United States; xvi., Competition, Consolidation, and Development; xvii., Introduction of the Telephone in Europe and Abroad; xviii., Public Apathy and Appreciation; xix., The Multiple Switchboard; xx., Outside or Line Construction; xxi., Ten Years' Progress; xxii., The Development of Dry-core Cable; xxiii., Early Exchange "Systems"; xxiv., Telephone Engineering on a Scientific Basis; xxv., The "Branching" System; xxvi., The Common Battery System; xxvii., Automatic and Semi-Automatic Switchboards; xxviii., Long-Distance Service; xxix., Instruments; xxx., Rates; xxxi., The Economics of the Telephone; xxxii., The Telephone and Governments; xxxiii., Conclusion.

Chap. xii., on Reis's work, should, chronologically, be near the beginning of the book, but it is put later because "its consideration is facilitated by the preceding chapters." On the question of priority the author maintains that Reis invented a musical telephone and not a talking telephone, and that "his work had no direct effect on the invention of the speaking telephone, for Bell fortunately went on entirely independent lines and without any reference to the prior work of Reis." Throughout the book the work of Bell and his colleagues is given especial prominence, sometimes to the detriment of others, such as Reis, Hughes, Gray, and Edison. In fact, the "pro-Bellism" of the author is a feature to which some exception might be taken. In a similar way, when dealing with long-distance service, Pupin's work is highly and deservedly appreciated, whilst that of O. Heaviside (who made the discovery that by increasing the inductance of lines their speaking qualities could be improved) is insufficiently recognised. These, however, are minor blemishes in an exceptionally valuable book. T. MATHER.

OUR BOOKSHELF.

Subtropical Vegetable-Gardening. By P. H. Rolfs. Pp. xviii+309. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1916.) Price 6*s.* 6*d.* net.

THE Rural Science Series, under the able editorship of Prof. L. H. Bailey, enjoys a deserved reputation for the high standard of excellence reached by its constituent volumes, and the one before us is no exception in this respect. Those whose lot is cast in the hotter parts of the world ought to be grateful to Mr. Rolfs for his practical and sensible work on subtropical vegetable growing. The author is the director of the experimental station of Florida. In America the exploitation of the land is looked on as a proposition of chief importance, and much enterprise, brains, and money are devoted to the solution of the multifarious problems that confront the cultivator.

Although Mr. Rolfs's book is designed primarily to meet the needs of the Florida people, it will be found, none the less, of great use in other parts of the tropical and subtropical belts, and the suggestive way in which difficulties of all kinds are indicated and disposed of should render it good reading to the dwellers of temperate zones as well.

The chapter on irrigation is an example to the point, for the water-question is certain to turn up in one form or another in all gardens, wherever they may be situated. The present writer has seen something like the subterranean methods of irrigation there described applied with remarkable results, even in this country. The cultural notes respecting the different vegetables are good, and the hints as to suitable manures, as well as the accounts of the various pests likely to be encountered, will be useful. In fact, the author is able to draw on a wealth of experience and knowledge which is at his disposal as head of an important experimental station, and we have no hesitation in cordially recommending the book to all whom it may concern, and furthermore in congratulating the author on the skill with which he has discharged his part of the matter.

Earliest Man. By F. W. H. Migeod. Pp. xii+133. (London: Kegan Paul, Trench and Co., Ltd., 1916.) Price 3*s.* 6*d.* net.

THESE are the musings and observations of one who has had long experience of life among primitive men and wild animals. While resident in the Gold Coast Colony the author not only devoted himself with well-known success to the study of the native languages, but was also a keen and thoughtful observer of the various tribes and their environment. He is, therefore, well equipped by first-hand knowledge for making suggestions as to the manner in which the earliest men may have gradually acquired the various habits and manifestations of intellect which distinguished them from their ape-like ancestors.

Mr. Migeod assumes that "if a creature of some species low in the scale of evolution can perform certain acts tending to operate on inanimate nature, another creature no lower, such as Pre-man, cannot be denied the possession of the same capacity. Further, if there are natural occurrences which can cause lower species to act out of their usual habits, and evince undoubtedly new mental activities, the same potential capacity must also be allowed in the case of Pre-man." He then discusses in order the possible origin of man's primary instincts, the making of implements, the use of fire, the beginning of speech, and his special social organisation, with the dawn of religion. He concludes with an interesting observation that when an ordinary monkey dies in the forest, the rest of the troop simply leaves the corpse and abandons the place, at least for a time; while when an ape such as a chimpanzee dies, its companions drop the body into a hole in the ground if one can be found, and in any case cover it with a great heap of sticks and branches.

Some of Mr. Migeod's conceptions of the laws and causes of organic evolution will by no means commend themselves to those who are accustomed to approach the subject from a wider point of view, but the novelty of the circumstances in which his little book was written makes it stimulating and interesting. A. S. W.

LETTERS TO THE EDITOR.

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

A Nomenclature for "Resistance Derivatives."

IT is evident from Mr. Bairstow's National Physical Laboratory papers that the notion of "resistance derivatives" is likely to play a permanent part in the experimental study of aeroplane motions, as well as in the theoretical rigid dynamics associated with them. It therefore becomes important to have a uniform nomenclature for these quantities which shall be independent of the choice of axes, and thus free from any possible ambiguity or source of difficulty.

The following names are used by Mr. Bairstow to distinguish the quantities depending on translation and rotation respectively:—

Translational.	*Rotational.*
Longitudinal.	Rolling.
Normal.	Yawing.
Lateral.	Pitching.

Now, it will be found that a possible word of four letters can be made by combining the first two letters of any one of these names with the first two of any other, and such words are not more objectionable than nine-tenths of the names that are introduced to cover new inventions. The nine resistance derivatives for the longitudinal oscillations will then be designated as follows:—

Lolo	Lono	Lopi.
Nolo	Nono	Nopi.
Pilo	Pino	Pipi.

While the names of the lateral derivatives will be:—

Lala	Laro	Laya.
Rola	Roro	Roya.
Yala	Yaro	Yaya.

In the symbolic notations hitherto used the force component is always written first and the component of motion producing it is written after it as a suffix. It is therefore important that the same convention should be followed in the proposed nomenclature. Thus "Lopi" will stand for the X_r of my "Stability in Aviation," while "Pilo" stands for N_u. These words take no longer to write than $\log x$ or $\sin x$, and it would be easy to employ them in writing down formulæ, which would thereby gain much in clearness and suggestiveness.

G. H. BRYAN.

Plastic Flowing of Metals.

REGARDING the interesting research work published from time to time on the plastic flowing of metals under stress, might not these results have a bearing on the action of the fusion of wires by electric currents? For instance, it is well known to electrical engineers that erratic results are obtained by the use of the present formulæ for calculating the so-called "fusing" currents of wires.

At present, so far as the theory of electrical fuse wires is concerned, these theories deal merely with the generation of heat per unit length in the wire, and the loss of heat per unit length of the wire. Now, whatever the gain or loss of heat may be, that in itself is surely merely a cause increasing the plasticity of the wire, and thereby allowing the mechanical stresses acting on the wire to break it. Consequently, it would appear that any theory which omits all reference to the mechanical stresses set up by the heating is necessarily incomplete, and represents only a portion of the process.

At present, owing to lack of experimental data, it is impossible to say whether one can predict the fusing for any metal of given dimensions, but so far the results obtained seem more promising than by the older methods.

W. H. F. MURDOCH.

Westerlea, Mill Hill, Middlesex, November 1.

Optical Deterioration of the Atmosphere and Volcanic Eruptions.

IN NATURE of October 5 it is stated that the cause of the optical deterioration of the atmosphere in July and August "is for the time being still in doubt. Up to the present no reports of volcanic eruptions have come to hand from any part of the globe."

I wish to state that in July a strong outburst occurred of the Stromboli volcano, and that on July 4 there was an extraordinary eruption of fluid and incandescent lava to a great height, followed by a thick rain of lapilli and ashes. The emission of enormous columns of black cloud lasted many days.

A. RICCÒ.

R. Osservatorio di Catania ed Etneo, October 30.

POSITION AND PROMISE OF BRITISH DYESTUFF MANUFACTURE.

THE question is frequently asked: "What is being done to produce British dyes?" Broadly, it may be said, the problem is being dealt with as efficiently as could be expected under present conditions. The difficulties may be roughly classified as follows:—

(1) The raw materials necessary for dyestuff manufacture are also in the main the raw materials from which high explosives are made, as well as other important products of the utmost value in the present war. It is only with great difficulty that the necessary raw materials are released by the Munitions and other Government Departments.

(2) There is an extraordinary shortage of adequately trained chemists. This shortage has been accentuated owing to the great demand for chemists in explosives works, the sending of chemists to the Front to study questions of gas poisons, etc., the recruiting for military service, and the failure of tribunals to appreciate that one clever chemist working at home may discover the means of saving thousands of our men and accounting for the destruction of thousands of the enemy.

(3) The problems to be solved by chemists are not only numerous, but many are exceedingly intricate and complex. The patents taken out by Germans in this country for many years past have been drawn up in an extraordinarily skilful manner by the help of our ablest lawyers, patent agents, and experts, so as to disguise in every conceivable way the method of arriving at the production of the patented article or its manufacture. This has been a scandal that has been allowed to gain force year by year. It is almost incredible that we should have allowed ourselves to be hoodwinked in this way, granting these great privileges to powerful German firms in order to restrain manufacture in this country.

(4) A serious difficulty will have to be faced in settling the question as to how to distribute amongst chemical manufacturers the many problems that await solution. It is most desirable to avoid overlapping of effort in research, etc., or quite unnecessary duplication of plant. Otherwise we shall have, say, one firm trying to solve too many problems and others, quite competent and suitable, making no efforts at all. These questions, it is proposed, shall be dealt with by some central authority, such as the recently formed Association of British Chemical Manufacturers, one of whose objects is to help manufacturers in this and many other desirable ways, *e.g.* to unite their efforts to fight the common foe rather than to compete with one another at home. Had such an association been in existence early in the war, these particular troubles would have been largely avoided, and much valuable time and money saved.

(5) The U.S.A. Government, although relatively a Free Trade one, has lately promised duties of more than 100 per cent. on dyestuffs and chemical products after the war so as to help America to build up what to all intents and purposes is for them, as it is for us, an infant industry. Our Government has so far resolutely refused any definite indication in that direction; and yet, without heavy protective duties, the chemical industry of the finer products, including dyestuffs, cannot possibly be built up and firmly established in this country.

(6) It is now quite clearly recognised that only very large undertakings can afford to carry on the kind of research that is essential for the success of the dyestuffs industry. This is perhaps the chief,

if not the sole, excuse that could be adduced for Government support of a very substantial character to one firm only rather than helping a relatively large number of smaller concerns, which many now believe would have produced more immediately satisfactory results.

(7) In spite of manifold difficulties much has been done by universities and technical institutions of the higher order to help industry. Professors, lecturers, and post-graduate students have vied with each other in endeavours to meet many demands made upon them, and their collaboration with manufacturers has led in many cases to extraordinarily gratifying results. If all the facts could be published it would be a most agreeable surprise to many, who have taken an altogether too gloomy view of the possibilities of this collaboration. Leeds University and the Manchester School of Technology have started new departments for chemical research for special objects, such as the study of problems in connection with the dyestuff industry. Remarkably fine and eminently useful work has been carried out also for the Army and Navy. A great deal more could have been done in that direction but for the aforesaid shortage of well-trained chemists, the relatively small number of whom are at last "coming into their own." Salaries that would have been thought preposterously large a few years ago are now gladly paid. It is to be hoped that this will tend to attract to the profession a large number of suitable and able men as well as women. It may indeed be said that unless this takes place there is not much hope for the establishment and maintenance on an adequate scale of the dyestuffs and allied industries; and not only must those who have to deal with the scientific and practical side of the industry be chemists, but what is equally important, the men who direct the administrative side of the business must also be well-trained chemists of business experience, or good business men with a chemical training. It is facts such as these that are appreciated far less than they deserve to be. But the war is teaching us many things, and as we have perhaps at last realised the importance of the work of the chemist in war-time, so it is just conceivable that the nation may in time come to realise that in peace-time also industrial and material progress is going to depend more than it ever did before on the successful work of the chemist.

A. R.

PRESERVATION OF NATURAL COLOUR IN PLANTS.

So long ago as 1908 Prof. J. W. H. Trail described in the *Kew Bulletin* a method which he had worked out for fixing the green colour in plants. By placing the plant for a shorter or longer period in a boiling solution of copper acetate dissolved in acetic acid, a combination of the copper salt with the chlorophyll was formed which rendered the colour permanent when the specimen was exposed to the light after drying or placed in a preservative solution such as alcohol.

The method deserves to be more widely known than it seems to be among those interested in preparing plant specimens for exhibition in museums or for lecture purposes. It is essentially a method the results from which gain by experience; different plants lend themselves to the treatment with different degrees of success, and require very different periods of treatment; the time for which it is necessary to keep the plant in the boiling solution varies from one minute to forty minutes, according to the action of the copper salt upon the plant. If the action is proceeding satisfactorily, a period of one to five minutes should suffice; the end of the operation is easily judged by the colour or by treating two different specimens for different periods; a specimen that by such comparison appears to require longer treatment can always be reimmersed to get the desired effect. Many plants, notably the leaves of evergreen shrubs, are more difficult and generally less satisfactory in the ultimate colour, probably owing to the presence of mucilaginous or decomposition products or tannins. These require long treatment varying from twenty to forty minutes; after the first immersion they turn yellowish, and then after a time the yellow gradually gives place to green, generally an olive-green. Other plants, notably Aucuba, fail entirely, as they pass from the yellow to a muddy-brown or black colour.

After treatment the plants should be washed (like photographic prints) in running water for about two hours. They are then dried under as light pressure as is compatible with keeping the plants from twisting, or, after shaking off as much water as possible, may be dried in hot sand. In many cases the plants are rendered so flaccid by boiling that sand-drying is difficult or impossible. Plants that have required long boiling not infrequently revert to a bad colour when sand-dried.

Young parts of plants green better than old; better results may be expected from "spring" leaves than from "autumn" leaves.

A stock solution is made by saturating commercial strong acetic acid with powdered copper acetate. For treatment, dilute the stock solution with water in the proportion of three or four parts of water to one of stock solution. The solution is heated in a non-metallic vessel, glass beakers being probably the most suitable, and wooden, not metal, forceps should be used for manipulating the specimens.

This method has been used at the Natural History Museum for some time past in the preparation of plants for exhibition purposes, and good results have been obtained with cryptogams as well as flowering plants; ferns especially give satisfactory results, and, as Prof. Trail has noted, fresh green Algæ can be successfully treated. Proceeding out of these investigations, experiments have been made with the object of preserving the natural colour of seaweeds or of introducing a colour that is natural and permanent. The exhibition of Algæ in the Botanical Gallery, which has been recently rearranged, shows an appreciable success for the red Algæ and some satisfactory results for the brown Algæ. It is proposed to present an account of these experiments shortly before one of the scientific societies.

A. B. RENDLE.

DR. J. O. BACKLUND.

ASTRONOMERS will hear with regret of the death of Dr. Backlund at Pulkova on August 29. He was a native of Sweden, having been born at Langhem, in Wermland, on April 28, 1846. He studied mathematics and astronomy at the University of Upsala, and in 1873 went to Stockholm Observatory as assistant to Prof. Gylden, whose new methods of perturbations he studied with enthusiasm. After a brief return to Upsala in 1875, he left Sweden for Russia, where he remained permanently. He was at Dorpat Observatory for three years, and in 1879 went to Pulkova as assistant to Dr. Otto Struve. On Prof. Bredichin's death in 1895 he was appointed director of the Observatory, retaining this post until his death.

Dr. Backlund is best known for his immense researches on the motion of Encke's comet, for which he received the gold medal of the Royal Astronomical Society in 1909. Encke had detected the acceleration in the comet's mean motion, which he ascribed to the action of a resisting medium. After his death in 1865 von Asten took up the research, adopting some of Gylden's methods. He was unable to represent the comet's motion by any constant value of the acceleration, and died at Pulkova in 1878 without solving the problem completely. Backlund took up the matter, receiving grants from M. E. Nobel and the Petrograd Academy of Sciences for assistance in computing the perturbations, which were redetermined from 1819 to 1891, and afterwards to 1911.

Backlund found clear evidence that sudden changes in the amount of acceleration took place in the years 1858, 1868, and 1895. He later found evidence of a fourth change about 1905; after this the acceleration had only one quarter of its value before 1858. He also studied the changes in brightness of the comet (it is generally brighter before than after perihelion), and made the tentative suggestion that its particles are flat and oriented parallel to a particular plane, so that when seen edgewise they reflect little light.

A valuable by-product was the determination of the mass of Mercury, the value being 1/9,700,000 of the sun. This mass cannot be found except by comets, for even Venus is not appreciably perturbed by Mercury. Several approaches of the comet to Mercury yielded accordant results.

Dr. Backlund showed great energy in administration; he found that the climate of Pulkova was unsuited for delicate astrophysical researches, and succeeded in establishing branch observatories at Odessa, and Feodosia, in the Crimea. He took part in the Russo-Swedish determination of an arc of the meridian, visiting Spitsbergen for this purpose. A valuable new method of determining the flexure of transit-circles was introduced at Pulkova under his auspices. In conjunction with Dr. Hough he formed a list of stars to be used as fundamentals in astrographical reductions, and arranged that the "Star Corrections" for several hundreds of them should be printed at Pulkova.

The British observers who visited Russia for the eclipse of August, 1914, remember with gratitude his kind help in the difficulties which arose from the outbreak of war.

NOTES.

WE notice with much regret the announcement, in the *Times* of November 6, that Prof. H. H. W. Pearson, Harry Bolus professor of botany, South African College, Cape Town, died on November 3, at Mount Royal Hospital, Wynberg, at forty-six years of age.

THE many friends of Major T. Edgeworth David, professor of geology in the University of Sydney, will be delighted to learn that he has recovered from the effects of serious injuries received while conducting mining operations in northern France, and hopes shortly to rejoin his regiment.

IN answer to a question by Mr. Montague Barlow in the House of Commons on October 26, suggesting the adoption of the metric system of weights and measures, the Prime Minister stated that he was aware that the proposal to adopt the metric system had a certain measure of support, but that it was difficult to say how far this was general. He understood that the attention of Lord Balfour of Burleigh's committee had already been directed to the subject. This reply will probably not be regarded as encouraging by those who are of opinion that the immediate obligatory adoption of the metric system is urgently necessary in order that we may be fully prepared, when the war is over, to cope with competition in foreign trade. Though the metric system has been legal for all purposes of internal and export trade for nearly twenty years, very little advantage has so far been taken of it by the trading community generally; while the large body of retailers are still completely ignorant of the nomenclature and equivalents of the system.

EMERITUS PROFESSOR JOHN FERGUSON, who last year resigned the Regius chair of chemistry in the University of Glasgow, died, after a very brief illness, on November 3. Prof. Ferguson was in his eightieth year, and had held the chair since 1874. His connection with the University had been continuous, as student, assistant, and member of the Senate, for well over sixty years. Among his pupils or assistants were Prof. J. M. Thomson, Sir William Ramsay, Sir J. J. Dobbie, Prof. G. Henderson, Prof. W. Lang, Prof. Carrick Anderson, Prof. M. A Parker, Dr. A. W. Stewart, and other distinguished chemists. He had made many contributions to the history of chemistry, to bibliography, and to archæology, the most notable being his "Bibliotheca Chemica," published in two quarto volumes in 1906. He was an LL.D. of St. Andrews, and an honorary member of many British and foreign learned societies, including the Imperial Military Academy of Medicine, Petrograd, and the Société Française d'Archéologie. Last year, on his retirement from the chair, he was appointed honorary curator of the books and MSS. in the Hunterian Library, on the catalogue of which he was engaged at the time of his death. On many occasions he was sent to represent the university at centenary and other academic celebrations at home and on the Continent. His fine presence and courtly manner made him an acceptable delegate on such occasions. He had accumulated a vast collection of medieval books and manuscripts dealing with alchemy, natural magic, "secrets," and "origins." It is to be hoped that the collection will be kept together for the benefit of students of scientific history.

The leading article in *Engineering* for November 3 is devoted to a discussion on the status of the engineer. The divorce of the engineer from public affairs, and the minor place he occupies in popular estimation, are causing disquietude on the other side of the Atlantic, where a case has occurred recently of a lawyer having been appointed to the post of county engineer because it was held that the post must be filled by a politician. The actual engineering work has therefore to be done by deputy. This is characteristic of our own national services, where it has been common to appoint clerks as heads of departments, even when these are concerned with highly technical matters. The official view is that expert knowledge is unnecessary in such cases, as trained assistants can be secured to do the work, whilst the nominal chief signs the inevitable forms. As Lord Sydenham puts it, the results of such a system are that the man who knows all about some subject has to refer to, and be overruled by, someone who knows nothing whatever about it. The working of the system as exemplified during the recent times of stress has been more instructive than edifying.

We record with much regret the death on November 5, in his forty-ninth year, of Prof. H. M. Waynforth, professor of engineering, King's College, University of London.

Prof. G. Carey Foster, a past president of the Institution of Electrical Engineers, has been elected by the council an honorary member of the institution.

The opening of the next annual meetings of the Institution of Naval Architects has been fixed for Wednesday, March 28, 1917.

Dr. D. F. Lincoln, a former secretary of the American Social Science Association, died recently in Boston at the age of seventy-five. He was the author of "School and Industrial Hygiene," "Electro-Therapeutics," "Hygienic Physiology," and "Sanity of Mind."

We regret to note that *Engineering* for November 3 records the death of Dr. C. A. Harrison at the age of sixty-eight. Dr. Harrison was for many years engineer-in-chief to the North-Eastern Railway; the structures which remain as monuments to his skill are principally bridges. He was for a time a member of the council of the Institution of Civil Engineers, and received the degree of D.Sc. at Newcastle in 1906, as a tribute of honour to his work in connection with the King Edward Bridge.

The death on October 29 of Prof. O. V. Muller is announced. Prof. Muller was professor of history and political economy at Elphinstone College, Bombay. A *Times* correspondent writes that during the plague in Bombay he laboured hard to persuade the plague-stricken to allow themselves to be taken to hospital, and for his efforts towards stamping out the plague he received the Kaisar-i-Hind medal. Prof. Muller was a keen archæologist, and formed valuable collections of Danish, English, and Indian stone and bronze antiquities.

The death is announced, in his seventy-first year, of Mr. V. G. Bogue, a leading American engineer. He was a member of a commission appointed by President Harrison to investigate the methods for improving the navigation of the Columbia River, and acted as consulting engineer for the Government of New Zealand on the proposed railway across South Island. He prepared the plan and report for Greater Seattle and for the harbour of Tacoma. While employed from 1880 to 1886 as an assistant engineer in the construction of the Northern Pacific Railway, Mr. Bogue discovered the Stampede Pass in the Cascade Mountains. From 1886 to 1891 he was chief engineer of the Union Pacific.

We regret to learn of the death of Lance-Corpl. J. W. Hart, who, having volunteered in the early days of the war, was killed on September 15, while taking part in the first wave of an attack against the enemy trenches. Mr. J. Hart received his early training at University College, Reading, and showed the greatest promise as a student. He obtained the diploma in horticulture at Reading, and afterwards the B.Sc. (war) degree of London University. At the beginning of the war he held the post of horticultural assistant at Bedford College, London, and was in charge of the botany garden, the successful development of which was largely due to his skill and energy. Mr. Hart was no militarist; hating the wastefulness of war, he abandoned the constructive work he had at heart for that greater cause for which he believed his country to be fighting. His death will be keenly felt by the many friends to whom his manly, enthusiastic, and cheerful outlook on life had endeared him, while scientific horticulture has lost one of its most promising adherents.

A quotation in the *Morning Post* from the *Gazette de Hollande* emphasises the use made in Germany of geological advice in trench warfare, and Prof. Salomon, of Heidelberg, is said to have urged the formation of a special organisation of geologists in connection with the Army. It is probably no secret that excellent use has been made by the British military authorities of our own Geological Survey staff, members of which have been of technical assistance in fields as wide apart as the deeply dissected strata of Gallipoli and the undulating Cretaceous expanses of the Paris-Brussels basin. The geologist has been found of service in military mining as well as in questions of water supply, and the memoir recently issued by the Geological Survey on "Sources of Temporary Water Supply in the South of England and Neighbouring Parts of the Continent" (see Nature, vol. xcv., p. 244) was drawn up specially to meet the needs of camps.

A lecture was delivered at the Royal Society of Medicine on October 31 by Dr. Sherman, of Pittsburg, on the method of sterilising wounds introduced by Dr. Carrel, the well-known American surgeon. The method consists in opening up the wound so far as necessary to reach every part of it, and rubber tubes are passed into all the recesses, and are kept in place by gauze packing. An antiseptic solution is then allowed to flow from a container, and by means of the tubes flushes out every part of the wound. This is done every two hours, and the wound is re-dressed every day. The effect is very striking, and the wound is rendered completely sterile in a few days. The antiseptic solution employed by Dr. Carrel is Dakins's solution somewhat modified; this was finally adopted after a trial of 200 different antiseptics. The solution consists of chloride of lime, sodium carbonate, and sodium bicarbonate in ordinary water compounded in a particular manner, details of which will be found in the *Lancet* of November 4, p. 800. It is claimed that by this method of treatment the healing of wounds is greatly accelerated.

Dr. C. D. Walcott, secretary of the Smithsonian Institution, and Mrs. Walcott have just returned to Washington, D.C., after several months' field work on the Continental Divide, which forms the boundary line between Alberta and British Columbia south of the Canadian Pacific Railway, studying the Cambrian rocks. Mrs. Walcott visited Glacier, British Columbia, where she measured the position of two large glaciers, and determined that the front ice foot, in each case, had retreated at the rate of 100 ft. a year during the past two years. Steel plates were placed on the ice on the present surveyed boundary lines. The plates will be buried beneath the winter snows, but, since their positions are relatively low as to altitude, the snow will be melted off next summer, and their locations then will indicate the amount of forward flow of ice during the year. Mrs. Walcott's studies show that the ice has been steadily retreating during the past six years, and her measurements agree with observations made in Alaska. During the field work a large number of photographs were taken, including a dozen or more panoramic views, exposures being made on continuous films 8 ft. in length.

Lieut. John Handyside, who fell in one of the recent advances on the Somme, at the age of thirty-five, was a distinguished graduate of Edinburgh and Oxford, and since 1912 had been lecturer in philosophy in the University of Liverpool. At Edinburgh he carried off all the honours open to students of philosophy, and at Oxford, after taking a first in Greats, he was elected a fellow of St. John's College. On the completion of his Oxford course he returned to Edinburgh, and acted for three years as assistant to Prof. Pringle-Pattison. After his appointment to Liverpool, the long illness of Prof. Mair threw upon him the chief responsibility for the work of the philosophical department. It was a severe test, and Mr. Handyside proved himself a successful teacher and a most helpful colleague. In 1915 he was granted leave of absence for military service, and obtained a commission in the 16th Batt. King's Liverpool Regiment. He had been between three and four months at the front, and was mortally wounded while rallying his men during an attack. His engrossment in teaching work during the last years prevented him from writing much, but he had completed a translation of two of Kant's smaller treatises, which he intended to equip with a critical introduction, and he had also in view some independent work in ethics. It is hoped, therefore, that some specimen of his work may yet be published.

Quickly after Ehrlich and Metchnikoff, his fellow Jews, has passed Prof. Albert Neisser, of Breslau, whose name will ever be associated with theirs in the history of the scientific advance against venereal disease. He was only twenty-four when, in 1879, he identified the gonococcus, a markedly characteristic form of diplococcus which is the cause of gonorrhœa. He devoted all his later years to the study of venereal disease, contributing largely to the biochemical tests for the identification of syphilitic infection, and being the founder, fourteen years ago, of the German society which corresponds to our National Council for Combating Venereal Diseases, founded in London last year. Though the discovery of the gonococcus has not led, as yet, to the construction of any direct chemical remedy, such as salvarsan in the case of syphilis, or to the production of an antitoxin, as in the cases of diphtheria and tetanus, Neisser's discovery has nevertheless been of incalculable value in the treatment, the identification, and, in our own times, the prophylaxis of the disease. Thanks to him, the gonorrhœal nature of *ophthalmia neonatorum* has been demonstrated, and the dependence of many cases of rheumatism or arthritis upon the same organism; while gynæcology tells us that at least one-half of all the cases where a major abdominal operation is required in women are due to gonorrhœal infection, which is, in fact, the great steriliser of femininity, and a leading enemy of the birth-rate everywhere. Thanks also to Neisser, the treatment of the disease has been vastly improved, the introduction of protargol being due to him, and his warnings and the microscopic resources which we owe to him enable us to know that the disease is still present in many cases where it would otherwise have been ignored.

At a time when it is strongly urged that more capital must be employed in food production, any method that will enable the farmer to calculate the risk of his crops being destroyed by unfavourable weather conditions deserves careful study. In the July issue of the *Geographical Review* (New York) Messrs. W. G. Reed and H. R. Tolley show how the risk for a crop which is in a condition to be damaged by frost between any two dates in spring and autumn may be computed if sufficient observations for that district are available. Using the well-known method of mean squares, "standard deviation" figures are calculated for 569 stations in the United States. These constants are a measure of the departure from the average dates of the last killing frost of spring and the first killing frost of autumn. Naturally these standard deviations are lowest for the central areas and highest for maritime States like Florida and California. If a crop is in a condition to be damaged on the average date of the last killing frost in spring, the risk is 50 per cent. In the case of a station with a standard deviation of 14·4 the risk falls to 10 per cent. nineteen days later than the average date. By combining the risks in spring and autumn the total risk may be computed for a crop which is exposed to both dangers. The risk of loss which may be profitably carried naturally varies with the crop and the economic conditions. Given the necessary data, the authors believe that risks from weather conditions other than frost may be computed in this way.

In the Proceedings of the American Philosophical Society (vol. lv., No. 3) Dr. Raymond Pearl describes some interesting experiments on the effect of continued administration of alcohol to the domestic fowl. Comparing the control group and the alcoholised group, he finds that there is no evidence that specific germinal changes have been induced by the alcohol treatment, at least in those germ-cells which produced zygotes, and that the germ-cells which produced zygotes were not in any respect deleteriously affected. Although the results are apparently in contradiction to those of some observers with mammals, the writer believes that the contradiction is more apparent than real. The discrepancy, he argues, is fundamentally due to a difference in the resistance of the germ-cells to alcohol.

Dr. Carl Hansen-Ostenfeld has published (Mem. Acad. Roy. Copenhagen, Sect. Sc., 8 ser., t. ii., No. 2, 1916) an account of the Protozoa found in the samples of plankton taken in Danish seas from 1898 to 1901. Some of these organisms, *e.g.* ciliates of the genus Tintinnopsis, are indigenous, but the majority, *e.g.* the two recorded species of Heliozoa, several species of Radiolaria and of Tintinnoid ciliates, appear to have been carried by currents from the North Sea into the Skager Rak or the Cattegat, but it is evident that most of them do not penetrate far, as they meet with water of low salinity from the Baltic, which is inimical to them. Noctiluca—a globular Cystoflagellate, about 1 mm. in diameter, and well known for its phosphorescence—is occasionally present in enormous quantities in Limfjord, but cannot maintain itself inside the Skager Rak; it disappears each winter and is reintroduced in the following autumn by the "Jutland current." A few planktonic organisms are carried into the Danish area by the outgoing current from the Baltic. One of these—*Ebria tripartita*, referred to a new order Pyritoflagellata, near the Silicoflagellata—is found to be capable of living under wide variations of salinity (4 per mille to 25 per mille). A short account is given of the occurrence of Vampyrella (parasitic in the diatom, *Chaetoceras boreale*) and of Hyalosaccus (parasitic in Ceratium), both organisms of uncertain affinities. A list is appended of the phytoplankton and protozoa recorded from Danish waters.

Several articles dealing with different aspects of the geography of New York occupy the September number of the *Geographical Review* (vol. ii., No. 3). Mr. Ellsworth Huntington, writing on the water barriers of New York City, shows the important part that ferries and bridges play in the economy of the city, and the inevitable tendency towards crowding that arises from the island site. This results on one hand in "sky-scrapers" and high rents, and on the other in weakened health and nervous strain. Another article, by Mr. E. P. Goodrich, on some problems incident to the growth of New York City, is particularly valuable on account of the number of maps reproduced. Although these are necessarily much reduced, and in cases a little difficult to decipher, they illustrate many important considerations in town planning and municipal organisation which are essentially questions within the province of the geographer. Some of these maps incorporate useful suggestions for other towns.

The recent formation of a conference of representatives of electric power supply companies to consider the best methods of linking up generating stations in the Greater London area, and the formation of a National Power Supply Joint Committee covering a still wider area, both point to a greater uniformity in orders and rules for the regulation of electric supply in the near future. It is to the interest of neither consumer nor supply company that a piece of apparatus which is pronounced dangerous or inefficient on one side of the street should be deemed adequate on the other side. That the same desire for greater uniformity in the rules for the regulation of electric supply is felt at the present time in America is shown by the recent issue by the Bureau of Standards of a circular of 260 pages dealing with the most important of the factors which determine the safety and efficiency of electric supply. It has been drawn up after conference with the supply companies and others concerned, contains rules and regulations suitable for companies under either State or municipal control, and gives specifications for the approval of the various types of electricity meters.

The appendix to the annual report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1915, as usual, consists of a selection of miscellaneous memoirs of interest to all engaged in the promotion of knowledge. The articles for the most part are those of the year 1915. Many are translations into English of foreign contributions to science, and among these may be mentioned the following:—A review of astronomy for the year 1913, by M. P. Puiseux, of the Paris Observatory; the earthquake in the Marsica, Central Italy, by M. Ernesto Mancini, secretary of the Royal Academy of the Lincei; Atlantis, by M. Pierre Termier, director of the service of the Geologic Chart of France; construction of insect nests, by Prof. Y. Sjostedt, of the Royal Museum of Natural History, Stockholm; excavations at Tell-El-Amarna, Egypt, in 1913–14, Herr Ludwig Borchardt; and vaccines, by Prof. L. Roger, of the Paris University. The original contributions to the report include:—Evidences of primitive life, by Dr. C. D. Walcott, secretary to the Smithsonian Institution; olden-time knowledge of Hippocampus, by Dr. C. R. Eastman, of the American Museum of Natural History; progress in the reclamation of arid lands in the Western United States, by Mr. J. B. Beadle, of the U.S. Reclamation Service. The appendix, as is customary, is illustrated by a profusion of beautiful plates.

The recent issue of the *Central*—the organ of the Old Students' Association of the City and Guilds (Engineering) College, South Kensington—is virtually a special number, in which some of Prof. Armstrong's old students have sought to put on record their impressions of the work of the Chemical Department of the college during the period from 1884 to 1914. The most remarkable feature of the record is perhaps the great variety of the subjects in which work of real value was done in a department which was always small in numbers, but for that very reason received an intensive cultivation which would have been impossible in a larger school or department. The writers include Prof. Pope, Mr. W. M. Heller, Prof. Compton, Dr. Lowry, Prof. Lapworth, Sir Henry Miers, Prof. Wynne, and Dr. Eyre, and Prof. Armstrong himself has added some "Personal Notes on the Origin and Development of the Chemical School at the Central." The chemical subjects touched upon in the record will be familiar enough to those who have followed the developments of chemical science during the past thirty years, but an even wider circle will welcome Mr. Heller's account of the "Reform in Education" with which Prof. Armstrong's name will always be associated. Sir Henry Miers has given an account of the school of crystallography at the Central, probably the only school in which the subject was taught regularly to all matriculated chemical students, and Dr. Eyre describes the biological investigations which became an important feature of the work of the department from 1900 onwards. The periodical contains an excellent photograph of Prof. Armstrong on holiday in 1909, and a list of careers of the students who passed through the chemical laboratory.

Mr. C. Baker, 244 High Holborn, London, has issued his October list of second-hand scientific apparatus. The list contains the usual large assortment of instruments, and all are guaranteed to be in perfect working order before being sent out. In view of the comparative scarcity of new apparatus owing to the demands of the war on manufacturers, this catalogue deserves the careful attention of science lecturers and others. The 1500 pieces of apparatus are for sale or, with some exceptions, for hire. The catalogue deals with microscopes and microscopic apparatus, surveying and drawing instruments, telescopes and accessories, spectroscopes, and a great variety of other physical apparatus.

Messrs. H. Sotheran and Co. (Strand and Piccadilly) have just issued the sixth and last part of their catalogue—"Bibliotheca Reuteriana" of modern standard works on mathematics, astronomy, physics, chemistry, engineering, crystallography, and meteorology, forming the final supplement to the "Bibliotheca Chemico-Mathematica." Messrs. Sotheran announce that after the war they will publish a library illustrated edition on fine paper of the "Bibliotheca Chemico-Mathematica" complete. It will contain about 125 full-page plates and an analytical subject-index.

MESSRS. J. WHELDON AND CO., 38 Great Queen Street, W.C., have just published No. 76 of the new series of their catalogue. It deals with the journals and transactions of many scientific societies, and with English and foreign literary and scientific periodicals. There are also addenda giving particulars of remainders of books relating to natural history. The catalogue should be of interest and service to many students of science.

MR. F. EDWARDS, High Street, Marylebone, has recently circulated a very interesting illustrated catalogue of autograph letters, manuscripts, and historical documents. A section of the catalogue is composed of documents relating to the United States, Canada, and the West Indies.

THE two following volumes are in preparation, among others, for appearance in the "University of Chicago Science Series" (*Cambridge University Press*):—"A Factorial Theory of Evolution," by W. L. Tower, and "Chemical Signs of Life," by S. Tashiro.

OUR ASTRONOMICAL COLUMN.

THE RADIAL VELOCITY OF β URSÆ MAJORIS.—From observations of the radial velocity made at Potsdam some years ago it was concluded by Ludendorff that β Ursæ Majoris was a spectroscopic binary with a period of 27·16 days and total range of $15\frac{1}{2}$ km./sec. Subsequent observations made at the Lick Observatory, however, gave a range of velocity no greater than that to be expected in the determinations for a constant-velocity star of type A. Further interest in the question was aroused last year by Guthnick and Prager's observations of the star with a photo-electric photometer, from which a variation through 0·02 mag. in a period of 0·3122 day was deduced; the Potsdam radial velocity values were thought to be consistent with this period. A further investigation of the radial velocity, with special reference to short-period changes, has since been undertaken at Mt. Hamilton (Lick Observatory Bulletin No. 284). Thirty-six plates were taken on three nights during February, 1916, but, as in the case of the earlier photographs, these do not appear to indicate a variation through any appreciable or dependable range of velocities. Prof. Campbell hopes that someone with less observing opportunity and more opportunity for computation will make a further effort to discover a periodicity of very small amplitude. The plates are available for loan to any experienced measurer of spectrograms who may have a plan for remeasuring them.

RADIAL MOTION IN SUN-SPOTS.—Mr. Evershed has recently reported on some further investigations of the radial motion in sun-spots discovered by him in 1909 (Kodaikanal Observatory Bulletin 51). Improved results have been obtained by the use of instruments which reduced the times of exposure, and by working only under the best conditions as to definition of the spot image. It now appears that the radial motion displacement may be very unequal at equal distances from the umbra, and the two spots investigated showed larger displacements on the limb side than on the side towards the centre. There is usually an acceleration of velocity from the umbra to the outer limits of the penumbra, and then a sudden fall to zero, or to a lesser speed which diminishes to zero at some distance outside the spot. The radial movement may amount to as much as 4 km./sec. at one edge of the penumbra for lines of intensity 0 and 1 in large spots. The diminution of the indicated velocity with increased intensity, which was found by St. John, and attributed by him to differences of effective level, is confirmed by the new measures. In opposition to St. John, however, no difference was found for enhanced lines of iron as compared with the arc lines of like intensity. Mr. Evershed further concludes that while movements at right angles to the radial motion may occur in the penumbræ, rotational movement is not a constant feature.

WOLF-RAYET BANDS IN THE NUCLEI OF NEBULÆ.—In continuation of the work of Wright, the nuclei of three additional planetary nebulæ have been found by G. F. Paddock to give the Wolf-Rayet type of spectrum (Lick Observatory Bulletin, No. 284). The nucleus of N.G.C. 6826 shows a fairly bright band at 4686, and a fainter band at 4657, which is not given in Campbell's list of Wolf-Rayet lines. In N.G.C. 418_2 the band 4686 is faintly seen in the nucleus, while that at 4650 is fairly bright. Four bright bands were found in the nucleus of N.G.C. 40, namely:—

Wave-length	Width	Intensity
4862·2 ...	14 A. ...	Faint.
4788·3 ...	13 A. ...	Faint.
4687·4 ...	15 A. ...	Fairly strong.
4652·1 ...	22 A. ...	Very strong.

The band at 4652 is strongest near its violet edge, and seems to shade off towards the red. That at 4862 corresponds to H_β.

BARNARD'S HIGH PROPER-MOTION STAR.—Some interesting details relating to the discovery of the star with the largest known proper motion have been given by Prof. Barnard (*Popular Astronomy*, vol. xlvii., p. 504). The star was shown on plates taken in 1894, 1904, 1907, and 1916, and the images were so far apart as to seem to represent different objects, which might be new or variable stars. It was found, however, that all the images were in a straight line, and that the different photographs could be reconciled by supposing the images to have been made by a star with an annual proper motion of about 10″, in a direction almost exactly north. At the epoch 1916·423 the R.A. of the star was 17h. 53m. 43·60s., and the declination $+4^\circ\ 27'\ 48''$; it was 9·1s. following, and 51″ north of B.D. $+4^\circ$ 3560. The star is situated in the northern part of Ophiuchus, and is of about the 10th visual magnitude. The movement may easily be detected in the course of a few months, and photographs and charts are given for the benefit of those desiring to observe the star.

Mr. Adams has found that the type of spectrum is M*b*, and that the star is approaching the earth with a velocity of 91 km./sec. The relative intensities of certain spectral lines suggest a parallax of 0·2″, and it would follow from this that the star's real velocity in space is 260 km./sec.

A CATALOGUE OF METEORITES.—An illustrated handbook and descriptive catalogue of the meteorite collections in the United States National Museum, prepared by Dr. G. P. Merrill, has recently been published by the Government Printing Office, Washington. Though the handbook is intended primarily for the general public, it is so arranged as to provide also for the needs of the student and investigator. At the beginning of the present year the collection included 329 falls and finds, and an equal number of thin sections for microscopic study. There is a brief introduction, giving an interesting account of the characteristics of meteorites, and of the system of classification, following in the main that proposed by Brezina. In a large number of cases the results of analyses are given.

MEMORIAL TO THE LATE SIR WILLIAM RAMSAY.

On Tuesday, October 31, a public meeting was held at University College, London, to consider the steps to be taken to raise a memorial to the late Sir William Ramsay. The assembly included the Ministers of Belgium, Roumania, Serbia, Chile, China, a representative of the American Embassy, and various officials and members of scientific and academic bodies, many of whom took part in the proceedings.

The Rt. Hon. Lord Rayleigh presided, and, in the course of his introductory speech, made brief references to his work with Sir William Ramsay. We heard, he said, a great deal of the research which was needed in connection with industry, but there seemed to be no thought of the difficulty of getting the right kind of people to do it. Among every six people who were able to understand, form intelligible opinions, and explain scientific matters, there was probably not one who had the gift of scientific initiative. This Sir William Ramsay had to an extraordinary degree. Lord Rayleigh paid a tribute to his thoroughness of method and his indifference to criticism which did not rest on cogent argument. Ramsay's discovery of helium he described as one of the most romantic pages of science, and his further discovery that helium appeared during the breakdown of radium was most important. Sir William's gifts were not only scientific; he was a master of several languages, and this faculty placed him in touch with the scientific genius of the world; combined with his extraordinary experimental skill and rapidity, it went a long way to explain his success. In conclusion, Lord Rayleigh spoke of Sir William's unusual power of influencing people, as the result of which many things had been done since the war began that but for him would not have been done at all.

The following was the main resolution of the meeting:—"That steps be taken to raise a substantial fund as a memorial to Prof. Sir William Ramsay, K.C.B., F.R.S., such fund to be utilised for the purposes of promoting chemical teaching and research under a scheme to be approved hereafter by the subscribers."

The resolution was moved by the Rt. Hon. J. A. Pease, Postmaster-General, formerly President of the Board of Education. He laid stress on the importance of discoveries such as those of Sir William Ramsay, because they widened the horizon of all educated people, irrespective of country or of race; they enforced an essential unity of knowledge among civilised people, just as we were struggling for a similar unity of standard in conduct among the civilised States. One of the lessons of the war has been that we have learnt as a State to respect and be guided by scientific method and scientific men to a degree which nothing but a great necessity could have achieved. The work of Ramsay illustrates not only the necessary co-operation of sciences, but the necessary co-operation of nations. Was it therefore too much to ask that his memorial should be an international as well as a national one? A magnificent response has been made to an appeal for funds for the memorial to a great figure in the field of war, Lord Kitchener; cannot a similar response be made to an appeal for the memorial to a great figure in the field of science? To a people who could raise five millions a day for the purposes of the war, surely it is possible to raise this memorial to show their belief in Ramsay's work and what it stood for? The form in which that belief shall be clothed can be determined later.

The President of the Royal Society (Sir Joseph J. Thomson), in seconding the resolution, dwelt on the more scientific aspect and importance of Ramsay's work and influence.

His Excellency the Belgian Minister (a vice-president of the University of Brussels) paid a graceful tribute to the memory of Ramsay, recalling a visit he paid to Brussels and the part he played in connection with the foundation by Solvay of the Institut International de Chimie; Ramsay did not merely belong to his own country; he belonged to humanity. Mr. W. H. Buckler, representing the American Ambassador, recorded the veneration in which Ramsay and his work were held in the United States.

In moving "That this meeting resolve itself into a General Committee for the purpose of raising the fund for the memorial to Prof. Sir William Ramsay," Sir Hugh Bell, Bart., referred to a suggestion made to him by Ramsay some time ago as to the possibility of distilling small seams of coal *in situ*. Probably no person other than Ramsay would have been able to persuade him that the experiment was at all possible, but, like others, he fell under the glamour of an entrancing personality, and arrangements were made for trying the experiment under extremely favourable conditions. These were nearly complete on the outbreak of war; the place was ready, and, if there were anyone found bold enough to pursue Sir William's suggestion, he would gladly put the preparations at the disposal of such person.

Prof. J. Norman Collie, the chairman of Convocation of the University of London and vice-chairman of the University College Committee (Sir Edward Busk), the president of the Chemical Society (Dr. Alexander Scott), Sir William A. Tilden, Dr. Morris Travers, Sir Joseph Larmor, and Prof. E. C. C. Baly also spoke.

The following were appointed an Executive Committee to make such arrangements as they deem desirable for furthering the memorial:—The Rt. Hon. Lord Rayleigh, the Rt. Hon. Lord Parmoor, Sir Hugh Bell, Bart., the Rt. Hon. Sir John Brunner, Bart., Sir Ralph C. Forster, Bart., Sir Charles Bedford, Sir G. T. Beilby, Sir James Dobbie, Sir Robert Hadfield, Sir Alexander Kennedy, Sir William Tilden, the President of the Royal Society, the President of the Chemical Society, the President of the British Science Guild, the President of the Society of Chemical Industry, Prof. Baly, Mr. Chaston Chapman, Prof. J. Norman Collie (hon. treasurer), Prof. F. G. Donnan, Mr. Alex. Duckham, Dr. T. Gregory Foster, Prof. F. Francis, Mr. Gathorne-Young, Mr. J. Gretton, Dr. R. Messel, Dr. Robert Mond, Dr. H. F. Parshall, Dr. Walter Seton, Dr. Samuel Smiles (hon. secretary), Lieut.-Col. Smithells, Dr. Morris Travers, and Prof. James Walker.

The proceedings terminated with a vote of thanks to Lord Rayleigh for presiding, moved by the Vice-Chancellor of the University of London (Sir Alfred Pearce Gould, K.C.V.O.), and seconded by Prof. F. G. Donnan, Sir William Ramsay's successor in the chair of general chemistry at University College, London.

After the meeting, Prof. J. Norman Collie delivered a memorial lecture on "The Scientific Work of Sir William Ramsay."

THE SWISS SOCIETY OF NATURAL SCIENCES.

The yearly meeting of the Société Helvétique des Sciences Naturelles was held in August at Schuls-Tarasp, in the Engadine. The chief object was an excursion into the National Park of Switzerland, which, though officially opened a year or two ago, had not yet been visited by the great society which has been primarily interested in its foundation.

We would recall to our readers the history of this institution. A large portion of the country in a mountainous region has been obtained from the communes of Zernez and Tarasp on a ninety-nine years' lease by the Société Helvétique and the Ligue Suisse pour la Protection de la Nature, backed by the Federal Government itself. This has been set apart for the beasts and the birds and the plants to live in, there to breed and to struggle for existence in their own untrammelled way.

There is no other place in the world corresponding to this. The Yellowstone Park is open to the tripper, and the wilds still unexplored in Brazil and elsewhere, even when free from savage man, may at any moment be exploited by the rapacious European or American. But the creatures of the National Park of Switzerland are protected against the lord of creation by a charter, which, it is to be hoped, will never be treated as a mere scrap of paper. Picnickers even are forbidden, and it was only by special permission that the members of the Société Helvétique were supplied with excellent refreshment in a flowery pasturage within the precincts.

As you pass along the solitary paths you have to check the impulse to cull the many-coloured flowers that carpet the borders, and even spring up between the stones at your feet. This is one of the first rules of the park, and brings home to the visitor the fact that the park is no more for the collector than it is for the tourist.

It was in the earliest dewy morning of a beautiful August day that some two hundred members of the society started up the Gorge of the Clemgia. By ten o'clock they had reached a rocky ridge, the Alp Minger, dominating a flowery mead, untouched by the scythe. Here Prof. Schröder, one of the originators of the movement to which the park owes its origin, addressed the members in German. By midday the party had reached a magnificent height, the Col de Sur Il Fass, at the boundary of the park. Here they rested on the short velvety grass; it was too high for the luxuriance of vegetation which had marked the lower slopes. In front the ground fell sharply down into a ravine, on the other side of which a line of snowy peaks stood up clear against the sky. On this grand spot another of the originators, Prof. Paul Sarasin, of Basel, addressed the assembly in French, welcoming the society to the park, and characterising the aims of its institutors. He stated that the project is being entertained of founding a second park of the same kind in French Switzerland.

When he had finished, before the party left the park, it was characteristic of such Swiss functions that one of the many beautiful Swiss airs should be sung in chorus. The words were particularly appropriate, "Salut, glaciers sublimes."

This expedition took place on the last of the three days (August 7–9) devoted to the meeting. On the first day a lecture was given by Prof. Edouard Fischer, of Berne, on "The Notion of Species in Fungi," and by Dr. Briner, of Geneva, giving an account of the experiments carried out by himself and others on "The Rôle of Pressure in Chemical Phenomena."

The Schaefli prize was awarded to Prof. Gogel, of Fribourg, for a valuable memoir on "The Radioactivity and Electricity of the Atmosphere," and we may note, as perhaps the most interesting event of the meeting from a scientific point of view, the presentation by the veteran Zürich geologist, Prof. Heim, of the volume of memoirs of the society concerning the Rhone Glacier. The observations chronicled in this volume cover a period of forty years; they have for a long time been carried on under the direction of Col. Held, supported financially by the Alpine Club; the task of digesting the results has been ably effected by Prof. Mercanton, of Lausanne.

A large number of interesting communications were made in the sections of mathematics, physics, geophysics and meteorology, chemistry, geology and mineralogy. For a list of these we must, for want of space, refer our readers to the *Enseignement Mathématique*, where also abstracts of many of the papers will be found.

GRACE CHISHOLM YOUNG.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

PROF. RIDGEWAY, in a paper on "The Origin of the Actor," pointed out that an examination of Greek drama and its descendants in Europe, as also of non-European drama, led him to the conclusion that tragedy originated in the honouring or commemoration of the dead. Pantomimic dances representing events in the life of the dead were like funeral games—a means of keeping the dead in remembrance. The wearing of masks was a concomitant of such mimetic dances. Cases were quoted from many parts in which the masks represented the spirit in whose honour the ceremony was held. In some instances, as in Manipur, a living member of the community is regarded as the actual residence of the spirit of the departed until his final send-off to spirit-land, and dresses in the clothes of the deceased and takes his place at the family table until the last rites are performed. In ancient Rome the dead man was personated by an actor dressed to represent him, who copied his peculiarities and was accompanied by masked attendants to represent his ancestors. It is probable that these were regarded as the temporary receptacles of the spirits of the deceased and his ancestors. If in Greek time the actor was still regarded as the temporary abode of the hero's spirit Solon's anger against Thespis is explained.

Prof. Keith, in a paper entitled "Is the British Facial Form Changing?" described some interesting facts derived from a comparison of a series of ancient and modern complete skulls. He finds that the malar bone is becoming tilted as a result of a gradual atrophy from disuse of the zygomatic processes of the temporal and maxillary bones—a natural result of the change in dietetics which has occurred since the early years of the Christian era, cooked food and soft cereals replacing tough meats and imperfectly ground corns. Besides the obvious maxillary shrinkage in a lateral direction, bone has been laid down so as to increase the vertical dimensions of the jaws and also around the orifice of the nares. This deposit Prof. Keith regards as inexplicable on the mechanical theory as if due merely to disuse of the jaws, but thinks it to involve some change in the mechanism of bone production under the influence of the internal secretions of the ductless glands, hazarding the suggestion that it may be in some way associated with the increased prevalence of adenoids. Associated with the dietetic changes, it is interesting to note that in early British skulls, while the teeth were much worn and dental abscesses and pyorrhœa were common, ordinary dental caries was unknown.

In the discussion Miss Freire-Marreco pointed out that these changes in the incidence of dental disease could be observed occurring within a single generation among the Pueblo Indians.

Mr. W. G. Collingwood, in a paper on "Early Christian Monuments in Northumbria," traces the history of the Anglian crosses from finely ornamented forms with well-drawn saints and angels with elaborate plaits and leaf scrolls by a gradual debasement of figure drawing, simplification of interlaced patterns, and the conversion of scroll-work into dragonesque ornament. All stages were shown, from early Anglian, in some respects resembling early Welsh, through the best Anglian period of native art and the decadent pre-Danish period, to the full Viking-age Scandinavian, which, however, received its fullest development beyond the boundaries of Northumbria.

Dr. Rivers presented a communication on "The Cultivation of Taro." In Melanesia and Polynesia taro is cultivated by means of irrigation, which is used for this purpose only. Perry has shown that irrigation has a distribution which corresponds closely with that of megalithic monuments, sun-cult, and other objects and customs which seem to have been carried over the earth by one migration or a connected series of migrations. The exclusive use of irrigation for the cultivation of taro in Oceania suggests that it also belongs to the group. This is confirmed by the distribution of the plant, which, when its tropical habit is taken into account, corresponds in general with that of other elements of the megalithic complex. An exception to this general correspondence occurs in the New Hebrides, where taro is absent or unimportant in a large part of the island of Malekula, although this island possesses a highly developed megalithic culture. Other evidence shows that the megalithic culture reached Melanesia in two chief waves, an earlier associated with mummification of the dead, and a later with interment of the dead in the extended position. The distribution of the cultivation of taro by irrigation in southern Melanesia points to its carriage by the earlier of these two migrations.

In "Personal Experience as an Element in Folk-tales" Miss Freire-Marreco pointed out that the striking resemblances between the dreams of children and those of adults of low mentality on one hand, and the myths of uncivilised peoples on the other, are to be explained, not by a semi-mystical analogy between the childhood of individuals and that of the race, but by supposing that very many folk-tales are founded on reported dreams, day-dreams, and trance experiences.

A study of "The Organisations of Witches in Great Britain" by Miss M. Murray showed that the witches practised a definite religion, with chief festivals, or sabbaths, at Candlemas, Roodmas, Lammas, and Hallowmas. The chief of the witches, called by Christian writers "The Devil," was regarded as a god incarnate in a man, or, when disguised in the skin of an animal, as incarnate in that animal. The ritual of admission into the society comprised the renunciation of any previous religion, dedication of body and soul to the god of the witches, vows of absolute obedience, baptism and the giving of a new name, and finally the signing of a contract or marking on the body, possibly by tattooing.

In papers on "A Summer and Winter among the Natives of Arctic Siberia" and on "The Physical Type of the Northern Tungus" Miss Czaplicka gave a descriptive account of the country and the native manners, customs, and types. Generally she showed that the Tungus in the north approach in type the Palæo-Siberians, and in the south the Mongols.

Mr. and Mrs. Scoresby Routledge described some of the results of their expedition to Easter Island, in the course of which they mapped and excavated the region of the terraces and of the images, and collected all that was still known of the old native culture. Little is now known by the natives with regard to the statues, though the last was overthrown so recently as 1830. The various features of the statues were, however, traced to customs of which knowledge remains. The life of the island appears to have turned on the finding of the first egg of a certain migratory bird, and it is possible that the statues were portrait-models on a large scale erected each year to commemorate the official discoverer of the egg. There were ten clans on the island perpetually at war, and cannibalism was rife. A special sanctity attached to the Miru clan, who alone had an Ariki, or chief, who was an authority on the tablets in an as yet unknown script found on the island, and who presided when these were read. It is not certain that these are very old, for white men who came in ships were regarded as gods, and ceremonies in their honour could be traced back for three generations.

In discussing the relations between "Magic and Religion," Dr. Jevons emphasised the importance of distinguishing from the earliest times between practices thought to be beneficial and of a religious character and those thought to be harmful and universally reprobated of a magical kind. Contrary to the views of Dr. Marett, he maintained there never had been or ever could be a magico-religious period or any practices which could be described as both magical and religious.

AN IMPERIAL DEPARTMENT OF MINERALS AND METALS.

PROF. HENRY LOUIS described in NATURE of October 5 (p. 91) the need for the organisation of the mineral and metal resources and industries of the Empire. We reprint below the memorandum which has been sent to Sir William S. M'Cormick, administrative chairman of the Advisory Council for Scientific and Industrial Research, by the leading technical societies concerned with the subject. The proposal for the establishment of a central Department of Minerals and Metals has also been communicated to the Dominion Governments.

On behalf and by authority of the councils of the following institutions:—The Iron and Steel Institute (incorporated by royal charter as representing the iron and steel industries); the Institute of Metals (incorporated as representing the users and manufacturers of non-ferrous metals and alloys); the Institution of Mining Engineers (incorporated by royal charter as representing coal and iron ore mining and allied industries); and the Institution of Mining and Metallurgy (incorporated by royal charter as representing the mining of minerals other than coal and iron ores and the production of metals other than iron and steel);

We, the undersigned, have the honour to submit the following considerations and recommendations in the hope that, through the intervention of the committee of the Privy Council for Scientific and Industrial Research, measures may be taken to provide the necessary machinery for the protection and advancement of the economic welfare of the mineral and metal industries of the Empire.

The absence of effective co-ordination of the organisations of these vital industries has been demonstrated and brought into prominence by the war, in many directions. The grave results to the national interests are generally admitted.

There are highly organised geological surveys and departments of mines in nearly all foreign countries, and their influence in the development of mineral resources is a factor of the first importance. There are similar well-organised departments in some of the British Dominions, but there is no connecting link or central "clearing-house" in the metropolis of the Empire to co-ordinate information on its mineral resources, to stimulate their development, and to safeguard Imperial interests.

Various departments of the Home Government, such as the Geological Surveys and Museum of Practical Geology, the Board of Trade, the Home Office, the Imperial Institute, and, since the outbreak of the present war, the Foreign Office, the Admiralty, the War Office, and the Ministry of Munitions, have all been concerned with the collection of information bearing on the sources of supply of minerals and the production of metals. There does not appear, however, to have been any serious attempt to co-ordinate and render available even such information as has been collected by these departments, and it is certain that there have been considerable overlapping and duplication of effort with corresponding waste and confusion.

It is, we submit, obvious that the overlapping and confusion will be seriously increased if the various technical committees appointed by the Advisory Council attempt to collect the information which is essential to enable the beneficent object of the committee of the Privy Council to be attained, in its wider aspects, in regard to the mineral and metal industries.

We respectfully urge this view upon the serious attention of the Advisory Council, as already there are evidences of increasing overlapping and consequent waste of time and energy, which we believe it is one of the main purposes of the committee of the Privy Council to eliminate so far as possible.

In the opinion of the institutions represented by us the organisation of a central Department of Minerals and Metals is imperatively necessary in the public interest, and the work of organisation, which will necessarily take much time to complete, should be commenced at the earliest possible moment.

It cannot be doubted that if a properly organised and efficiently conducted Department of Minerals and Metals had been in existence, much valuable time, many lives, and vast sums of money would have been saved to the nation in the conduct of the present war, and much of the cost and inconvenience to British industries depending largely for their raw materials on mineral products would have been saved, with corresponding advantages to the prosecution of the war and to many industries.

A Department of Minerals and Metals should not only be in intimate relationship with the Geological Surveys and Mines Departments of the Dominions, but also with the organisations representing the different branches of the mining and metallurgical industries, whose co-operation in the work of the department should form a vital part of its machinery.

The Geological Surveys of Great Britain and Ireland and the Museum of Practical Geology should also form an integral part of the department.

The functions of the department should be active and constructive. All overlapping by other Home Government departments, and also by the institutions representing the industries, should be absolutely prevented.

The duties of a Department of Minerals and Metals would include:—

(1) Arrangements for expediting the completion of mineral surveys of the United Kingdom and of the Crown Colonies and other British possessions.

(2) The systematic collection and co-ordination of information bearing on the occurrence, uses, and economic value of minerals and their products, special attention being devoted to securing industrial applications for newly discovered minerals or metallurgical products and to finding mineral materials required for new metallurgical products or inventions. Some of this information should be promptly and widely disseminated in summarised form to those interested in the industries, through the medium of the existing publications of the institutions directly concerned.

(3) The investigation of all questions and problems relating to the utilisation of the mineral or metallurgical resources of the Empire.

(4) The co-ordination and dissemination of information on mining laws, development of mineral areas, output, processes of extraction, plant, capital employed, markets, etc.

(5) A general review from time to time of the developed and undeveloped mineral resources and of the position of each mineral or metal, to ensure that the mineral wealth of the Empire is being exploited with due regard to Imperial interests.

(6) Generally, to advise the Imperial Government on all questions bearing on the mining and metallurgical industries. To perform this function efficiently, it is essential that complete information should be available, and also that the industries concerned should be consulted through their respective organisations.

We feel sure that the Advisory Council will fully appreciate the urgency of the question and the necessity for prompt action, so that the process of coordination may be inaugurated at once.

Wm. Beardmore, *President.* G. C. Lloyd, *Secretary.*	The Iron and Steel Institute.
George Beilby, *President.* G. Shaw Scott, *Secretary.*	The Institute of Metals.
W. Thorneycroft, *President.* L. T. O'Shea, *Hon. Secretary.* P. Strzelecki, *Secretary.*	The Institution of Mining Engineers.
Edgar Taylor, *President.* C. McDermid, *Secretary.*	The Institution of Mining and Metallurgy.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION I.

PHYSIOLOGY.

Opening Address (Abridged) by Prof. A. R. Cushny, M.A., M.D., F.R.S., President of the Section.

On the Analysis of Living Matter through its Reactions to Poisons.

I wish to-day to discuss an aspect of pharmacological investigation which has not been adequately recognised even by pharmacologists themselves, and which it is difficult to express in few words. In recent years great advances have been made in the chemical examination of the complex substances which make up the living organism, and still greater harvests are promised from these analytic methods in the future. But our progress so far shows that while general principles may be reached in this way, the chemistry of the living organ, like the rainbow's end, ever seems as distant as before. And, indeed, it is apparent that the chemistry of each cell, while possessing general resemblances, must differ in detail so long as the cell is alive. No chemistry dealing in grams, nor even microchemistry dealing in milligrams, will help us here. We must devise a technique dealing with millionths to advance towards the living organism. Here I like to think that our work in pharmacology may perhaps contribute its mite; perhaps the action of our drugs and poisons may be regarded as a sort of qualitative chemistry of living matter. For chemical investigation has very often started from the observation of some qualitative reaction, and not infrequently a good many properties of a new substance have been determined long before it has been possible to isolate it completely and to carry out its analysis. For example, the substance known now as tryptophane was known to occur in certain substances and not in others long before Hopkins succeeded in presenting it in pure form. And in the same way it may be possible to determine the presence or absence of substances in living tissues, and even some of their properties, through their reaction to chemical reagents—that is, through the study of the pharmacology of these tissues. I do not claim that pharmacological investigation can at present do much more than the qualitative testing of the tyro in the chemical laboratory, but even a small advance in the chemistry of living matter is worthy of attention.

All forms of living matter to which they have free access are affected by certain poisons, and some of these have obvious chemical properties which suggest the method of their action; thus the effects of alkalies and acids and of protein precipitants scarcely need discussion. Others, such as quinine and prussic acid, which also affect most living tissues, have a more subtle action. Here it is believed that the common factor in living matter which is changed by these poisons is the ferments, and quinine and prussic acid may therefore be regarded as qualitative tests for the presence of some ferments, notably those of oxidation, and, in fact, have been used to determine whether a change is fermentative in character or not.

In other poisons the action on the central nervous system is the dominating feature, and among these the most interesting group is that of the simple bodies used as anæsthetics and hypnotics, such as ether, chloroform, and chloral. The important use of this group in practical medicine has perhaps obscured the fact that they act on other tissues besides the central nervous system, though we are reminded of it at too frequent intervals by accidents from anæsthesia. But while they possess this general action, that on the nervous tissues is elicited more readily. Not only the nerve-cell, but also the nerve-fibre react to these poisons, as has been shown by Waller and others. And even the terminations are more susceptible than the tissues in which they are embedded, according to the observations of Gros. The selective action on the nervous tissues of this group of substances has been ascribed by Overton and Meyer to the richness in lipoid substances in the neurons, which leads to the accumulation of these poisons in them, while cells containing a lower proportion of lipoid are less affected. In other words, Overton and Meyer regard these drugs as a means of measuring the proportion of lipoids in the living cell. This very interesting view has been the subject of much discussion in recent years, and, in spite of the support given it by several ingenious series of experiments by Meyer and his associates, no longer receives general acceptance. Too many exceptions to the rule have to be explained before the action of these bodies can be attributed wholly to their coefficients of partition between lipoids and water. At the same time, the evidence is sufficient to justify the statement that the property of leaving water for lipoid is an important factor in the action of the bodies, although other unknown properties are also involved in it. And whatever the mechanism of the characteristic action, these substances in certain concentrations may be regarded as tests for the presence of nervous structures, and have been employed for this purpose.

More interest has been displayed in recent years in the alkaloids which act on the extreme terminations of various groups of nerves. These are among the most specific reagents for certain forms of living matter which we possess. Thus, if an organ reacts to adrenaline, we can infer that it contains the substance characteristic of the terminations of sympathetic fibres with almost as great certainty as we infer the presence of a phenol group from the reaction with iron. And this sympathetic substance can be further analysed into two parts by means of ergotoxine, which reacts with the substance of the motor sympathetic ends, while leaving that of the inhibitory terminations unaffected. Similarly, the endings of the parasympathetic nerves are picked out with some exceptions by the groups represented by atropine and pilocarpine, and here again there must be some definite substance which can be detected by these reagents.

Further, some light has been thrown on, at any rate, one aspect of these nerve-end substances by the observation that they all react to only one optical isomer in each case. Thus the dextrorotatory forms are ineffective in both atropine and adrenaline, and this suggests strongly that the reacting body in the nerve-ends affected by these is itself optically active, though whether it bears the same sign as the alkaloid is unknown. This very definite differentiation between two optical isomers is not characteristic of all forms of living matter. For example, the heart muscle seems to react equally to both lævo- and dextro-camphor. The central nervous system contains substances which react somewhat differently to the isomers of camphor and also of atropine, but the contrast is not drawn so sharply as that in the peripheral nerve-ends.

The tyro in the chemical laboratory is not often fortunate enough to be able to determine his analysis with a single test. He finds, for example, that the addition of ammonium sulphide precipitates a considerable group of metals, which have then to be distinguished by a series of secondary reactions. The pharmacologist, as an explorer in the analysis of living matter, also finds that a single poison may affect a number of structures which appear to have no anatomical or physiological character in common. But as the chemist recognises that the group of metals which react in the same way to his reagent have other points of resemblance, so perhaps we are justified in considering that the effects of our poison on apparently different organs indicate the presence of some substance or of related substances in them. A great number of instances of this kind could be given, and in many of these the similarity in reaction extends over a number of poisons, which strengthens the view that the different organs involved have some common reacting substance.

One of the most interesting of these is the common reaction of the ends of the motor nerves in striated muscle and of the peripheral ganglia of the autonomic system. It has long been known that curare and its allies act in small quantities on the terminations of the motor nerves in ordinary muscle, while larger amounts paralyse conduction through the autonomic ganglia. These observations appear to leave no question that there is some substance or aggregate common to the nerve-ends in striated muscle and to the autonomic ganglia. Other analogies exist between the ganglia and the post-ganglionic terminations of the parasympathetic, as is shown by their reactions to the tetramethyl ammonium series; between the heart muscle and the cardiac inhibitory centre, as shown by digitalis and aconitine; between kidney-cell and ordinary muscle, as shown by caffeine and other purine bodies.

Many other examples might be cited in which organs which are apparently not related, either morphologically or in function, react to poisons in quantities which are indifferent to the tissues in general. And this reaction in common can only be interpreted to mean that there is some substance or group of related substances common to these organs. The reaction may differ in character; thus a drug which excites one organ to greater activity may depress another, but the fact that it has any effect whatever on these organs in preference to the tissues in general indicates some special bond between them, some quality which is not shared by the unaffected parts of the body. I have, therefore, not differentiated between excitation and depression in discussing this relation. It seems probable that in this instance and in others the difference in the effect of these bodies in the tissues arises from differences in the behaviour of the molecule as a whole rather than in differences in the affinities of its special parts; that is, that the action of these poisons is due to their physical properties rather than to their chemical structure, although this, of course, is the final determining cause.

In the same way the common reaction of tissues, which I have so far ascribed to their possessing some substance in common, may arise from community of physical relationship, and I wish to avoid the implication borne by the word "substance," which I have used in the widest sense. The reaction of living tissue to chemical agents may arise from a specific arrangement in its molecule, but may equally be attributed to the arrangement of the molecules themselves. And the curious relationships in the reactions of different tissues may indicate, not any common chemical factor, but a common arrangement of the aggregate molecules. We are far from being able to decide with even a show of probability which of these alternatives is the correct one, and my object to-day has been to direct attention to these relationships rather than to attempt their elucidation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—The Vice-Chancellor, Lieut.-Col. Gilbert Barling, has been appointed consulting surgeon to the British Forces in France, and left Birmingham on November 1 to take up his duties. For some time past Col. Barling has acted as a consulting surgeon in the Southern Command. During his absence from Birmingham, which will extend over some months, his duties at the University will be discharged by Alderman F. C. Clayton, pro-Vice-Chancellor.

Cambridge.—The Vice-Chancellor has appointed Dr. R. T. Glazebrook to the office of reader on Sir Robert Rede's foundation for the ensuing year.

Mr. W. G. Palmer, who obtained first-class honours in both parts of the Natural Science Tripos, 1913–14, with distinction in chemistry, and was awarded the Hutchinson Studentship, has been elected to a fellowship at St. John's College.

Capt. E. Hindle, assistant to the Quick Professor of Biology, and formerly Beit Fellow for Medical Research, has been elected to the recently founded Charles Kingsley Lectureship in Natural Sciences at Magdalene College.

London.—Lieut.-Col. H. R. Kenwood, professor of hygiene and public health in the University of London, will deliver a public lecture at University College, Gower Street, on "Hygiene: Some Lessons of the War," on Friday, November 17, at 5.30 p.m. The chair will be taken at this lecture by Surgeon-General Sir Alfred Keogh, Director-General, Army Medical Service. The lecture is open to the public without fee or ticket.

Oxford.—The Rhodes Estate Bill, having now passed the Committee stage, has been reported to the House of Commons in its original form. Lord Hugh Cecil's suggestion, which met with some approval in Oxford, that the trustees should be left free, if they thought fit, to establish scholarships available to persons within or without the British Empire, did not prove acceptable to the trustees, who preferred to be left without discretion in the matter. It was explained by Lord Milner that unless it were clearly laid down that the new scholarships should only be tenable by students within the Empire, much disappointment would be caused to applicants from other countries. Many will think this scarcely a sufficient reason for the trustees to wish to have their hands tied in the way proposed by the Bill.

We learn from Wednesday's *Times* that Mr. H. Laming has just given 10,000*l.* to Queen's College, Oxford, to establish four scholarships of 100*l.* per annum, tenable for either three or four years, one to be offered each year. The scholars will, as a rule, be expected to take the Russian language for their honours degree. The idea is to provide a university course for candidates intending to follow a business career or to enter the consular service, and it is hoped that the scholarships may lead to a higher social and intellectual standard prevailing in those careers.

Notice has just been given of the next triennial prize at Guy's Hospital under the will of the late Sir Astley Cooper. The prize, the value of which is 300*l.*, will be awarded to the author of the best essay or treatise on "Gunshot Wounds of the Lungs and Pleura." The competition is open to all, with the exception of the staffs of Guy's and St. Thomas's Hospitals and their relatives. The competing essays, written in English, must be sent to Guy's Hospital on or before January 1, 1919. Further particulars of the competition may be obtained from Mr. C. H. Fagge, Guy's Hospital, S.E.

The main thesis put forward by Mr. James Swinburne in a lecture on "Science and Industry," delivered at King's College, London, on November 1, Lord Moulton being in the chair, was that technology or applied science was outside the province of university teachers, who should concern themselves with imparting a knowledge of properties and principles, which they are eminently capable of doing, and leave the manufacturer to work out his own problems, of which academic people can have only second-hand knowledge. Mr. Swinburne understands, of course, that many great industrial advances have had their origin in what he called academic science, but what he wished particularly to emphasise was the difference between laboratory conditions and operations on an industrial scale brought to the point of commercial success. Purely scientific research must be free and independent, with the advancement of knowledge as its sole aim; but the manufacturer is only interested as a man of business in research which will give him financial advantage. Scientific knowledge is gained for the benefit of whomsoever may care to make use of it, whereas trade processes are kept secret or protected from adoption by industrial competitors by means of patents. The university should train workers in research methods, but the practical needs of industry can be understood only in the works themselves. Lord Moulton, in his remarks upon Mr. Swinburne's address, said that Mr. Swinburne was "picturesquely wrong" in the sharp distinction made by him between academic and technological science. It may also be suggested that the view that manufacturers are able to look after their own problems and interests assumes that they possess the necessary scientific knowledge, which, to say the least, is an assumption that will not admit of general application in this country. Instead of insisting upon the divorce between university science and technology, what should be encouraged is systematic exchange between academic and industrial posts, so that men may leave professorial chairs to become managers of factories, while others leave factories to undertake teaching and scientific investigation. What is wanted is to bring science and industry in closer relationship, and that is not best accomplished by erecting a barrier of trade conditions between the laboratory and the factory.

The Departmental Committee appointed by the President of the Board of Education to report upon the question of juvenile education in relation to employment after the war has considered it advisable, in view of the urgency of present circumstances, to issue an interim report recommending the Board to strengthen and extend, in co-operation with the Board of Trade, the system of juvenile employment bureaux and of local committees connected therewith. It emphasises the need also of after-care committees for juveniles from fourteen to seventeen years of age. The report directs attention to the fact that the exigencies of the war have caused large numbers of children to be drafted into employments that cannot be permanent and into other unsuitable employments, and that extensive dislocation, seriously affecting the conditions of juvenile employment, will surely arise after the war. It is stated that about 500,000 children enter into employment each year. To leave such children in the main without guidance is a serious dereliction of public duty, and requires that public bodies shall take up this necessary and urgent work. Having regard to the evidence placed before the committee as to school attendance, it might have been expected that it would have added to its recommendations in its interim report, in view of the serious evils which are induced thereby, the urgent need for the abolition of "half-time," so prevalent in Lancashire and Yorkshire, and of all exemptions which interfere with full-time attendance up to the age of fourteen. Two valuable handbooks, the like of which should be available in every area, dealing with the opportunities of employment of boys and girls in the cities of Edinburgh and Liverpool have been prepared, the former in 1908, the latter in January in the present year. Their purpose is to inform parents, and also to be a guide for teachers, of the conditions and possibilities of employment for their children. The oversight of children up to the age of seventeen at least is clearly within the province of the local education authorities, and it is to be hoped that the committee may further recommend in its final report the institution of measures which will ensure that all such children shall have facilities for continuing their education, both special and general, for at least six to eight hours per week within the usual hours of work.

An interesting report of the proceedings of the Science Scholarships Committee of the Royal Commission for the Exhibition of 1851, dealing with the administration of the research scholarships since March, 1914, has just been issued, over the signature of Dr. Glazebrook, who has succeeded the late Sir Henry Roscoe as the chairman. The report deals with the science research scholars whose reports were examined in 1914–15, and includes scholars appointed so far back as 1909. Forty-five such scholars are reported upon, and it is gratifying to learn that out of this number the examiners were able to report that the work of thirty-nine of the scholars was satisfactory, and of seventeen of these eminently so as contributing results of high scientific value. It is interesting to observe that seven of the scholars took up industrial appointments on the conclusion of their period of research, whilst twenty-one entered upon university or scholastic appointments, and five entered the Government service to undertake specialised scientific work in the various research stations. Ten of the scholars entered directly into combatant service, either in the Army or Navy. Having regard to the vital importance of science in the development of industry, which the war has revealed with startling clearness, it would be very satisfactory to find a much larger number of research scholars entering into industry. The outbreak of the war rendered it impossible for scholars to proceed to German or other foreign laboratories, and other arrangements for their suitable employment in research were made. Many of the scholars elected to enter upon the prosecution of research bearing upon the requirements of the war. The committee had come to the conclusion to postpone all new appointments until after the war, but in deference to strong recommendations from the scientific advisers to the Government that it was desirable to maintain at the various university centres an adequate supply of qualified men to assist the Government in important investigations, it was decided not only to continue the scholarships, but also to offer six special war bursaries to organic chemists, the holders to undertake research under the direction of the Royal Society War Committee. The report indicates the manner in which the services of the scholars are being utilised in the preparation of explosives, drugs, dyes, etc., and in devising methods for improving war equipment or in combating disease.

SOCIETIES AND ACADEMIES.

London.

Challenger Society, October 25.—Prof. E. W. MacBride in the chair.—G. H. **Fowler**: Physical conditions in the Kattegat. Seasonal variation was shown to depend on the sealing of the inner Baltic rivers by frost or their release by warmer weather.—C. T. **Regan**: Schmidt's second report on eel investigations. The importance of Schmidt's results in relation to the problem of the origin of species was pointed out.

Mathematical Society, November 2.—Annual general meeting.—Sir Joseph Larmor, retiring president, and afterwards Prof. H. M. Macdonald, newly elected president, in the chair.—Sir J. **Larmor**: (1) Presidential address. (2) The Fourier harmonic analysis: its practical scope, with optical illustration.—Prof. W. H. **Young**: Multiple integration by parts and the second theorem of the mean.—E. H. **Neville**: Moving axes and their uses in the differential geometry of Euclidean space.—J. **Hodgkinson**: Areas and conformal representation.

Paris.

Academy of Sciences, October 16.—M. Camille Jordan in the chair.—P. **Vuillemin**: Anomalies resulting from traumatism in plants.—R. **Soreau**: The graphical anamorphosis of a topographical surface.—C. **Zenghelis** and S. **Horsch**: The chemical action of sodium peroxide upon the oxides of carbon. Carbon dioxide forms sodium carbonate, with a marked rise in temperature, oxygen being evolved. Carbon monoxide forms sodium carbonate, the rise of temperature not being so great as with the dioxide, although the heat of combination is greater. It is suggested that a percarbonate is the primary product of the reaction between sodium peroxide and carbon dioxide.—L. **Guitteau**: The action of sulphur on baryta in presence of water. Evidence is put forward that an unstable barium pentasulphide, BaS_5, can exist in solution; this decomposes into barium tetrasulphide, BaS_4, barium thiosulphate, hydrogen sulphide, and sulphur.—P. **Gaubert**: The crystalline liquids obtained by evaporation of a solution. Studies on liquid crystals from anisal-*p*-amidoazotoluene, ethyl anisalaminocinnamate, *p*-azoxyanisol; some cholesterol esters, and amyl cyanobenzalalamocinnamate.—F. **Grandjean**: The orientation of liquid anisotropes on crystals.—C. **Sauvageau**: The biological variations of *Saccorhiza bulbosa.*—Ch. **Dhéré** and G. **Vegezzi**: The pigmentary composition of hepatochlorophyll.—J. **Amar**: Sense education and prothesis apparatus. The results. The apparatus used in the re-education of the tactile sensibility in the stumps left after amputation has been described in earlier papers. Some of the results obtained are now described.

BOOKS RECEIVED.

Electric Switch and Controlling Gear. By Dr. C. C. Garrard. Pp. xviii+656. (London: "The Electrician" Printing and Publishing Co., Ltd.) 15*s*. net.

The Elements of Engineering Drawing. By E. Rowarth. Pp. xii+131. (London: Methuen and Co., Ltd.) 2*s*. 6*d*. net.

Raymond: or Life and Death. By Sir Oliver J. Lodge. Pp. xi+403. (London: Methuen and Co., Ltd.) 10*s*. 6*d*. net.

Syllabus of Personal Hygiene for Colleges. By Prof. E. C. Howe Third revision. Pp. 207. (Wellesley, Mass.: Prof. Howe.)

Shakespeare and Precious Stones. By Dr. G. F. Kunz. Pp. 101+illustrations. (Philadephia and London: J. B. Lippincott Company.) 6*s*. net.

The Mechanical Star Bearing Finder. By E. T. Goldsmith. (London: G. Philip and Son, Ltd.) 5*s*. net.

My Life and Work. By E. K. Muspratt. Pp. xi+320. (London: J. Lane.) 7*s*. 6*d*. net.

De Strijkinstrumenten. By J. W. Giltay. Pp. xi+103. (Leyden: A. W. Lijthoff.)

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 9.

ROYAL SOCIETY, at 4.30.—Methods of Raising a Low Arterial Pressure: Prof. W. M. Bayliss.—Selective Permeability; the Absorption of Phenol and other Solutions by the Seeds of *Hordeum vulgare*: A. J. Brown and F. Tinker.—The Toxic Action of Dilute Pure Sodium Chloride Solutions on the Meningococcus: C. Shearer.—The *Rôle* of the Phagocyte in Cerebro-spinal Meningitis: C. Shearer and H. W. Crowe.—Investigation dealing with the Phenomena of "Clot" Formations. IV. The Diphasic Erosive Action of Salts on the Cholate Gel: S. B. Schryver and Mary Hewlett.—Some Photochemical Experiments with Pure Chlorophyll and their Bearing on Theories of Carbon Assimilation: Ingvar Joergensen and F. Kidd.

OPTICAL SOCIETY, at 8.—Some Notes on Glass Grinding and Polishing: J. W. French.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Natural Divisions of England: C. B. Fawcett.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Eighth Kelvin Lecture: Some Aspects of Lord Kelvin's Life and Work: Dr. A. Russell.

FRIDAY, NOVEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 7.—Has Lymnæa an Auriculoid Ancestry? C. Hedley.—(1) *Anodonta cygnaea*, L., and *A. anatina*, L.; (2) *Pseudanodonta rothomagensis*, Locard: H. H. Bloomer and H. Overton.—Sexual Characters in the Shell and Radula of *Cyclostoma elegans*: Prof. A. E. Boycott.

PHYSICAL SOCIETY, at 5.—Note on the Diffusion of Liquids: B. W. Clack.—The Regularity in the Distribution of the Satellites of Spectrum Lines; with a Note on the Structure of the Green Line of Mercury and Terms of Correction in Using a Concave Grating: Prof. H. Nagaoka.

TUESDAY, NOVEMBER 14.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 6.—Ancient Stories of a Great Flood: Sir J. G. Frazer.

WEDNESDAY, NOVEMBER 15.

ROYAL METEOROLOGICAL SOCIETY, at 5.—A Meteorologist in China: C. E. P. Brooks.—The Storm of November 11-13, 1915, in its Passage over the British Isles: Lieut. A. E. M. Geddes, R.E.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Microscopic Work of the Accademia dei Lincei: Dr. C. Singer.—A New Tank and Pond-weed Holder for use with Greenough Immersion Objectives: S. C. Akehurst.

ENTOMOLOGICAL SOCIETY, at 8.—The Factors which determine the Cocoon Colours of *Plusia moneta* and other Lepidoptera: Mrs. P. A. Merritt Hawkes.

ROYAL SOCIETY OF ARTS, at 4.30.—Opening Address: The Stability of Great Britain: Dr. Dugald Clerk.

THURSDAY, NOVEMBER 16.

ROYAL SOCIETY, at 4.30.

INSTITUTE OF MINING AND METALLURGY, at 5.30.

CHILD STUDY SOCIETY, at 6.—Experiments in Hand-writing in Schools: Speed Tests in Manuscript Writing: Dr. C. W. Kimmins.—The Artistic Aspect of Manuscript Writing: W. Scutt.—Manuscript Writing in a Central School: J. W. Samuel.—Manuscript Writing in a Boys' Elementary School: A. Sinclair.

LINNEAN SOCIETY, at 5.—(1) Pedanios Dioscorides of Anazarba; his Writings and his Commentators; (2) The New Cabinets for the Linnean Herbarium: The General Secretary.—A New Australian Genus of Hydrocharidaceæ: Dr. A. B. Rendle.—Some Collections of the Littoral Marine Fauna of the Cape Verde Islands, made by Cyril Crossland in the Summer of 1904: A. W. Waters.

FRIDAY, NOVEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Report of the Hardness Tests Research Committee.

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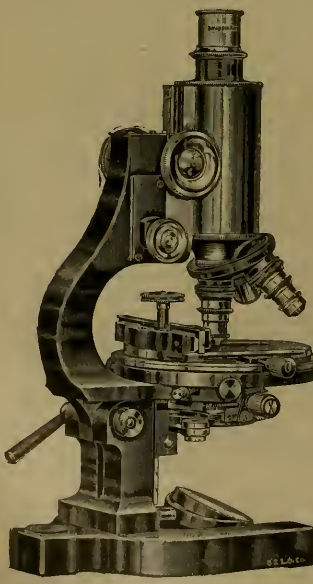

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THURSDAY, NOVEMBER 16, 1916.

NORTHERN COUNTIES LORE.

(1) *Highways and Byways in Galloway and Carrick.* By the Rev. C. H. Dick. Pp. xxix + 536. (London: Macmillan and Co., Ltd., 1916.) Price 6*s.* net.

(2) *Cleator and Cleator Moor: Past and Present.* By the Rev. Cæsar Caine. Pp. xviii + 475. (Kendal: Titus Wilson, 1916.) Price 21*s.* net.

(1) GALLOWAY, comprising the county of Wigtown and the Stewartry of Kirkcudbright, is probably less pervaded by tourists than any other attractive part of Scotland. Messrs. Macmillan have done well to commit to the Rev. C. H. Dick and Mr. Hugh Thomson the task of dealing with this district in their admirable "Highways and Byways" series, for these two gentlemen between them, one with his pen, the other with his pencil, have produced an ideal volume—not a guide-book in the ordinary sense so much as a *vade mecum* for the traveller. Mr. Dick, while not neglecting the highways, finds his chief delight in the byways and in those great tracts of moorland and mountain which constitute the southern upland of Scotland. Here he pursues his leisurely way, dropping off his bicycle at little wayside inns and lonely shepherds' cottages, at solitary pele-towers and immemorial kirkyards, wherever he may glean armfuls of legendary and historic lore. Galloway was the chief stronghold of the westland Whigs; memorials of the heroes and martyrs of the Covenant are as holy in his eyes as the sculptured crosses of the primitive Celtic church or the ruins of such noble fanes as Sweetheart and Dundrennan.

Grey recumbent tombs of the dead in vacant places,
Standing stones on the vacant wine-red moor,
Hills of sheep, and the homes of silent vanished races,
And winds austere and pure.

The killing, however, was not all done by Claverhouse and Lagg. The Covenanters did not shrink from shedding blood on occasions.

"Carsphairn abounds in hills of sheep and has its circle of standing stones, but is the only parish in the Glenkens where there is no martyr's grave. The village, however, has its story of the killing time. Pierson, the Episcopal minister, maintained a persecuting policy towards the Covenanters in the parish, and kept Lagg informed of those who absented themselves from church. The people were not cowed, but merely exasperated, and, led by James MacMichael, proposed to make some sort of treaty with the minister to secure peace in the parish. Pierson received a deputation in the manse, but on learning their errand was enraged, would listen to none of their remonstrances, barred the door, and drew out his pistol. Companions of the deputies, who had remained outside, hearing cries from within, broke down the door with MacMichael at their head. He, seeing the pistol outstretched and conceiving his friends to be in imminent danger, shot Pierson dead."

In treating of the scenery of Galloway Mr. Dick deals only with its external beauties and its association with legend and history. In a single volume so full of interesting matter it would be too much to expect detailed notice of fauna and flora. The geology of the district has been admirably explained in Sir Archibald Geikie's "Scenery of Scotland." There is, however, one feature which has long occupied the attention of geologists and deserves notice in any traveller's handbook. The prevailing formation in this region is Lower Silurian, the beds of which are tossed to a height of 2764 ft. in the Merrick, the loftiest summit in southern Scotland. Twelve miles S.S.W. of Merrick stands Cairnsmore-of-Fleet, 2331 ft., an intrusive mass of granite, altering the Silurian beds around it. On the very summit of Merrick lie many huge blocks of Cairnsmore granite, some of them as big as a small cottage. Ice-borne, no doubt, but how have they been carried to an elevation 400 ft. greater than that of the hill whence they came? The easiest explanation is that Cairnsmore has lost much of its original height by sub-aerial denudation.

We have but a single fault to find with Mr. Thomson's masterly pencil sketches, namely, that in his otherwise accurate drawing of the Peter Stone at Whithorn (p. 239) he has left out the Chi-Rho loop on the right of the upper limb of the cross. This is a serious omission, seeing that this feature, derived from the Emperor Constantine's *labarum,* occurs only on two other sculptured stones in Scotland, both in Galloway.

(2) Very different in scope and purpose from Mr. Dick's rambling notebook is the Rev. Cæsar Caine's "Cleator and Cleator Moor," which is a record, historical, industrial, geological, and biographical, of this famous ironfield. The earliest documentary evidence of iron-mining in West Cumberland is a deed of gift by William Earl of Albemarle, who died in 1179, of a mine at Egremont and a forge at Wynefell to the Abbey of Holm Cultram; but relics of the industry in prehistoric and Roman times have been found at Cleator and Furness. Mr. Caine discusses the various theories about the formation of hæmatite ore, such as aqueous deposition in solution, igneous injection, and chemical displacement or substitution, and agrees with J. D. Kendall in regarding the metasomatic replacement of limestone by ferrous carbonate as the prevailing cause, while less frequently hæmatite has probably been deposited in fissures by filtration.

The output from the Cleator mines shows so serious a falling off, namely, from 4,505,951 tons in the decade 1871–80 to 1,266,208 tons in the decade 1901–10, as to indicate the approaching close of the industry at no very distant date. Mr. Caine, however, looks forward to a day when "a man with large means and equal courage to carry out his ideas may bore through the coal measures which are known to overlie the carboniferous limestone in a large part of the neighbourhood of Cleator and find immense bodies of ore to reward him."

It is claimed for the Cleator Linen Thread Mill (now included in the great Thread Combine) that it is "the oldest flax-spinning mill in the country, and perhaps in the world." Winding thread on spools was first started here, the thread having previously been done up in hanks. It is strange, therefore, that Mr. Caine, in a dissertation upon place-names, should seek to connect that of a field close to the mill, Linethwaite, with the Anglo-Saxon "linde," a lime tree. It is plain Norse for "flax-field"—*lin-thveit*. A list of the flora and fauna of Cleator is given in an appendix, but it is valueless for any scientific purpose, inasmuch as none but English popular names are given. It does not carry one very far to be told that in this parish are found the linnet, the goose, the orchis, the gentian, etc., with no indication of species.

A COMPOSITE AMERICAN TEXT-BOOK OF GEOLOGY.

A Text-book of Geology. By Prof. L. V. Pirsson and Prof. C. Schuchert. Part i., *Physical Geology*. By Prof. L. V. Pirsson. Pp. vii + 444. Price 10*s*. net. Part ii., *Historical Geology*. By Prof. C. Schuchert. Pp. vi + 405–1026. Price 12*s*. net. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.)

GEOLOGY, being such a many-sided science, is especially handicapped in regard to text-books. It is provided with a library of books dealing with its various subdivisions and aspects, but the provision of an up-to-date manual which deals with the whole range of the subject in about a thousand pages, and of the standard required by students in higher technical schools and by those taking geology as a secondary subject in universities, is a perennial difficulty. Specialisation in geology has gone so far that it is becoming impossible for any one author to deal with the whole science in the detail required in such a work. The new text-book of geology by Profs. Pirsson and Schuchert, with chapters by Profs. Barrell and Lull and Dr. Ulrich, show the effort to overcome this difficulty by joint authorship. That method has its own drawbacks, for it is very difficult thus to secure that unity of view and uniformity of standard which are indispensable in an educational text-book.

The first part of this work, by Prof. Pirsson, deals with physical geology. It is divided into two divisions, dynamical and structural, and in the course of 400 pages gives a most excellent summary of these subjects. Its illustrations are numerous and clear, and are all useful. Those illustrating the geological conditions of arid regions are especially good. His account of the igneous rocks is short and conservative, and British teachers may be grateful for the fact that he does not mention the American classification or adopt its terminology. A few relatively unimportant slips occur, such, for example, as the remark on p. 178 that the one boring in a coral atoll in the Pacific shows a thin cap of coral "on the volcanic rock which forms the main mass." The author attributes (p. 79) the fact that the Caspian is fresher than ordinary seas to the precipitation of its salt in Karabugas; but it would appear more probably due to the former dilution of the Caspian by the Volga. Prof. Pirsson introduces into geology the term "nonconformity" for those varieties of unconformity in which the dip of the formations is visibly different; for the other section of unconformities he accepts Grabau's term of disconformity. His description of potholes as a minor feature would appear to underrate their significance, for their formation is probably the main process by which mountain streams deepen their valleys in hard rock.

The chapter on the formation of mountains is one of the most interesting in the volume. In spite of some American opinions to the contrary, the author concludes that the crust is contracting in consequence of the lessened volume of the earth as a whole; and he is disposed to attribute the shrinkage, not to cooling, but to chemical changes in the internal material. He adopts also the steadily growing view that crustal movements occur with a rhythmic periodic progression; but the author will surprise many of his readers by his conclusion that the earth, "except locally or to a superficial depth, may not be hot, at least in any such sense that it could experience the notable contraction from loss of heat demanded for the origin of the folded ranges" (p. 366). The author refers to recent suggestions throwing doubt on the origin of the West American block mountains by faulting; but he concludes that the dominant processes in the formation of many, if not most, of these ranges are the faulting of the region and the tilting of the blocks. In his classification of mountains it is perhaps a pity that the author has not adopted the usual sequence of terms. He reverses the order of chain and system, and represents several mountain systems as forming a mountain chain; and he continues that a combination of mountain chains constitutes a cordillera. The term "cordillera" seems best restricted to a mountain system such as the Andes, composed of parallel chains.

Prof. Schuchert's part of the work, which is also published as a separate volume, consists of a most interesting series of essays. But it would appear of less use to British students as a college text-book than the first part. It is overweighted at the start by the long hypothetical pre-geological history of the earth. The arrangement of the material, and such illustrations as the portraits of geologists, are less suitable for the technical student than for the general reader; thus most students would probably have found it more convenient to have the descriptive palæontology all together instead of distributed between the stratigraphical chapters.

Among the excellent features of this part is an explanation of the binomial nomenclature, which students are often expected to understand without any such help; but though the first edition of the "Systema Naturæ" was published in 1735, that is not accepted as the date of the establishment by Linnæus of the binomial system. The relegation of the technical names of the fossils illustrated in the text to an appendix is symptomatic of the present state of palæontological nomenclature; only general names are given in the legends of the figures. The use of popular names has the drawback that they vary so much locally, and English students are not likely to know what are meant by Sowbugs or Pillbugs (p. 605). The author accepts as undoubted the identification of some impressions in pre-Cambrian rocks of Brittany as radiolaria, though this conclusion is rejected by some who have examined the material. There is less evidence for the author's view that Eozoon is a calcareous alga than for its original reference to the Foraminifera, and it seems rather a "bull" to refer to some of these plants as fresh-water seaweeds.

In the historical geology the chief departures from the usual classification are the adoption of two additional systems; of these the Ozarkian System occurs between the Cambrian and the Ordovician, but as the Beekmantown beds are excluded its value appears doubtful. If the Beekmantown and allied faunas be included in the Ozarkian System a much stronger case could be made out for it. The Lower Cretaceous is raised to a system, the Comanchian, which includes from the Wealden to Albian inclusive. Prof. Schuchert's account of the historical geography is illustrated by admirable maps of geographical distribution; it gives a most useful summary of the stratigraphy of North America, and its up-to-date account of the principles of stratigraphy could be read with advantage by all British teachers of geology; but as the historical geology of the British area is incomplete and less accurate, this part of the volume will be of less value to British students than Prof. Pirsson's section.

The most serious drawback to this valuable text-book is the absence of references.

J. W. G.

RADIOGRAPHIC METHODS.

Localization by X-rays and Stereoscopy. By Sir J. Mackenzie Davidson. Pp. xi+72+xxvi plates. (London: H. K. Lewis and Co., Ltd., 1916.) Price 7*s.* 6*d.* net.

IN this book the author describes in detail several of the methods which have been devised for the accurate localisation of foreign objects in the human body.

The first two chapters deal with the experimental conditions which should be observed in order that good radiographs may be obtained, and with some simple yet excellent experiments illustrating the radiographic advantage of a good focus-point on the anti-kathode. The undesirable effects of secondary radiation receive mention; they are responsible for a good many of the defects which occur in radiographs, and constitute a danger (second only to the primary rays) to the operator, which the author does well to insist upon.

The main facts of X-ray stereoscopy are described and illustrated. By transposition of two stereoscopic photographs the point of view of the observer becomes reversed; some explanation of this would be of great assistance to the beginner.

The advantages of stereoscopy to the surgeon who is to remove the foreign object are obvious, and we agree with the author that some successful method of rendering stereoscopic images upon a fluorescent screen would be a great advance on present procedure. There are, however, many experimental difficulties to be overcome before this can be effected.

The author has done much to elaborate a precise means of localising foreign objects in the human body, and all the details of the "cross-thread" method are entered into. In cases where a foreign body is lodged in the eye or the orbit, precise localisation is absolutely essential; the chapter devoted to such cases is perhaps the best in the book.

The author directs attention to the misleading nature of a single X-ray photograph, but describes a method by which the depth of a foreign body below the surface may be obtained by means of a single X-ray exposure; this method entails the use of two sets of cross-wires which are placed at a known vertical distance apart. An oblique ray from the anti-kathode casts a shadow of the foreign body and of the lower set of cross-wires with respect to the other set of cross-wires, which is in contact with the photographic plate; simple measurements from the single photograph give the vertical depth of the foreign body below any point previously selected on the surface.

The book closes with a series of twenty-one stereoscopic illustrations on plates, which will repay careful study; it is worth noting that stereoscopic vision may be very considerably improved by practice.

Much of the wreckage of human life occasioned by the war would be past repair were it not for the extra vision vouchsafed to the surgeon by X-rays; whether in dealing with projectiles which have entered the body or in the damage to the structures, bony and otherwise, methods have been evolved which enable the surgeon to know exactly where to look and almost as surely what to find. The attitude of the author is that too much information cannot be given to the surgeon thus engaged, and it is safe to say that the methods of localisation described, together with a stereoscopic picture of the foreign body giving its relation to the neighbouring anatomical parts, inspire confidence.

OUR BOOKSHELF.

Economics in the Light of War. By Prof. R. A. Lehfeldt. Pp. 56. (Johannesburg: The South African School of Mines and Technology; London: Wm. Wesley and Son, 1916.) Price 1s.

In this slight, but well-reasoned, essay Prof. Lehfeldt contemplates the influence which the present war has had on economic theory. He deals only with consumption and production, "not," he says, "because the problems of distribution are not urgent, but because there seems to be less that is novel to say about them." This is surely a remarkable finding in view of the experiments in Germany and France. If there be little novel to say, there must then be many striking new proofs of old tenets of belief.

More attention will, Prof. Lehfeldt thinks, have to be given in the future to the human factor in economics. We are beginning to realise the necessity of a qualitative as well as a quantitative analysis of consumption. The human powers of production are more dependent than we have supposed on the human will to produce.

The essay is strikingly sound, if somewhat uninspiring; and it is refreshing after the cant which has been talked on the former and the absurdities which have been written on the latter to read the sound common sense of the author on the two problems of the size of the family and social welfare, and of the influence of taxation for the war loan on supplies of capital. It is, however, presumably popular in purport, and Prof. Lehfeldt does not venture on the treacherous currents of finance. A. L.

Interpolated Six-Place Tables of the Logarithms of Numbers and the Natural and Logarithmic Trigonometric Functions. Edited by H. W. Marsh. Pp. xii+155. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 5s. 6d. net.

The publication of these tables helps to mark a change in the use of logarithms, both for teaching and practical purposes. Nowadays most teachers use four-figure tables for teaching purposes, even in the laboratory; on the other hand, the reason given for the issue of this volume is that in many technical problems five significant figures are essential, so that a six-figure table is necessary. The contents of the book are: (1) logs of numbers, with differences and full tables of proportional parts; (2) logarithmic sines, etc., interpolated to the second; (3) natural sines, etc., tabulated to the minute, with proportional part for the second; (4) lengths of circular arcs to radius unity; (5) various tables of length, specific gravity, etc. Change of a leading figure in a mantissa is indicated in an unusually clear way; the figures used are mostly "old faced," and, although rather fine cut, do not seem to be tiring. But in using the tables it will be almost unavoidable to use a card to guide the eye along the lines; this is suggested in the introduction, which gives other useful hints. It seems to us that it would add considerably to the convenience of the book to give the values and the logarithms of certain constants, such as π, e, $\sqrt{\pi}$, Euler's constant, and so on; this would not require more than a page.

The World's Wonder Stories for Boys and Girls. By A. G. Whyte. Pp. xiv+270. (London: Watts and Co., 1916.) Price 6s. net.

These stories take the form of brightly written and interesting answers to a number of questions propounded by the author. How was the world made? Where did the plants and animals come from? Who was the first man? are specimens of questions which provide the opportunity for giving much biological and geological information, and for introducing a simply worded explanation of evolution.

A second type of question is made to serve another and additional purpose. Where did all the religions come from? Where did the Bible come from? Where did right and wrong come from? are questions asked to enable the author primarily to give moral instruction on a rational basis.

The chapters throughout are written in easy English which young children can understand; the information is correct and modern; and the language is dignified and circumspect. Orthodox teachers and parents whose teaching of morality follows conventional lines would undoubtedly derive benefit from the method of presentation adopted, while no child could read the book without understanding something of the scientific method and what it has accomplished.

Petit Atlas Céleste. By G. Bigourdan. Five charts. Pp. 59. (Paris: Gauthier-Villars et Cie, 1915.) Price 2.75 francs.

An admirable introduction to the study of the heavens is provided by this little book, which has been prepared by a distinguished member of the staff of the Paris Observatory. The constellations over the entire sky are represented in considerable detail in five excellent maps, the stars being shown in black on a white ground, and names and index letters in red. The introductory text includes a brief history and description of the constellations, and two very useful lists of stars. One of the catalogues is arranged in order of right ascensions, and is notable as indicating the spectra, in addition to the proper names, positions, and magnitudes, of 195 of the principal stars. The other is arranged according to constellations, in alphabetical order, and will be convenient as a means of quickly finding particulars of a star which is indicated only by its constellation and letter. The book is of a convenient size (9 in. × $5\frac{1}{2}$ in.), and may be recommended as a handy work of reference for use in the observatory as well as to beginners in observational astronomy.

LETTERS TO THE EDITOR.

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

The Concilium Bibliographicum of Zürich.

There appears to be in England some misapprehension in regard to the Concilium Bibliographicum of Zürich. All zoologists are probably aware that the international agency founded by the International Congresses of Zoology and Physiology has for twenty-one years been concerned in editing the "Bibliographia Zoologica"; but many seem to believe that the ownership has remained vested in the hands of Wilhelm Engelmann, of Leipzig, and that the undertaking has consequently fallen a victim to the war. To give the proper historical perspective to the work, its genealogy may be tabulated as follows:—

Series			Titles
I.	("Bibliotheca historica naturalis," I.)	1700–1846	13,560
II.	("Bibliotheca Zoologica")	1846–1861	40,750
III.	("Bibliotheca Zoologica," II.) ..	1861–1880	125,000
IV.	(*Zoologischer Anzeiger*)	1861–1895	115,000
	Prior to Concilium ...		294,310
V.	("Bibliographia Zoologica")	1896–	202,500
	Total...		496,810

On the death of Prof. J. Victor Carus, in 1903, the Concilium Bibliographicum became sole editor of the "Bibliographia Zoologica"; but the work remained a part of the *Zoologischer Anzeiger*, and was printed and distributed in Leipzig. In 1909 arrangements were made for printing in Zürich. Three years later the Concilium Bibliographicum acquired all rights over the "Bibliographia," and the relationship with the *Zoologischer Anzeiger* was severed. Vols. xxiii.–xxv. (1912–13), however, were still distributed to the book trade through the intermediary of Wilhelm Engelmann, the last part being ready in March, 1914. Vol. xxvi. went to press in April, 1914, and a circular announcing the fact that all services had been brought together in Zürich and that the new volume would be sent only to such as filed a new order was issued in June and July. The vacations and the outbreak of the war have caused this circular to be entirely overlooked, so that many zoologists have fancied that the great historic work had been suspended. This is far from being the case. Despite formidable difficulties, vols. xxvi.–xxix. have appeared, and vol. xxx. is in the press.

There has doubtless been a great falling off in the scientific output of all European countries, and the postal service is to blame for many gaps, but, in general, the experience of the past two years has shown the wisdom of the choice of a small neutral State as the centre for international co-operation. It is also worthy of being pointed out to the world of science that Switzerland, in spite of financial difficulties, which made it necessary for the Government to suspend almost all its support of Swiss science, made an exception for this international agency. The President of the Confederation proclaimed allegiance to the "Red Cross" of science, and our international institute continued to receive State subsidies. At the same time a public subscription brought together the necessary funds for covering the war-time deficit.

Herbert Haviland Field,
Director of the Concilium Bibliographicum.
Sunnyside, Mayow Road, Forest Hill, S.E.,
October 31.

Scarcity of Wasps.

Judging from the correspondence which has recently appeared in Nature, the dearth of wasps this autumn in many parts of England has been most pronounced, but I have not noticed any reference to the county of Somerset.

From August 26 to September 12 I was staying, with my wife and son, in a cottage on Christon Hill, on the Mendip Hills, situated between Loxton and Banwell, and although sunshine was only occasional, and rain somewhat frequent and often very heavy, we were simply besieged by wasps, which were particularly tiresome at the breakfast-table. They were so numerous at times, coming in from the open windows, that we frequently had to abandon our meals temporarily to punish the offenders, my son continuing his captures often for half an hour at a time. They were killed by the score daily, but still they seemed to infest everything, not only preserves and other food, but one's clothing also. In neighbouring houses we heard of the abundance of wasps. About 150 yards from our cottage we found a large nest of wasps in a bank by the roadside.

I cannot recollect ever having seen so many wasps in a house, unless it was during the hottest part of 1911 (August 31 to September 9), when I was conducting archæological excavations on Exmoor. At the hotel we were greatly pestered by the quantities of wasps which attacked the food.

H. St. George Gray.
Taunton Castle, November 4.

A Peculiar Thunderclap.

Referring to Mr. Don's letter (Nature, August 17), it may be of interest to note that for many years I have been observing thunderstorms, often from high places on Etna, and from a distance, and I have never seen a lightning flash which was a single one. Lightning flashes from the clouds to the earth are always two, three, or more, either very rapidly repeated on the spot and along the same track, or in different places, sometimes very far apart, and simultaneously.

In connection with the remarks by "H. O. F." (Nature, August 24), it may be worth mentioning that, as is well known, a lightning stroke induces in volcanic rocks a permanent magnetisation, often strong enough to make the needle of a pocket compass turn through an angle of 180°. From a large number of observations on Etna and Stromboli, my brother, Prof. Gaetano, and I have noted that, when lightning strikes a wall, or a large lava block, or the earth-wire of a lightning rod near a wall, south polarity is found in the lava, or in the bricks of the wall, to the right of the observer, and north polarity to the left. Such a disposition shows that the discharge was from +electricity of the ground to −electricity of the clouds.

Other observations on similar autoregistrations of lightning strokes and of their direction have shown that the discharge from the clouds to the earth is much less frequent than that from the earth to the clouds.

My brother and I will be glad to send our published notes to anyone who cares to have further details on the subject.

Giovanni Platania.
University of Catania, October 6.

The Pollination of Toadflax.

Can any reader kindly state—from observation—which insect pollinates the round-leaved toadflax—*Linaria spuria*?

S. P.

Linaria spuria, Miller, is a not uncommon weed of cornfields on calcareous soils in the Midlands and south of England, in western, central, and southern

Europe, in northern Africa, and in western Asia, and it occurs adventitiously in North America. I have never observed insects pollinating the flower. The corolla is closed, and probably small insects are unable to effect an entry; there are no "nectar-guides"; the four anthers are adherent, mature simultaneously with the stigma, and dehisce internally. It would seem, therefore, as Kunth ("Handbook of Flower Pollination," English translation by Ainsworth Davis, vol. iii., p. 177) states, that "automatic self-pollination is inevitable." I fear "S. P." will regard this answer to his question as analogous with the dictum: "There are no snakes in Iceland!" C. E. MOSS.

Botany School, Cambridge, November 9.

SCIENTIFIC GLASSWARE.

AN interesting account of the efforts which have been made in France to replace glassware for scientific and technical purposes which had formerly been imported from Germany and Austria by home productions is given in an article in the July–August number of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*. The article consists of a detailed account of an exhibition of French products of this kind, and affords interesting comparisons with the similar but much smaller exhibition recently held in the rooms of the Institute of Chemistry in Russell Square. The French exhibition included optical glass, and utensils for the heavy chemical trades.

In regard to optical glass, of course, it is not surprising to find that the French are in a far better position than that yet reached in this country. The firm of optical glass manufacturers which was founded in Paris by one of the Guinand family has been steadily developed, and has for years past—under the names of Mantois and latterly of Parra-Mantois—issued lists of optical glasses of a range and quality quite as wide as, and in many respects more satisfactory than, those of Schott, of Jena. It is, in fact, worth while remembering that on many occasions during the twelve or fifteen years preceding the war the British manufacturer of optical glass was confronted with a more serious competition from Mantois than from Schott.

This state of affairs must be held highly to the credit of the French glass-makers, and we see indications of similar skill and enterprise in other directions connected with the glass industry. French plate-glass, associated with the name of the great firm of St. Gobain, has long held a high reputation, while the name of Appert is a household word wherever glass is studied. Accordingly we see in the present record of the French exhibition a most comprehensive list of products of all kinds, including not only laboratory-ware, such as beakers, flasks, etc., but many specialities such as glass for X-ray tubes and glass for serum tubes. The list of exhibitors is so large, the range of products exhibited so wide, and the claims made for the quality of the products so sweeping, that one might well suppose that the French efforts in this direction had been crowned with complete success, and that their industries had been rendered entirely independent of imported goods. It is sincerely to be hoped, in the interests of our Allies, that this impression is correct, and that the ordinary users of this ware are really able to obtain it in the regularity—as regards both quality and quantity—which is essential for practical purposes.

So far as can be judged from the printed descriptions and the photographs with which it is illustrated, the French exhibition was on an altogether larger scale than the one recently held by the Institute of Chemistry. The latter was, in fact, somewhat disappointing as regards both number of exhibitors and range of exhibits. Some very creditable achievements were, of course, represented, particularly in regard to laboratory-ware, such as flasks, beakers, and similar articles. Those exhibited were excellent examples of their kind so far as workmanship and the obvious qualities of the glass are concerned. It was disappointing to find, however, that there was no evidence as to the real qualities of the various articles shown. Public testing laboratories are available in this country perfectly competent to give certificates of quality in regard to all articles of this kind; this being the case, why were not these exhibits accompanied by such certificates showing the behaviour of the glass to chemical reagents and to sudden changes of temperature? In the absence of such evidence we can only hope that the glasses labelled "resistant" are really fairly satisfactory for their purpose, and that the flasks and beakers will stand the usage to which they are of necessity exposed in the laboratory.

Another marked feature of the Institute of Chemistry exhibition was the circumstance that it was confined very largely to the lighter kinds of laboratory-ware. While manufacturers are to be congratulated upon the measure of success which they have achieved in this very important direction, it seems desirable to direct attention to the fact that laboratories cannot exist on light glassware alone. There is a whole range of glass articles of a heavier type which are also necessary—such as desiccators, separating funnels, jars and cylinders, etc.—which were formerly obtained from abroad. So far as the writer is aware, English-made articles of this class are not yet available, although the difficulties of manufacture are probably much less than those connected with ware which has to resist severe physical and chemical conditions.

In conclusion, it may perhaps be suggested that, while a good exhibition is of considerable value in bringing before those interested the best samples of the home products now available, the future of this glass industry and of the technical and scientific operations related to it depends upon a factor which can never be brought out by any exhibition—*i.e.* the steady and regular trustworthiness of the articles produced. In the chemical laboratory, for instance, it becomes a serious matter if at intervals a beaker or a flask should crack at a critical point in a long and delicate operation. It is only fair to point out that such untoward accidents did occur from time to time when Jena glassware was used, but, broadly speaking, they were rare. It is, of course, too early in their career to pronounce upon the British manufacturers of these goods in this respect, and the matter is only mentioned here in the desire to impress upon them the extreme importance of this factor of uniformity and trustworthiness. Beautiful samples sent for exhibition and specimens sent for trial or test which behave extremely well may serve to initiate trade and to introduce the products, but only complete regularity and dependence will ever succeed in building up a permanent industry and trade in these goods.

PROF. H. H. W. PEARSON, F.R.S.

BY the death of Prof. H. H. W. Pearson, which occurred on November 3 at the Mount Royal Hospital, Wynberg, Cape Colony, South Africa is deprived of one of the ablest and most popular of her scientific men, and botanists have lost a colleague richly endowed with the qualities which go to make an ideal student of Nature.

Harold Henry Welch Pearson was born at Long Sutton, Lincolnshire, in 1870; he was privately educated; after holding a teaching post in an Eastbourne school he entered the University of Cambridge as a non-collegiate student, and later became a member of Christ's College, where he remained until his election to the Frank Smart studentship, which necessitated migration to Gonville and Caius College. His Cambridge career was a series of successes: in 1899 he was awarded the Walsingham medal for work in Ceylon on the vegetation of the Patanas. In 1898 he was appointed curator of the Cambridge Herbarium, and in 1899 he joined the staff of the Kew Herbarium. In 1902 he was appointed professor of botany at the South African College, Cape Town, where he laboured with conspicuous success up to the time of his death. He was elected into the Royal Society in the present year. Though the double responsibilities of the professorship and the Botanic Garden were no light burden, Pearson enlisted as a trooper in a Local Defence corps.

Full advantage was taken of the splendid opportunities of exploration afforded by South Africa, and Pearson proved himself to be an explorer of the best type; he visited Damaraland four times, and in January of this year he wrote home from Windhoek after a particularly arduous journey undertaken with the fullest approval and support of General Botha. He also explored Namaqualand, Bushmanland, Angola, and other regions, always returning with valuable booty, of which he made the best use both by his own researches and by generous gifts to institutions and other botanists. Pearson's expeditions were readily assisted by scientific bodies, and especially by the Percy Sladen Trustees, whose liberal contributions were well earned and thoroughly appreciated. His first paper (1898) dealt with the anatomy of the seedling of the Cycad Bowenia, and in 1899 the Linnean Society published the results of his field-work in Ceylon. In 1902 he wrote on the double pitchers of a Dischidia.

Pearson's most important work is on Welwitschia and Gnetum; he not only greatly extended our knowledge of these Gymnosperms, but with conspicuous ability demonstrated the nature of the "endosperm," for which he proposed the term trophophyte. Pearson's more recent contributions have strengthened his position on the vexed question of the degree of affinity of the Gnetales to the Angiosperms. In one of his most recent letters Pearson referred to the MS. of a promised volume on the Gnetales as almost complete. Observations on South African Cycads, investigations on the common maize disease caused by the root-parasite *Striga lutea*, an account of the Thymeleaceæ in the Flora of Tropical Africa, a paper on the internal temperature of Euphorbia and Aloe, and well-written descriptions of travels illustrate the wide range of his activities.

The greatest service rendered by Pearson to South Africa was the part he played in the foundation of the National Botanic Garden, and it was his tactful and untiring efforts which led the Government to set apart about 400 acres on the Kirstenbosch estate, on the east side of Table Mountain, for a National Garden, of which he was appointed honorary director in 1913.

Pearson was a botanist of many parts, and a man who inspired affection in an unusual degree by his geniality, honesty of purpose, and boyish enthusiasm. He recognised the almost unlimited possibilities of botanical and economic developments through the Kirstenbosch Garden, and it is for his successors to do their part in carrying out the broadly conceived scheme of the first director. In a letter dated July, 1913, he wrote: "It will be a great burden, but it is worth carrying, even if it never falls to me to exploit its contents."

A. C. SEWARD.

PROF. HENRIK MOHN.

THE death of Henrik Mohn, on September 12 at Christiania, removes from the meteorological world a very well known and popular figure. Born at Bergen on May 15, 1835, he had completed his eighty-first year. He took part in all international assemblies of meteorologists from the commencement of the series of 1873 until the meeting of the International Meteorological Committee at Rome in 1913, when he excused himself on account of the long journey. Shortly afterwards he retired from his appointment as director of the Norwegian Meteorological Service and professor in the University of Christiania, which he had held since 1866. He maintained his scientific activity to the end of his life. His most recent work was the discussion of the meteorological observations of Amundsen's expedition to the South Pole, which was published in 1915. It displays remarkable ingenuity in giving a connected meteorological account of the conditions near the Pole based upon a very limited number of data, but with true insight.

Mohn's best-known work is a text-book of the principles of meteorology, which passed through many editions and was translated into almost all European languages except English. By the series of papers on the movement of the atmosphere,[1] written in collaboration with C. M. Guldberg, and published in Christiania in 1876 (revised 1883), he became one of the most successful exponents of dynamical meteorology. His institute was prominent among its fellows for the excellence of its regular publications and the promptitude with which they were issued. He was a strenuous advocate of the use of the hypsometer for absolute determinations of pressure; and on the occasion of a visit to England he took the opportunity of making a comparison between barometric standards by that method, which agreed with direct comparisons within a thousandth of an inch.

Mohn's published papers are very numerous and cover all sections of meteorological science. He was the author of the article on the geography of Norway in the ninth edition of the "Encyclopædia Britannica" and a number of articles on the climate of Norway. He had a remarkably close grip of the conditions and limitations of meteorological observations and observers, and on that account was a most valued member of the International Meteorological Committee and of the various conferences and congresses at which the principles and the programmes of international co-operation were discussed. His personal qualities secured for him universal esteem as the *doyen* of international meteorologists. He was generally chosen by the Norwegian Academy as one of its representatives at international celebrations. The regret called forth by his retirement on account of his advancing years was revived and heightened by the news of his death. NAPIER SHAW.

NOTES.

WE learn with much regret of the death, on November 12, at sixty-one years of age, of Prof. Percival Lowell, director of the Lowell Observatory, Flagstaff, Arizona, where his notable work on Mars and other planets has been carried on since 1894.

HIS MAJESTY THE KING has been pleased to approve of the following awards this year by the president and council of the Royal Society:—A Royal medal to Dr. J. S. Haldane, for his services to chemical physiology, more especially in reference to the chemical changes of respiration; a Royal medal to Prof. H. M. Macdonald, for his contributions to mathematical physics. The following awards have also been made by the president and council:—Copley medal to Sir James Dewar, for his investigations in physical chemistry, and more especially his researches on the liquefaction of gases; Rumford medal to Prof. W. H. Bragg, for his researches in X-ray radiation; Davy medal to M. le Prof. H. L. le Chatelier, for his researches in chemistry; Darwin medal to Prof. Yves Delage, for his researches in zoology and botany; Sylvester medal to M. J. Gaston Darboux, for his contributions to mathematical science; Hughes medal to Prof. Elihu Thomson, for his researches in experimental electricity.

[1] An English translation is given in Abbé's "Mechanics of the Earth's Atmosphere." Third Collection. (Smithsonian Institution, 1910.)

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council at the anniversary meeting on November 30:—*President*, Sir J. J. Thomson; *Treasurer*, Sir A. B. Kempe; *Secretaries*, Prof. A. Schuster and Mr. W. B. Hardy; *Foreign Secretary*, Prof. W. A. Herdman; *Other Members of the Council*, Prof. J. G. Adami, Dr. H. T. Brown, Dr. Dugald Clerk, Prof. A. R. Cushny, Prof. A. Dendy, Prof. P. F. Frankland, Prof. J. W. Gregory, Dr. H. Head, Mr. J. H. Jeans, Major H. G. Lyons, Major P. A. McMahon, Prof. F. W. Oliver, Prof. C. S. Sherrington, Prof. A. Smithells, Hon. R. J. Strutt, and Mr. Richard Threlfall.

ELEVEN members of Sir Ernest Shackleton's Antarctic expedition arrived in London last week, including Mr. Frank Wild (second in command), Messrs. J. Wordie, R. S. Clark, R. James, L. Hussey, and G. Marston (of the scientific staff), Major Orde Lees (motor engineer), and Messrs. A. Macklin and J. McIlroy (surgeons). The remaining members of the Weddell Sea party will arrive shortly, with the exception of Sir Ernest Shackleton, who is on his way to New Zealand to join the *Aurora*. In an interview in the *Daily Chronicle* Mr. Wild gives some account of the experiences. The *Endurance* was nipped in the ice four months before she eventually sank, and the explorers fortunately had ample time even at the end to remove stores and equipment to the ice. With these stores, and meat provided by shooting the dogs, as well as a few seals and penguins, they managed to survive. On Elephant Island, with its scanty resources, the food problem caused grave anxiety, for the stores were running low. We have not heard any details as yet about the scientific results, but they must be considerable, at least in oceanography and meteorology. A number of kinematograph films have been brought back, including views of the crushing of the *Endurance*, the abandoning of the ship and her foundering, as well as of the explorers' life on the drifting ice-floe and on Elephant Island.

THE Women's National Land Service Corps has just issued an interim report on the work of the last eight months. This organisation is recognised by the Board of Agriculture and has received a Government grant. It has endeavoured to create a favourable opinion as to the value of women's work in agriculture by supplying a body of workers capable of making a good impression, and so break down the prejudice of those farmers who are opposed to the employment of women. From the start the selection committee has spared no pains to prevent unsuitable women from going on the land, with the result that, considering the difficulties involved, the number of failures has been extraordinarily small. The corps has several training centres in different parts of the country, where women are given short courses of instruction in farm work. Besides supplying labour units to farmers, another, and perhaps more important, branch of the work has been directed against the view, widely held in the rural districts, that work on the land is derogatory. The interesting letters appended to the report give a very clear idea of this difficulty. The corps is urgently in need of more recruits to meet the demand from farmers which cannot now be met, and is certain to become greater after January 1, 1917, when exemptions of agricultural labourers are to be reconsidered. The secretary of the corps is Miss A. C. Franklin, and the headquarters are at 50 Upper Baker Street, London, N.W.

AN inter-departmental committee, presided over by Mr. Harcourt, has now arranged the respective spheres of work and co-operation, in dealing with commercial inquiries, of the new Commercial Intelligence Department of the Board of Trade and the Imperial Institute, which in recent years has become a central department for information and investigation respecting the sources and uses of the raw materials of the Empire. In future the Technical Information Bureau of the Imperial Institute will answer all commercial inquiries respecting the sources of supply, technical uses, and value of raw materials within the Empire, and will be responsible for supplying all information required in order to bring the producer overseas in touch with the manufacturer at home. Inquiries as to immediate supplies may be addressed either to the Board or to the Institute, as may be most convenient, but the Commercial Intelligence Department of the Board of Trade will as a rule be prepared to deal with inquiries for immediate supplies of well-known raw materials which can be obtained at once through ordinary trade channels. In answering those inquiries in which special statistical or trade information is required, in addition to technical information, the Board and the Institute have arranged to co-operate. Investigations of the possible industrial uses of raw materials will, as heretofore, be dealt with by the Imperial Institute. The arrangement proposed by the committee has now been accepted by the Secretary of State for the Colonies, the President of the Board of Trade, and the Executive Council of the Imperial Institute.

DR. HENRY HEAD, F.R.S., has been appointed a member of the committee to inquire into the position occupied by natural science in the educational system of Great Britain.

WE regret to announce the death on November 13 of Mr. Charles Smith, master of Sidney Sussex College, Cambridge, and author of many well-known works on mathematics, at seventy-two years of age.

THE Stockholm correspondent of the *Morning Post* states that the Nobel prize for physiology for 1916 will probably be awarded to Prof. H. J. Hamburger, of Groningen University. It is stated that the Swedish Academy of Sciences has decided not to award this year the Nobel prizes for physics and chemistry.

MR. R. N. DOWLING, organiser of agricultural education to the Lindsey County Council, Lincs., has been appointed director of the first Government farm colony for ex-service men in the East Riding of Yorkshire. An account of the Government scheme for the establishment of this land-settlement colony was given in NATURE of October 26, p. 152.

AT a recent meeting of the Optical Society the election to honorary membership took place of Sir Frank Dyson, Astronomer Royal, Prof. R. A. Sampson, Astronomer Royal for Scotland and professor of astronomy in the University of Edinburgh, and Prof. H. C. Plummer, Royal Astronomer of Ireland and Andrews professor in the University of Dublin.

THE Maria Mitchell Memorial Astronomical Fellowship at Harvard Observatory, value 100*l*., is offered to a woman for the year beginning September 15, 1917. The fellowship at all times must be used for purposes of serious study, and the fellow should be as free as possible from other responsibilities. Application must be in the hands of the secretary of the committee, Mrs. Charles S. Hinchman, 3635 Chestnut Street, Philadelphia, Pennsylvania, on or before April 1, 1917.

THE next award of the quinquennial Cartwright prize of the Royal College of Surgeons of England will be for the five years ending December 31, 1920. The prize consists of a medal in bronze and an honorarium of 85*l*. The subject for the competing essays is "The Treatment of Injuries of the Jaws, and the Restoration by Mechanical Means of Parts of the Jaws Lost as the Result of Injury or Removed on Account of Disease." Further particulars of the competition are obtainable from the secretary of the college.

IT had been proposed to establish a whaling station with its accompanying works near Fiskebäckskil, on the Gullmar fjord, north of Gothemburg, but the Swedish Government has now placed its ban on any such handling within Swedish terrritory of right whale, sperm whale, or beaked whale. This decision will be welcomed by the workers at the neighbouring biological station of Kristineberg, as well as by all naturalists who wish for some limit to be set to the chase of these interesting and threatened animals.

THE introductory lecture of a course of twelve lectures (the Swiney Lectures on Geology) on "The Mineral Resources of Europe" was delivered by Dr. J. S. Flett, at the Royal Society of Arts, on Tuesday, November 14. The remaining lectures will be given on Tuesdays, Thursdays, and Fridays, at 5 p.m., until Friday, December 8. The subjects to be dealt with are coal resources, petroleum, iron ores, copper, tin, manganese, lead, the precious metals, and the salt deposits of Germany, France, and Britain. The lectures will be illustrated by lantern-slides, and admission to them is free.

AT the anniversary meeting of the Mineralogical Society held on November 7 the following were elected officers and members of council:—*President*, Mr. W. Barlow; *Vice-Presidents*, Prof. H. L. Bowman and Mr. A. Hutchinson; *Treasurer*, Sir William P. Beale, Bart.; *General Secretary*, Dr. G. T. Prior; *Foreign Secretary*, Prof. W. W. Watts; *Editor of the Journal*, Mr. L. J. Spencer; *Ordinary Members of Council*, Capt. W. Campbell Smith, Dr. J. W. Evans, Dr. F. H. Hatch, Mr. J. A. Howe, Mr. T. V. Barker, Mr. G. Barrow, Prof. C. G. Cullis, Mr. F. P. Mennell, Mr. H. Collingridge, Mr. T. Crook, Dr. G. F. Herbert Smith, and Dr. H. H. Thomas.

CAPT. R. W. NICHOLS, who was killed in action on October 23, at thirty-one years of age, entered the service of Messrs. Arthur Guinness, Son, and Co., Ltd., at the age of fifteen. On the formation of the Guinness Research Laboratory in 1901 Capt. Nichols was employed as assistant to Mr. F. Escombe. In all work in connection with this he showed conspicuous ability. He left the service of Messrs. Guinness about five years ago, and, after a short service with an English firm, emigrated to Canada, and soon obtained a position at the Agricultural Station at Ottawa, where he was employed up to the time of joining the Army. Capt. Nichols was an extremely keen worker, and his cheerful temperament gained him a great number of friends. His loss will be deeply regretted by all his associates.

IN the Scottish lighthouse service there have been for many years a number of lightkeepers interested in natural history, especially in bird-life, who have contributed valuable records on the migratory movements of birds to the annual reports on Scottish ornithology. One of these has just passed away in the person of Mr. J. M. Campbell, who was, besides, keenly interested in the study of marine life, for which his nine years' residence on the Bell Rock afforded him ample opportunities. In 1904 he published a well-written volume on the "Natural History of the Bell Rock," in which he described, month by month, the seasonal fluctuations of the invertebrate life exposed at low tides on the rocks around the lighthouse, and of the birds visiting it and the lantern. On his transference to the Bass Rock he turned his attention to the hosts of sea-fowl resorting to that famous nesting haunt, more particularly to the gannet, on which he contributed many valuable notes to Mr. Gurney's monograph of that bird. Mr. Campbell also made some useful contributions to Mr. Evans's papers on the moths occurring at the lanterns of the northern lighthouses, which recently appeared in the *Scottish Naturalist*.

BY the death on November 5, after a long illness, of Prof. H. M. Waynforth—until recently professor of engineering in King's College, London—engineering teaching has suffered a great loss. Born in 1867, Prof. Waynforth was educated at the Haberdashers' School and at the Finsbury Technical College, his apprenticeship being served at Messrs. Bennett and Sons, engineers. He was assistant to Prof. Perry at Finsbury for some time, after which he went to Mason College, Birmingham, as demonstrator in engineering, leaving Mason College to join the engineering staff of King's College, London, in 1896. He was appointed assistant-professor of engineering in 1902, and University professor in 1912. His work for engineering teaching in the University of London was most valuable and important. The present syllabus for the B.Sc. degree in engineering, especially in theory of structures, strength of materials, and theory of machines, owes much to his energy and professional ability. An eminently practical man, he laboured assiduously to keep the syllabus as practical as possible, and at the same time to maintain a high standard of academic attainment. He did a good deal of original work on the testing of materials, but it will be as a great teacher that he will be best remembered. His lectures at King's College were marked by great freshness and vigour, and his breadth of mind and cordial sympathy endeared him to all his students. His loss will be felt by his old colleagues at King's College and in the University of London, but he will be especially mourned by the large number of King's College men who now, on many battle-fronts and in the Grand Fleet, are applying the principles he taught so well to the engineering problems of the war.

THE Kelvin lecture delivered before the Institution of Electrical Engineers on November 9 by Dr. Alexander Russell dealt with some aspects of Lord Kelvin's life and work. After giving a short account of his early life, Dr. Russell showed how, in many fields of fundamental importance to the electrical engineer, Lord Kelvin's work had provided the basis on which his successors had built. His solution of the problem of the transmission of signals along a submarine cable given in 1851 only requires a slight extension to make it suitable for the electric transmission of power in a three-phase system, while his proof that the temperature of a heated body may be less when it is surrounded by a bad conducting covering than when it is left bare has been reproduced by others as a new discovery. Many of the theoretical extensions of Lord Kelvin's work we owe to Dr. Russell himself, as, for example, the calculation of the force between electrified spheres. As, in addition, he is a former pupil of Kelvin, it would have been difficult to find one more fitted than Dr. Russell to treat of Lord Kelvin's work with understanding and with sympathy. As a teacher of the natural philosophy class at Glasgow University, with pupils whose principal ambition was to pass the M.A. examinations, Lord Kelvin was to a great extent wasted. If he could have spent his time in inspiring with his own spirit and enthusiasm for research a selected body of students more capable of appreciating his genius, how much richer science would have been. May we hope that by the time another Kelvin appears we shall have learnt how to utilise his powers to greater advantage than in preparing undergraduates for their degree examinations.

At the annual meeting of the Society for Extending the Rothamsted Experiments, held on November 6, Mr. J. F. Mason, M.P., being in the chair, an address was given by the Rt. Hon. the Earl of Crawford and Balcarres, President of the Board of Agriculture, who sketched briefly the history of the Rothamsted Experiment Station and the part it has played in the development of British agriculture. During the war the work of the station has necessarily been modified. Two-thirds of the total staff are either fighting or engaged on direct war work, the special experience gained at Rothamsted having proved unexpectedly useful in certain highly important directions. Some of the staff hold commissions in the Sanitary Corps; some are engaged under the Ministry of Munitions in the large-scale manufacture of a certain indispensable constituent of high explosives; while some are fighting in infantry regiments. Those left at the laboratory are kept occupied with special inquiry work sent in by the Board of Agriculture and other departments. Nevertheless, the ordinary work is still being continued. Women workers have come in to take the place of some of the men who have gone, and they are keeping nearly all the lines of experiment alive, so that not only is nothing being lost, but steady progress in the experiments is being made. The whole of the organisation is thus being kept in working order, and in readiness for full development to deal with the problems of the new situation which will undoubtedly arise after the war. The director of the station, Dr. E. J. Russell, was able to announce some handsome gifts during the year, including 1000*l.* from the widow and daughter of the late treasurer, Dr. Hugo Müller; 300*l.* from the Carnegie Trustees for the purchase of books for the library; 232*l.* from the Rt. Hon. Sir John T. Brunner, P.C., for furnishing the library; as well as other gifts for the laboratories and the library. The sum of 500*l.*, needed to clear off the Building and Equipment Fund, was raised at the meeting on November 6.

IN the third issue of *Folk-lore* for the current year Mr. S. A. H. Burne discusses some examples of survivals of folk memory in Staffordshire. Thus he points out that local tradition describes with some correctness Cromwell's action in regard to the rights of freeholders in Needwood Forest, and a local rhyme, still current, expresses the popular joy at the Restoration, the despotism of the Executive under Cromwell being much disliked. The idea, still prevalent, that the corpse of a person dying through violence should not be touched before the arrival of the police is traced back to medieval criminal procedure, which imposed a certain presumption of guilt upon the first finder of a dead body. Hence it was manifestly wise to let someone else discover it, and the current idea is a survival from coroners' law in the Middle Ages.

THE tests used for determining colour vision and tactile discrimination by the Cambridge Anthropological Expedition to the Torres Straits fifteen years ago are criticised in great detail by Prof. E. B. Titchener in the Proceedings of the American Philosophical Society (vol. lv., No. 3). The findings of this expedition have been so often quoted, and so many generalisations from these tests made about the native mind, that the writer of the paper thinks that more attention should be paid to the technique and suitability of the tests. He criticises Dr. McDougall's use of the æsthesiometer from the point of view of method, and the apparatus chosen by Dr. Rivers to test colour vision. If the tests themselves are faulty, then the generalisations based on them are invalid, and the writer thinks that the Murray Islanders ought not to be judged by these experiments. Anthropologists and ethnologists will find the whole article of interest.

ALTHOUGH the lack of a definition of disease does not prevent the practice of medicine, the amount of litigation which has recently arisen about medical matters, such litigation turning upon the meaning of terms like injury, accident, disease, etc., necessitates the accurate definition of such terms. It is the object of an article by Dr. Charles Mercier in the October number of *Science Progress* to define "a disease." Every part of the human body has a duty towards the whole, which Dr. Mercier calls its extrinsic function, and a duty towards itself (which consists in making good the waste consequent on the performance of its extrinsic function), its intrinsic function. When the intrinsic or extrinsic function of a part of the body is disordered or defective, there is usually some sign of such disorder or defect. The sign may be perceptible to the patient alone, to bystanders alone, to a skilled physician alone, or to all three. Such a sign is termed a symptom. Disease is a term covering not only all disorders of function and all symptoms, but also all results of disorder of function. Indigestion, a disorder purely of extrinsic function; atrophy, a disorder purely of intrinsic function; albuminuria, a result of disorder of extrinsic function; cancerous breast, a result of disorder of intrinsic function; and pain, are all disease. But none of these is "a disease." Diseases may become symptoms, but the only way they can do so is in the way we contemplate them. Certain things sometimes called diseases are not diseases. Structural disease is not "a disease"; thus a cancerous liver may be removed from a dead body and preserved in spirit, and it would obviously be absurd to call the preserved organ a disease. It is a diseased organ, but not a disease. A valve of the heart of a patient suffering from rheumatic fever may undergo structural damage, which, with its consequences and symptoms, constitutes "heart disease." But the latter is only part of "the disease" from which the patient suffers, which is acute rheumatism. When, however, the rheumatism disappears, leaving the heart damaged, this structural damage, together with its symptoms and consequences, becomes "the disease."

DR. A. RASMUSSEN, in the *American Naturalist* for October, gives a very valuable summary of all the theories which have been advanced in explanation of the hibernation of animals since Gesner wrote in 1551. Conrad Gesner was apparently the first to conduct experimental work by way of an attempt to solve the mystery which enshrouds this peculiar state of torpor, though speculation on the subject goes back to the time of Aristotle. Although the author refers occasionally to the hibernation of "man and other animals," yet in his essay he confines his remarks entirely to mammals. He insists that until certain causal relations are definitely established between the factors concerned many of these theories are of little value except as a stimulus to further research. If the hibernation of mammals is only an extreme form of ordinary diurnal sleep, as some maintain, it is especially to be hoped that this subject will continue to be investigated by more modern and adequate means, for no entirely satisfactory theory has yet been advanced to explain the physiological cause of ordinary sleep.

IN a recent report to the governors of the Huddersfield Technical College, Dr. A. E. Everest, the newly appointed head of the Department of Coal-Tar Colour Chemistry, refers to the objects which the governing body had in view in grafting this extension on to the courses already existing in the college. The aim is to establish in Huddersfield "a laboratory for research and post-graduate work that shall be the national centre to which all firms connected with the coal-tar colour industry shall naturally come for assistance, and around which all matters connected with coal-tar colour chemistry shall centre." It is recognised that the first essential to the success of this scheme is to keep the new laboratory open to the participation of all industrialists interested in this branch of applied chemistry, and to this end the governors have selected as the head of the department one not in any way tied by appointment to any particular firm. British Dyes, Limited, the directors of which have helped the new venture with a substantial endowment, are now in possession of the Tunbridge works of the old firm of Messrs. Read Halliday and Sons, Limited. Moreover, this company has made great progress with its new factory in the auspiciously named suburb of Dalton. At Deighton, within a stone's-throw of the Dalton site, are the rapidly extending works of Messrs. L. B. Holliday and Co., at present engaged on an improved process for an urgent necessity. At Milnsbridge, also in the same valley, is the old-established firm of Messrs. Leitch and Co., who have accomplished work of national importance. These and other firms outside Huddersfield have interested themselves in the new department, and have rendered valuable assistance. At present teaching and research work are in progress, temporary accommodation having been found in the chemical department. These facilities are, however, quite inadequate, and a suitable site has been acquired for the colour department, on which well-equipped laboratories, offices, and reference library will be built so soon as the necessary funds are available.

THE "Galvanoset," a patented piece of apparatus utilising the ordinary electricity supply for medical purposes, has been submitted to us for examination by the Medical Supply Association, Gray's Inn Road, W.C. It may be described as a potential divider using tap-water as the medium conveying the main current. The water is contained in a cylindrical glass vessel about 9 in. in diameter and 4 in. deep. Into the water dip two vertical rods of electric light carbon placed as far apart as possible, and supported from the flat ebonite cover of the glass vessel. From these electrodes current is taken to the patient. Just below the cover is a horizontal arm which rotates about a vertical central axle and carries at its ends two vertical carbon electrodes which are connected to the mains. When the movable electrodes have their joining line perpendicular to the line joining the fixed electrodes, there is no potential difference between them, but when their joining line coincides with that between the fixed electrodes there is the maximum potential difference. The pairs of electrodes never touch, so there is no danger of passing a large current through the patient. By the aid of a graduated circle on the cover and an outer index attached to the arm carrying the movable electrodes, an approximate notion of the voltage in the derived circuit is obtained, but for greater precision a milliammeter is provided on the cover. A trial shows that when a pressure of 100 volts is applied between the fixed electrodes a maximum current of about 200 milliamperes flows in the derived circuit. Quite apart from the medical purposes for which it is designed, an apparatus such as this would have manifold applications in all laboratories where small variable currents are required.

OUR ASTRONOMICAL COLUMN.

THE ECLIPSING BINARY RX HERCULIS.—An extended series of observations of photographic magnitudes of this variable has lately been made and discussed by R. H. Baker and Edith E. Cummings (Laws Obs. Bull., No. 25). The observations were made by the extra-focal method and, in combination with the spectroscopic evidence, lead to the following conclusions:—The two stars are slightly ellipsoidal, and each has a radius about one and a half times that of the sun. The mass of each star is a little less than that of the sun, and the density is about one-fourth of the sun's density. The star eclipsed at principal conjunction is of magnitude 7·96, and is brighter by 0·12 magnitude than its companion; its surface brightness, mass, and density are greater than those of the fainter star by 12, 6, and 9 per cent. respectively, and it is of slightly earlier spectral class (A). The distance between the centres of the two stars is about five times the radius of either star, or about 5,280,000 km. At conjunction 70 per cent. of the disc of one star is eclipsed by the other. The period is 1·7785740 days (Shapley), and the semi-duration of eclipse 2h. 53m. The photographic magnitude of the system is 7·264, and the magnitudes at primary and secondary minima 7·84 and 7·71 respectively. Outside eclipse the intensities generally increase towards secondary minimum, showing that the light of the star eclipsed at this time is augmented by radiation of its brighter companion.

SPECTROSCOPIC RESOLVING POWER.—The resolving power of a spectroscope is limited by the diffractional broadening of the geometrical images of the slit, and, following Lord Rayleigh, the limit of resolution usually adopted is determined by the condition that the maximum of the central band corresponding to one of the lines should fall on the minimum of that of the second line. Under these conditions, for two lines of equal intensity, the intensity at the centre of the combined bands is 0·81 of that of the maxima. An experimental investigation made by C. M. Sparrow at the University of Virginia (*Astrophysical Journal*, vol. xliv., p. 76) has led to the result that the limit of resolution is given by the "undulation condition"—that is, by the condition that the central minimum shall just disappear. The theoretical resolving power thus derived is about 26 per cent. greater than that given by the Rayleigh criterion. Among other matters of interest, a simple approximate formula is given for the resolving power of the Fabry and Perot interferometer.

THE MINIMUM RADIATION VISUALLY PERCEPTIBLE.—Adopting the light from a 6th magnitude star as the smallest amount perceptible, Dr. H. E. Ives has made an interesting calculation of the corresponding least quantity of radiant energy capable of exciting the sensation of light (*Astrophysical Journal*, vol. xliv., p. 124). Taking Russell's estimate that a candle at one metre distance is of stellar magnitude $-14·18$, it is easily deduced that the brightness of a 6th magnitude star is $0·849 \times 10^{-8}$ of this. Since a metre-candle is equivalent to 1·59 ergs per sec. per sq. cm., it follows that the least power corresponding to illumination from a light-source of the above brightness is $1·35 \times 10^{-8}$ ergs per sec. per sq. cm. Assuming 6 mm. as the diameter of the pupil, the radiation entering the eye from a light-source of maximum efficiency of the brightness of a 6th magnitude star would be $0·38 \times 10^{-8}$ ergs per sec. On the assumptions made, this is the smallest amount of radiation perceivable by the eye, but it is important to note that the figures given only apply to radiation from a distant point-source, such as a star. At this rate of energy-reception the eye would receive through the pupil the elementary energy-quantum in one-thousandth of a second.

METEOROLOGY IN WAR.

LONG before the outbreak of the world conflagration of the past two years war and the weather was a subject which captivated many minds, mainly of non-scientific or semi-scientific people who were prepared to accept as proof the most superficial circumstances which seemed to substantiate any popular belief. Even during the progress of the present war there have been many discussions in the Press and before societies in this and in other countries which have had for their object the perpetuation of the old belief that gun-firing causes rain, though round Shoeburyness, our great gun-firing station, less rain falls than in any other part of the British Isles! These quasi-learned discussions have been of no assistance to the fighting forces on sea or land.

Scientific investigators, however, have not been idle, though little or nothing of their activities is known outside official circles. The meteorological establishments of the various countries involved in the great war have been doing their utmost to utilise the now very greatly increased knowledge of the physics of the atmosphere for the immediate benefit of the armies. Perhaps, at first sight, it would be natural to infer that meteorologists can go no further than prepare, on the lines familiar to us during the past half-century, predictions of the weather changes likely to take place within the coming twenty-four hours. But the matter has got far beyond this. As is stated in the eleventh annual report of the Meteorological Committee for the year ended March 31 last, just issued (Cd. 8381, price 1*d.*):—"The variety of ways in which the weather affects warlike operations in all parts of the world has become very apparent from the diversity of the information which the Office is called upon to supply at short notice. The results of meteorological inquiries initiated in what appeared to be the remote interest of the theory of the circulation of the atmosphere have turned out to have important practical bearings."

Both for naval and military operations accurate forecasts have been greatly enhanced in value, yet probably they are not more important than other tasks now undertaken by the meteorologists—for example, the behaviour of the upper atmosphere for the information of the flying services, and the condition of the surface atmosphere and its relation to gun-sighting and range-finding. According to the official report referred to above a separate unit of the Royal Engineers was created for a meteorological field service, that with the Expeditionary Force in France being under the command of Major Gold, one of the Meteorological Office superintendents, and that in the eastern Mediterranean under Capt. Wedderburn, honorary secretary of the Scottish Meteorological Society, assisted by Lieut. Kidson, of Canterbury College, New Zealand, and magnetician in the service of the Carnegie Institution of Washington. In view of the importance of an adequate knowledge of the weather to the proper conduct of naval and military operations in the Mediterranean generally, Major Lyons, R.E., formerly Director-General of the Egyptian Survey Department, was appointed to take charge of this section. Further, the importance of co-ordinating the experience of flying officers with the work of the Office and observatories in order to obtain more effective knowledge of the structure of the atmosphere has led to the appointment of Major G. I. Taylor, Schuster reader in meteorology, to the professorship of meteorology to the Royal Flying Corps.

That the responsible authorities appreciate the work performed by the meteorological services is evidenced by the Distinguished Service Order conferred on Major Gold, and the inclusion of some of his assistants in the Commander-in-Chief's despatches; while the

Meteorological Office has received the special thanks of the Admiralty for its services in the Mediterranean. The world at large has been unaware of these manifold activities, imagining that the Meteorological Office practically ceased to exist when the daily forecasts in the newspapers came to an end. Yet during its silence the department has been worked far harder than ever before, and it was in recognition of the success of the service that the director received the honour of knighthood.

EDUCATION AT THE BRITISH ASSOCIATION.

AFTER the presidential address, the section took up the discussion of the reform of the primary school. Mr. J. C. Legge dealt with handwork, but unfortunately he spent the greater part of his half-hour upon historical and psychological preliminaries. Of the constructive suggestions outlined in the abstract the most interesting was the idea of finding in the soldiers returned from the war a great reservoir of admirable men who might be trained as teachers of handwork. He concluded with a plea for greater freedom to local authorities, a freedom such as would allow them to develop along their own lines, under the gentlest supervision from a very human central authority. Prof. T. P. Nunn pointed out the dangers of formality in handwork—a danger from which Mr. Legge's paper was not wholly free, in so far as it seemed to separate the activity of muscle and nerve from purposefulness. Manual activity must not be regarded as an end in itself, a danger which it shared with all other school subjects, as shown especially by mathematics and geography. Some body of central interest, life itself perhaps, is essential in order to give meaning to the several parts of the curriculum. In school, handwork should be an aid to the so-called intellectual subjects, and it should be the means of developing the feeling for craftsmanship and art. Prof. J. A. Green pleaded for a larger place and a new use for books. The bookiness of the primary school was not due to a superfluity of books, but to the unrealities for which books stood. Rightly understood, it is more books, not fewer, that are wanted there. A disappointing discussion followed, in which side-issues rather than fundamentals were raised—a result perhaps inevitable when the wide range of the subject is remembered.

A better result was achieved next day, when the place of science in secondary and higher education was considered. Mr. J. S. Talbot, referring to a committee of the Incorporated Association of Headmasters which had met recently at Wellington, said there was general agreement as to the necessity of finding a place for science amongst the subjects essential to a good school education. From two and a half to four hours a week should be provided for it in the school time-table of all boys up to sixteen. At the same time, they were not agreed that the school science of to-day was wholly satisfactory. A well-educated boy should surely know something of men like Newton, Darwin, and Pasteur, though he might now do much science at school without hearing of them. Dr. Gray's precise scheme of reform followed broadly the same line. The division between classical and modern sides should, he thought, be dropped for all boys in public schools before sixteen, though the division might take place at fourteen in municipal secondary schools, where it would follow technical and commercial lines of demarcation. After sixteen all boys should be taught the principles of biology. Dr. Hadow dealt with the subject from the point of view of the universities. The present first-year work might be better done in the schools, and the three years' university course begin at the end of what is now the intermediate course. As to research, the pure science student might start immediately he had graduated, but applied science men should go to the works first and return to the university after a year or two there. Dr. E. F. Armstrong deprecated the booky man of science. Present methods produced few men of any use in business where scientific methods of attacking problems were the first essential. But the prizes in industry depended in the last resort upon capacity for organisation and command. In the discussion, all the speakers agreed in condemning early specialisation and demanding a fuller recognition of science in the schools, and some further emphasis was laid upon the doubt as to whether just the right kind of science was being provided for boys amongst whom a large proportion had literary or linguistic tastes. Similar problems in relation to girls' education were discussed in the afternoon, though the issues were narrowed down to the school science more suited to girls preparing for the medical profession on one hand, and for domestic life on the other.

The last meeting of the section was devoted to a consideration of the report of the Mental and Physical Factors Committee, which had conducted an inquiry into the development of facility in the first four rules of arithmetic as shown by elementary-school children between eight and fourteen years of age.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION K.

BOTANY.

OPENING ADDRESS (ABRIDGED) BY A. B. RENDLE, M.A., D.Sc., F.R.S., PRESIDENT OF THE SECTION.

SINCE our last meeting the Great War has continued to hold chief place in our lives and thoughts, and in various ways, and to a greater or less degree, has influenced our work. In the case of many botany has had for the time being to be set aside, while others have been able to devote only a part of their time to scientific work. On the other hand, it is gratifying to note that some have been able to render helpful service on lines more or less directly connected with their own science. The trained botanist has shown that he may be an eminently adaptable person, capable, after short preparation on special lines, of taking up positions involving scientific investigation of the highest importance from the points of view of medicine and hygiene.

Some months ago the various sectional committees received a request to consider what could be done in their respective sections to meet problems which would arise after the war. Your committee met and discussed the matter, with the result that a set of queries was sent round to representative botanists asking that suggestions might be presented for consideration by the committee. A number of suggestions were received of a very varied kind, indicating that, in the opinion of many botanists at any rate, much might be done to utilise our science and its trained workers in the interests of the State and Empire. Your committee decided to arrange for reports to be prepared on several of the more important aspects by members who were specially fitted to discuss these aspects, and these will be presented in the course of the meeting. These reports will, I am convinced, be of great value, and may lead to helpful discussion; they may also open up the way to useful work.

For many of us this means the breaking of new ground. We have taken up the science because we loved it, and if we have been able to shed any light on its numerous problems the work has brought its own reward. But some of us have on occasion been brought into touch with economic problems, and such must have felt how inadequate was our national equipment for dealing with some of these. In recent years we have made several beginnings, but these beginnings must expand mightily if present and future needs are adequately to be met, and if we are determined to make the best use of the material to our hand.

Without trenching on the domain of economics, we may assume that increased production of foodstuffs, timber, and other economic products will be desirable. The question has been raised as to the possibility of increasing at the same time industrial and agricultural development. But as in industry perfection of machinery allows a greater output with a diminished number of hands, so in agriculture and horticulture perfection of the machinery of organisation and equipment will have the same result.

The improvement of the plant from an economic point of view implies the co-operation of the botanist and the plant-breeder. The student of experimental genetics, by directing his work to plants of economic value, is able, with the help of the resources of agriculture and horticulture, to produce forms of greater economic value, kinds best suited to different localities and ranges of climate, those most immune to disease and of the highest food-value. Let the practical man formulate the ideal, and then let the man of science be invited to supply it. Much valuable work has been done on these lines, but there is still plenty of scope for the organised Mendelian study of plants of economic importance.

The introduction of new plants of economic value is within the range of possibility; our répertoire has increased in recent years, but an exhaustive study of food plants and possible food plants for man and stock would doubtless yield good results.

We have heard much lately as to the growing of medicinal plants, and experience would indicate that here is opportunity for investigation, and, unless due care is taken, also danger of waste of time, money, and effort. A careful systematic study of species, varieties, and races is in some cases desirable in order to ensure the growth of the most productive or valuable plant, as in the case of the Aconites; and such a study might also reveal useful substitutes or additions. Here the co-operation between the scientific worker and the commercial man is imperative.

The advantages arising from a closer co-operation between the practical man and the botanist is illustrated by the research laboratories recently organised by the Royal Horticultural Society at Wisley. Such an institution forms a common meeting-ground for the grower of plants and the botanist. The former sets the problems, and the latter takes them in hand under conditions approaching the ideal and with the advantages of mutual discussion and criticism. Institutions such as these will give ample opportunity to the enthusiastic young botanist who is anxious to embark on work of investigation. The student of plant physiology will find here work of great interest. The grower has perforce gained a great deal of information as to the behaviour of his plants under more or less artificial conditions, but he is unable to analyse these conditions, and the co-operation of the physiologist is an invaluable help. Experiments in the growth of plants under the influence of high-tension electricity are at the present time being carried out at Wisley. Such experiments may be conducted anywhere where land and power are available, but it is obviously advantageous that they should be conducted by an expert plant physiologist versed in scientific method and not directly interested in the result. Dr. Keeble's recent series of lectures on "Modern Horticulture" at the Royal Institution deal with matter which is full of interest to the botanist. For instance, he shows how the work of Continental botanists on the forcing of plants has indicated methods, in some cases simple and inexpensive, which have proved of considerable commercial value, and that there is evidently scope for work in this direction, which, while of interest to the plant physiologist, may be also of general utility.

The subject of the soil offers problems to the botanist as well as to the chemist and proto-zoologist. In the plant we are dealing with a living organism, not a machine; and an adequate knowledge of the organism is essential to a proper study of its nutrition and growth.

The study of manures and their effect on the plant should attract the botanist as well as the chemist. In this connection I may refer to Mr. Martin Sutton's recent work at Reading on the effects of radio-active ores and residues on plant-life. A series of experiments was carried out in two successive years with various subjects selected for the different character of their produce, and including roots, tubers, bulbs, foliage, and fruit. From the immediate point of view of agriculture and horticulture the results were negative; the experiments gave no hope of the successful employment of radium as an aid to either the farmer or gardener. But, though the immediate result was unsatisfactory to the grower, there were several points of interest which would have appealed to the botanist who was watching the course of the experiments, and, if followed up, might throw light on the effect of radium on plant-life and lead in the end to some useful result. As Mr. Sutton points out, many of the results were "contradictory," while a close examination of the trial notes, together with the records of weights, will furnish highly interesting problems. For instance, there was evidence in some cases that germination was accelerated by the presence of radium, though subsequent growth was retarded; and the fact that in several of the experiments plants dressed with a complete fertiliser in addition to radium have not done so well as those dressed with the fertiliser only may be regarded as corroborating M. Truffaut's suggestion that radium might possess the power of releasing additional nitrogen in the soil for the use of plants, and that the plants in question were suffering from an excess of nitrogen. Certain remarkable variations between the duplicate unmanured control plots in several of the experiments led to the suggestion that radium emanations may have some effect, apparently a beneficial one. I have quoted these experiments as an example of a case where the co-operation of the botanist and the practical man might lead to useful results, and at the same time afford work of much interest to the botanist.

The utilisation of waste lands is a big subject and trenches on the domain of economics. But important botanical problems are involved, and careful ecological study will prepare the way for serious experimental work. The study of the growth of plants in alien situations is fraught with so many surprises and apparent contradictions that successful results may be looked for in most unlikely situations.

The study of the diseases to which plants are liable, and their prevention and cure, offers a wide and increasing field for inquiry, and demands a larger supply of trained workers and a more definite and special system of training. For the study of those which are due to fungi it is obviously essential that a thorough general knowledge of fungi and laboratory methods should be acquired, preferably at some pathological institution which would also be in touch with the cultivator and naturally approached by those requiring advice and help in connection with disease, on the same principle that a medical school is attached to a hospital. An important part of the training should be the study of the disease in the field and the conditions under which it arises and flourishes. From the point of view of mycology much useful scientific work remains to be done on the life-history of the fungi which are, or may be, the causes of disease. Other plant diseases afford problems for the physiologist, who is a necessary part of the equipment of the Pathological Institute.

The anatomical and chemical study of timbers might with advantage occupy a greater number of workers. The matter is of great economic importance. Questions of identity are continually arising, and in the present vague state of our knowledge it is often difficult or impossible to give a satisfactory answer. Samples of timber are put on the market shipped, say, from West Africa under some general name such as mahogany; the importer does not supply leaves and flowers for purposes of identification, and in the present incomplete state of our knowledge it is often impossible to make more than a vague attempt at determination. Or a merchant brings a sample which has been sent from X as Y, which it obviously is not; but what is it, whence does it probably come, and what supply of it is likely to be forthcoming? These are questions which it would be useful to be able to answer with some greater approach to accuracy than at present. And it should be the work of definitely trained persons.

The various illustrative suggestions which I have made would imply a close co-operation between the schools of botany and colleges and institutions of agriculture, horticulture, and forestry; to pass from the former to one or other of the latter for special work or training should be a natural thing. While on one hand a university course is not an essential preliminary to the study of one or other of the applied branches, the advantages of a broad, general training in the principles of the science cannot be gainsaid. The establishment of professorships, readerships, or lectureships in economic botany at the university would supply a useful link between the pure and applied science, while research fellowships or scholarships would be an incentive to investigation.

There is the wider question of a *rapprochement* between the man of science and the commercial man. Its desirability is obvious, and the advantages would be mutual; on one hand it would secure the spread and application of the results of research, and on the other the man of science would be directed to economic problems of which otherwise he might not become cognisant. The closer association between the academic institution and those devoted to the application of the science would be a step in this direction.

Our British possessions, especially within the tropics, contain a wealth of material of economic value which has been only partially explored. One of the first needs is a tabulation of the material. In the important series of Colonial floras incepted by Sir Joseph Hooker, and published under the auspices of Kew, lies the foundation for further work. Consider, for instance, the "Flora of Tropical Africa," now rapidly nearing completion. This is a careful and, so far as possible with the material at hand, critical descriptive catalogue of the plants from tropical Africa which are preserved in the great British and European herbaria. The work has been done by men with considerable training in systematic work, but who know nothing at first hand of the country the vegetation of which they are cataloguing. Such a "Flora" must be regarded as a basis for further work. Its study will indicate botanical areas and their characteristics, and suggest what areas are likely to prove of greater or less economic value, and on what special lines. It will also indicate the lines on which areas may be mapped out for more detailed botanical exploration. That this is necessary is obvious to any botanist who has used such a work. A large proportion of the species, some of which may, on further investigation, prove to be of economic value, are known only from a single incomplete fragment. Others, for instance, which may be of known economic value, doubtless exist over much larger areas and in much greater quantity than would appear from the "Flora." The reason of these shortcomings is equally obvious. The collections on which the work is based are largely the result of voluntary effort employed more or less spasmodically. The explorer working out some new route, who brings what he can conveniently carry to illustrate the plant products of the new country; the Government official or his wife, working during their brief leisure or collecting on the track between their different stations; the missionary or soldier, with a penchant for natural history; to these and similar persons we are largely indebted for additions to our knowledge of the plant-life. Advantage has sometimes been taken of a Government expedition to which a medical man with a knowledge of, or taste for, natural history, or, in rare cases, a trained botanist, has been attached.

It is time that pioneer work gave place to systematic botanical exploration of our tropical possessions and the preparation of handy working floras and economic handbooks. Work of botanical exploration should be full of interest to the young botanist. But if he is to make the best use of time and opportunity he must have had a proper course of training. After completing his general botanical course, which should naturally include an introduction to the principles of classification, he should work for a time in a large herbarium and thus acquire a knowledge of the details of systematic work and also of the general outlines of the flora of the area which he is to visit later. He should then be given a definite piece of work in the botanical survey of the area. From the collated results of such work convenient handbooks on the botanical resources of regions open to British enterprise could be compiled. There will be plenty of work for the systematist who cannot leave home. The ultimate elaboration of the floristic work must be done in the herbarium with its associated library. There is also need of a careful monographic study of genera of economic value which would be best done by the experienced systematist at home, given a plentiful supply of carefully collected and annotated material. Closely allied species or varieties of one and the same species may differ greatly in economic value, and the work of the monographer is to discover and diagnose these different forms and elucidate them for the benefit of the worker in the field.

If we are to make the best use of our resources botanical research stations in different parts of the Empire, adequately equipped and under the charge of a capable trained botanist, are a prime necessity. We seem to have been singularly unfortunate in the management of some of our tropical stations and botanical establishments.

A botanical station for research to be effective must be under the supervision of a well-trained botanist with administrative capacity, who must have at his disposal a well-equipped laboratory and ground for experimental work. The director will be ready to give help and advice on questions of a botanical nature arising locally, and he will be on the look-out for local problems which may afford items of botanical research to visiting students. Means must be adopted to attract the research student, aided, if necessary, by research scholarships from home. The station should have sufficient Imperial support to avoid the hampering of its utility by local prejudice or ignorance. The permanent staff should include a mycologist and a skilled gardener.

Finally, I should like to suggest the holding of an Imperial Botanical Congress at which matters of general and special interest might be discussed. The visit of the British Association to Australia was, I think, helpful to the Australian botanists; it was certainly very helpful and of the greatest interest to those coming from home. Many of the addresses and papers were of considerable interest and value, but of greater value was the opportunity of meeting with one's fellow-workers in different fields, of conversation, discussion, and interchange of ideas, the better realisation of one's limited outlook, and the stimulus of new associations. A meeting which brought together home botanists and botanical representatives from oversea portions of our Empire to discuss methods of better utilising our vast resources would be of great interest and supremely helpful. Let us transfer to peace purposes some of the magnificent enthusiasm which has flowed homewards for the defence of the Empire in war.

In this brief address I have tried, however imperfectly, to indicate some lines on which botanists may render useful service to the community. To a large extent it means the further development and extension of existing facilities added to an organised co-operation between botanists themselves and between botanists and the practical and commercial man; this will include an efficient, systematic cataloguing of work done and in progress. We do not propose to hand over all our best botanists to the applied branches and to starve pure research, but our aim should be to find a useful career for an increasing number of well-trained botanists and to ensure that our country and Empire shall make the best use of the results of our research. Incidentally there will be an increased demand for the teaching botanist, for he will be responsible for laying the foundations.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BY invitation of the college authorities, the next annual meeting of the Association of Public School Science Masters will be held at Eton on Wednesday and Thursday, January 3 and 4, 1917, under the presidency of Prof. H. H. Turner. After the president's address the main subjects of discussion and their openers will be as follows:—Science for the rank and file, Prof. R. A. Gregory; Technical bias in science teaching in schools, Mr. E. R. Thomas; The place of the text-book in science teaching, Mr. G. N. Pingriff. There will be the usual exhibition of apparatus, but it will consist chiefly of exhibits by members of the association.

THE current issue of the *Fortnightly Review* contains an article by Dr. R. Brudenell Carter on "Science and Education." The subject is made interesting to the general reader from the variety of aspects under which it is viewed, and the interest is enhanced by literary style and historical illustration. The importance of early sense-training is emphasised, and attention is directed to the value of a pocket magnifying-glass as a child's possession. The author's views on the development of intelligence, individual and racial, appear at times to challenge orthodox genetic psychology, but this may be due to the difficulty of popular exposition in a short article. However this may be, general assent will be given to the proposition that instruction in science should "change the view taken by the pupils of the events around them, and produce a conviction of ignorance of many forces and conditions by which the lives of nations, as well as of individuals, are liable to be powerfully or overwhelmingly influenced." Dr. Carter's proposals for science instruction in schools will scarcely be accepted as adequate, even as part of the all-round instruction of those who do not intend to pursue a scientific career, since they depend upon lectures alone, a course which teaching experience has proved to be ineffective unless a period of practical and more intensive study is added. But science teachers will welcome the general trend of the article, and all readers will gain by the freshness and vigour of the essay. Even now our legislators need to be reminded that "wisdom is hardly to be expected from men who regard its highest manifestations with the unseeing eyes of the scientifically ignorant."

THE Mathematical Association has now expressed its agreement with the Classical, English, Geographical, Historical, and Modern Language Associations in the view that any reorganisation of our educational system should make adequate provision for both humanistic and scientific studies; that premature specialisation should be avoided; and that technical preparation for a particular profession should be conceived in such a spirit that it misses none of the essentials of a liberal education (see NATURE, September 7, p. 23) The Mathematical Association submits that from a school course of mathematics the pupil should acquire (1) an elementary knowledge of the properties of number and space; (2) a certain command of the methods by which such knowledge is reached and established, together with facility in applying mathematical knowledge to the problems of the laboratory and the workshop; (3) valuable habits of precise thought and expression; (4) some understanding of the part played by mathematics in industry and the practical arts, as an instrument of discovery in the sciences and as a means of social organisation and progress; and (5) some appreciation of organised abstract thought as one of the highest and most fruitful forms of intellectual activity. This statement is signed by Prof. A. N. Whitehead, president of the Mathematical Association, and by Mr. A. W. Siddons, chairman of the Teaching Committee. It will be remembered that the Association of Public School Science Masters has also expressed agreement with the resolutions adopted by the associations representing humanistic studies, and has emphasised the needs which natural science meets in the direction of the search for truth and of a comprehension of the part played by science in modern civilisation (see NATURE, October 26, p. 162).

To *Science Progress* for October Sir Ronald Ross contributes an essay dealing with the question whether our public-school education is in need of reform, and, if so, how much, from the point of view of parents. The discussions which have taken place in the House of Lords and elsewhere would seem to lead one to believe that there is general agreement as to some reform being necessary, but not as to its amount. Unfortunately there is a tendency for the modern educationist to believe that he alone should decide the nature of the curriculum, and many people besides the parents of public-school boys think that boys are taught what the schoolmaster is able to teach rather than what they should be taught. Lord Desborough's Committee for Public-School Reform sent to the parents of boys at Eton and other public schools a memorandum (published in NATURE of June 8) urging reform, and requesting replies for or against it. The response indicated that the parents are overwhelmingly in favour of reform. Sir Ronald Ross urges that early education should be wide rather than deep, and suggests a long list of outdoor qualifications, arts, languages, and knowledges which should be the possession of an ideally trained young man of twenty. He refers to many amazing arguments which have been urged in favour of grammatical education (*e.g.* that to it is due the success of voluntary recruiting in Britain), and from the discussion draws the conclusions :—(1) That the first elements of Greek and Latin are necessary for every intellectual employment; (2) that a complete classical education is necessary for very few intellectual occupations; (3) that an exclusive classical education is insufficient for any such occupation; (4) that a knowledge of one or more modern languages is more useful than, and just as educative as, similar knowledge of a dead language; and (5) that a man who is entirely ignorant of science can scarcely be considered educated.

COMPULSORY Greek in university entrance examinations received little support at the meeting of the Hellenic Society on Tuesday, when the subject of "The Future of Hellenic Studies" was under discussion. Dr. Walter Leaf, who was in the chair, declared himself against this condition of entrance at Oxford and Cambridge, which are the only two Universities where Greek is made compulsory for all students; and this was also the view of most of the speakers who followed him. The discussion was intended to exhibit the claims of classical studies to continued attention as against the demands made by the advocates of the natural sciences at a meeting held last May, but the impression received from most of the speakers was that which Balak expressed after he had asked Balaam to assist him in stopping the advance of the Israelites: "I called thee to curse mine enemies, and behold thou hast altogether blessed them these three times." Prof. Conway stated that Greek need not be essential in preparatory schools or in the public schools, and could be studied very successfully by interested students after entering the university. He rightly pointed out that boys working for scholarships are not given time for science in preparatory schools or opportunity in public schools. Other speakers agreed that the knowledge of classical languages acquired by most pupils was insufficient to enable authors to be read with intelligence, and that from the point of view of influence upon life and character it would be better to devote time to the reading of translations. There was, indeed, little said at the meeting with which reasonable advocates of scientific studies would be disposed to differ, and nothing upon which a conflict between classics and science could be based. What is wanted most of all is joint action to change the attitude of the public in general towards all knowledge of which no direct commercial advantage can be seen. When this has been accomplished, and obscurantists of all kinds have been removed, it will be possible to contemplate courses of study apart from traditional or other interests, and to construct them with the sole aim of promoting the development of all that is best in the body and mind of the pupil.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 2.—Sir J. J. Thomson, president, in the chair.—Sir William **Crookes**: The photographic spectra of meteorites. Thirty rare earthy meteorites, mostly acquired through the courtesy of the British Museum Trustees, have been examined. The examination has revealed the presence of unexpectedly large traces of chromium in all the specimens, a condition quite different from that found in the siderites or meteoritic irons, where chromium is practically absent. The proportion between chromium and nickel remains constant in twenty-six out of the thirty aerolites, and is clearly shown in the photographs. In three only nickel is almost absent. From the experience gained it has been possible to make a mixture containing known quantities of nickel and chromium, which, with the addition of iron, produces a spectrum in the neighbourhood of the chromium group that is practically identical with that produced by the aerolite Aubres.—Prof H. **Lamb**: Waves in an elastic plate. The theory of waves in an infinitely long cylindrical rod was discussed by Pochhammer in 1876. The somewhat simpler problem of two-dimensional waves in a solid bounded by parallel planes was considered by Lord Rayleigh and by the author in 1889. The main object in these investigations was to verify, or to ascertain corrections to, the ordinary theory of the vibrations of *thin* rods or plates, and the wave-length was accordingly assumed to be great in comparison with the thickness. It occurred to the author some time ago that a further examination of the two-dimensional problem was desirable for more than one reason. The period-equation is, however, at first sight rather intractable, and it is only recently that a method of dealing with it has suggested itself. The result is to give a fairly complete view of the more important modes of vibration, together with indications as to the character of the higher modes which are of less interest.—Prof. W. H. **Young**: Multiple integrals. This note gives certain results and formulæ fundamental in the theory of multiple integration with respect to a function $g(x, y, \ldots.)$ of bounded variation (integrator). For simplicity the discussion is confined to two variables. The integrator may, without loss of generality, be taken to be a positive monotonely monotone ascending function—that is, one the monotone increase of which with respect to either of the variables has an increasing rate as the other variable increases.—Prof. W. H. **Young**: The order of magnitude of the coefficients of a Fourier series.—T. C. **Sutton**: A determination of the heat of vaporisation of water at 100° C. and one atmosphere pressure in terms of the mean calorie.—G. H. **Livens**: The mechanical relations of the energy of magnetisation. The usual mathematical formulation of the relations of the magnetic field leads to the same expression, viz. $\mu H^2/8\pi$, for the density of the energy associated with the field, whether this arises from rigid magnets or from steady currents; but as in the first case the energy is treated as potential energy, and in the second as kinetic energy, the apparently consistent result in the two cases really involves a discrepancy. In the present paper a new formulation of the relations is given which overcomes the difficulty of interpretation in the two cases. The fundamental change made in the work consists in the choice of the magnetic induction vector B, instead of the more usual magnetic force H, to denote the conditions in the æther.

Zoological Society, October 24.—Dr. A. Smith Woodward, vice-president, in the chair.—S. **Maulik**: Cryptostome beetles in the collection of the Cambridge University Museum. The collection is a representative one, containing species from all parts of the world. Three new genera, one new subgenus, and two new species are described.—H. G. **Newth**: Investigations into the early development of the Echinoderm Cucumaria. The larval life is very short as compared with that of the Auricularia. It takes place at the expense of the yolk, and is complete in about five days. Formation of the cœlomic vesicles occurs by the bending and constriction of the archenteron. No separate anterior cœlom appears. The hydrocœle ring closes in the left dorsal interradius, and the radial canals and five primary oral tentacles arise directly from it, alternating with one another. The internal madreporite arises as a secondary differentiation of the walls of the stone-canal.—R. E. **Turner**: Wasps of the genus Pison. One hundred and nine species are dealt with, of which fifteen are described as new. Reasons, drawn from the numerical distribution of the species in different areas, are given for supposing the genus to be in a declining state—fifty of the total number of species being from the continent of Australia. In addition to Pison, the small allied genera, Aulacophilus and Pisonopsis, are dealt with, one new species of the former being described.

Physical Society, October 27.—Mr. F. E. Smith, vice-president, in the chair.—Dr. S. G. **Barker**: The application of the Kerr effect to the determination of the saturation values for magnetism of ferro-magnetic metals, compounds, and alloys. The paper describes work carried out in the laboratory of Prof. Du Bois on the relation between the intensity of magnetisation of various ferro-magnetic materials and the rotation of the plane of polarisation of plane polarised light reflected from a polished surface of the material. The specimens, in the form of circular discs 5 mm. in diameter and 0·5 mm. thick, were soldered to one of the pole pieces of a large electromagnet. Through an aperture in the other pole monochromatic light, polarised in two nearly coincident planes by means of a Lippich polariser, was incident almost normally on the polished surface of the specimen. The reflected beam passed through an analyser, the rotation of which could be measured, by means of an auxiliary optical system, to a high degree of accuracy. In the first part of the paper results are given for a number of materials of known magnetic properties in order to establish the validity of the method, due to Du Bois, of obtaining the value of the saturation intensity from the curve connecting field strength with rotation. The method is then applied to materials of unknown properties. The variation of the Kerr constant with the wave-length of the light was also determined for a number of substances.—D. **Owen**: The influence of the time element on the resistance of a solid rectifying contact. The resistance at a solid rectifying contact, and consequently the exact shape of the resistance characteristic, depend upon the time for which the testing current is allowed to flow. A series of characteristics is given corresponding to durations of contact extending over the range one forty-thousandth of a second to thirty seconds. The following conclusions are drawn:—(1) That the variation of resistance with voltage may be attributed entirely to thermal effects. (2) That the characteristic obtained by applying the testing voltage for one hundredth of a second is, at moderate voltages, materially the same as that which would be found at the expiry of a period of the order of a millionth of a second. (3) That the sensibility of a wireless receiving circuit (in which the rectifying contact is used) does not differ very appreciably from that deduced from a slow period characteristic. (4) That an important fraction of the contact-resistance resides in a stratum of molecular thickness at the interface of the two elements of the contact; and that it is in this region alone that rectifying action at very high frequencies is effected.

Linnean Society, November 2.—Sir David Prain, president, in the chair.—Prof. G. S. **Boulger**: Early chapters in plant distribution. The author sketched the first glimpses in the works of Cardinal Bembo, M. de l'Obel, Sir Hans Sloane, Dr. Christian Mentzel, and J. Pitton de Tournefort. The second chapter was devoted to Carl von Linné, whose "Flora lapponica" and several theses in the "Amœnitates academicæ" were brought forward in support. Next followed Haller, J. G. Gmelin, Buffon and Forskl, C. L. Wildenow, with a brief allusion to P. A. Broussonet.—L. A. **Borradaile**: The Pontoniinæ and Carides from the western Indian Ocean.

Aristotelian Society, November 6.—Dr. H. Wildon Carr, president, in the chair.—Dr H. Wildon **Carr**: Presidential address: The problem of recognition. In the experience of recognition there is an element which may be named "againness." The problem of recognition is the nature and genesis of this element. There are two forms of recognition, in each of which we meet with this element of "againness"—an intelligent form and an instinctive form. These appear to be quite separate, but the cognitive fact is the same in each. In intelligent recognition we seem able to account for the "againness" by repetition, memory, and the judgment or perception of identity or similarity—the mental process being an external act of comparison between a present sense-datum and a past. This, however, is an illusion, because in reality the essential factor, repetition, is absent. Recognition implies prior cognition, but does not depend on the presence of a memory-image of the prior cognition. Recognition is the conditionate, and not the condition, of learning by experience; learning by experience is a primary, not a dependent, fact. In instinctive recognition there can be no memory-image of the prior cognition, because this prior cognition lies beyond the individual in the racial experience. Yet in instinctive recognition we have sentience, familiarity, and pre-awareness—all of which are mental characteristics. We have, therefore, to conceive the mental process, or the mind, as a continuous organisation of experience. Past experience has not only contributed its quota to this organisation, but is incorporated within it, giving to it, and receiving from it, its character and individuality. New sentient experience in entering this organisation receives the impression of its stamp or mould, and this is the mark of the past on the present cognition which constitutes it recognition.

Mineralogical Society, November 7.—Anniversary meeting.—Mr. W. Barlow, president, in the chair.—Dr. J. W. **Evans**: The combination of twin operations. The question of complex twin-crystals in which two distinct laws of twinning are represented was dealt with. A distinction was made between cases in which the twin-axes are parallel or at right angles, and those in which they are inclined to one another obliquely. In the former the result of the combination is itself a twin operation, while in the latter it is a rotation, the direction of which depends on the order in which the operations are applied; it is in some cases combined with an inversion.—Dr. J. W. **Evans**: A modification of the Kohlrausch method of determining refractive indices. The observing instrument is a microscope placed vertically and fitted with a Bertrand lens. An immersion theodolite stage of the Klein type is used so that the substance under investigation may be rotated beneath a liquid of higher refractive index about two axes, the first at right angles to the optical axis of the instrument, and the second at right angles to the first and to the plane surface of the object. This is observed through the natural surface of the liquid, and rotated in either direction until the position of total reflection is reached. By rotation of the object about the second axis the refractive indices in all directions parallel to its plane surface may be determined, and the values of the principal refractive indices thus obtained.—A. **Holmes** and Dr. H. F. **Harwood**: The basalts of the Brito-Arctic Province. The basalts from Hare Island, which were collected by Thomas Reid in 1855, include six varieties, of which four are free from olivine and carry silica among the amygdale minerals, and the remaining two contain olivine and are without free silica. All the rocks are rich in titaniferous magnetite, and analyses indicate that their most noteworthy feature is the unusual abundance of titania. The analyses cannot be closely matched except by those of basalts from Scoresby Sound, Iceland, the Faröe Islands, and the west of Scotland. This paper is the first of a series in which the authors hope to describe rocks from all the important localities within the province.—Miss N. **Hosali** exhibited models of crystals constructed by herself.

Optical Society, November 9.—Mr. F. J. Cheshire, president, in the chair.—J. W. **French**: The grinding and polishing of optical surfaces. The polished surface of metals consists of a layer which covers over small scratches and pits in the underlying material. When the surface layer is removed by etching, the scratches and pits are exposed. When the polished surface of glass is etched, numerous fine scratches reappear, and it has been wrongly assumed that glass behaves like metals. For purposes of description, the original material is referred to as α glass and the modified material constituting the surface layer as β glass. Clean scratches comparable with those on metal cannot be formed on the α glass. The material splinters in the characteristic conchoidal fashion. Perfectly clean scratches can be formed in the β layer; they can be filled in by further polishing, and it is these scratches that reappear after etching. The cohesion of the silicates constituting the surface layer is too small to permit of the bridging over of pits, such as minute airbells, that are just exposed, and no evidence of any inclusion of foreign matter in the β layer scratches has been obtained. An optical glass surface is produced as follows:—The action of the pitch polisher loosens or liquefies, as it were, the surface layer of molecules, which rearrange themselves uniformly under surface tension. The polishing medium subdivides, breaks up, and removes the surface layer, thus exposing the underlying material. This process then repeats itself, and a perfect surface is obtained only by the removal of material beyond the bottom of the hollows produced in the glass during the earlier abrasion process.

Paris.

Academy of Sciences, October 23.—M. Camille Jordan in the chair.—The President announced the death of M. E. F. Maupas, correspondant in the section of anatomy and zoology.—A. **Lacroix**: The volcanic glasses of the Cantal massif.—G. **Humbert**: Some remarkable numerical functions.—C. de la Vallée **Poussin**: The zeros of $\zeta(s)$ of Riemann.—A. **Verschaffel**: Advantages of circles both mobile and with multiple origin.—W. H. **Young**: Trigonometrical series and the means of Cesàro.—D. **Pompeiu**: Series with positive terms and the derived functions.—D. **Menchoff**: The unicity of the trigonometrical development.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1916. Details of observations made on seventy-nine days during the quarter.—C. **Camichel**: The determination of the velocity of propagation a in high-pressure water mains.—C. **Zenghelis** and S. **Horsch**: The chemical action of sodium peroxide upon hydrogen sulphide. The main product of the reaction is sulphide; polysulphides, sulphate, and thiosulphate are formed in smaller quantities.—Ph. **Flajolet**: Perturbations of the magnetic declination at Lyons (Saint-Genis-Laval) during the second quarter of 1916.—L. **Vegard** and O. **Krogness**: The results of observations of the aurora borealis carried out at the Observatory of Haldde. The discussion of determinations of heights measured by photographs taken simultaneously from two points. The lower limit of height always exceeds 85 kilometres, the upper limit from 100 to 330 kilometres.—G. **Bourguignon** and J. **Lucas**: Classification of the muscles of the superior member in man following their radicular systematisation, by the velocity index of excitability.—M. **Weinberg** and P. **Séguin**: Contribution to the etiology of gaseous gangrene. A description of a new bacillus (*B. histolyticus*) which, while incapable of itself producing a gaseous infection, appears to play an important part in the etiology of certain cases of gaseous gangrene.

October 30.—M. Camille Jordan in the chair.—G. **Bigourdan**: Astronomical observations at Paris from 1632 to the foundation of the Observatory. From 1632 to 1637 work was done by Gassendi, Beaugrand, Boulliau, and Descartes. About this period there commenced scientific gatherings which later resulted in the formation of the Academy of Sciences. The solar eclipse of June 1, 1639, was observed by three different groups. The paper concludes with a tabular statement showing the more important observations made between 1653 and 1667.—H. **Le Chatelier** and F. **Bogitch**: The determination of the density of solid bodies. A discussion of the chief causes of error in density measurements of solids. The method suggested is based on the direct measurement in a narrow graduated tube of a liquid by the powdered solid. It is shown that either benzene, carbon tetrachloride, or petroleum spirit may serve as the displaced liquid, but that water is quite unsuitable.—M. **Hamy**: A reduction formula for prismatic spectra.—MM. **Costantin** and **Bois**: The varieties of vanilla.—C. de la Vallée **Poussin**: The Riemann zeros of $\zeta(s)$.—W. **Kilian**: The exact age of the "Plaine des Rocailles," near the Roche-sur-Foron (Haute-Savoie), and fluvioglacial stages of Genevois-Faucigny.—L. **Bouchet**: The variations of thickness of a caoutchouc sheet under the influence of an electrostatic field. It is proved experimentally that under the action of an electrostatic field vulcanised india-rubber contracts in the direction of the lines of force.—J. **Bougault**: The semicarbazones of the α-ketonic acids. α-Di-iodo- and α-dibromo-phenylbutyric acids. α-Iodo- and α-bromo-phenylcrotonic acids.—L. **Daniel**: Experimental cultures at the seashore. In the course of fifteen years plants of various kinds, transferred from Rennes to Erquy, near the sea, have acquired none of the characteristics of halophytic plants.—P. **Lesage**: Trials of the seeds of *Lepidium sativum* under varying conditions. The effects of germination in dilute potash solutions, in alcoholic solutions, in solutions of chlorides, nitrates and sulphates of potassium, sodium, and ammonium were studied. The effects of time of immersion, soaking in petrol or ether, of moist air, and of solutions of hydrogen peroxide are also given.—F. **Vincens**: A Verticilliaceæ of doubtful affinities.—M. **Baudouin**: Results of the examination of the mandible of a young infant of the polished Stone age.—W. T. **Porter**: Low arterial pressures and their treatment. Experiments on animals have proved that when the diastolic pressure is as low as 45 mm. to 50 mm., unless appropriate treatment is applied the animal dies. Observations on wounded at the front show that there is no essential difference between the effects of a low pressure in man and in animals, and the same mode of treatment can be applied with success in both cases. The means adopted are:—(1) Mechanical; (2) adrenaline; (3) injection of isotonic serum.—Ch. **Richet**: Remarks on the preceding paper.—J. **Beauverie**: Researches on the influence of the osmotic pressure on bacteria. The case of the cholera vibrion.—L. C. **Bailleul** and P. **Girard**: The polarisation of the cicatricial tissue and the electrical treatment of deep cicatricial adherences.

NEW SOUTH WALES.

Linnean Society, July 26.—Mr. A. G. Hamilton, president, in the chair.—R. J. **Tillyard**: Studies in Australian Neuroptera. No. 4. Descriptions of new genera and species of the families Ithonidæ, Hemerobiidæ, Sisyridæ, Berothidæ, and the new family Trichomatidæ. An attempt is made, by a critical study of the venation, to clear up the difficult question of the relationships of a mass of forms usually relegated to the Hemerobiidæ. Reasons are given for restricting this family to forms combining a number of characters, among which the principal are the number and structure of the radial sectors.—Dr. A. J. **Turner**: Studies in Australian Microlepidoptera. Five genera and sixty-five species of Meyrick's two groups, Œcophorides and Eulechriades, are described as new, and a number of known species are recorded from additional localities.—Rev. W. W. **Watts**: Some cryptogamic notes from the Botanic Gardens, Sydney.

BOOKS RECEIVED.

Elementary Practical Chemistry. By Profs. F. Clowes and J. B. Coleman. Part ii. Eighth edition. Pp. xvi+255. (London: J. and A. Churchill.) 3*s*. 6*d*. net.

A Text-Book of Physics. Edited by A. W. Duff. Fourth edition. Pp. xiv+692. (London: J. and A. Churchill.) 10*s*. 6*d*. net.

Om Ole Rømers Opdagelse of Lysets Tøven. By K. Meyer. (København: Høst und Søn.) 2 kronen.

Chemistry for Rural Schools. By E. Jones and J. J. Griffith. Pp. 184. (London: Blackie and Son, Ltd.) 2*s*. 6*d*. net.

Typographical Printing Surfaces. By L. A. Legros and J. C. Grant. Pp. xxiv+732. (London: Longmans and Co.) 2*l*. 2*s*. net.

Oil-Field Development and Petroleum Mining. By A. B. Thomson. Pp. xix+626+maps viii. (London: Crosby Lockwood and Son.) 25*s*. net.

A Concordance to the Works of Horace. Compiled and edited by L. Cooper. Pp. ix+593. (Washington: Carnegie Institution.)

The Coal Measures Amphibia of North America. By R. L. Moodie. Pp. x+222+plates 26. (Washingtone: Carnegie Institution.)

Gonadectomy in relation to the Secondary Sexual Characters of some Domestic Birds. By H. D. Goodale. Pp. 52+plates vii. (Washington: Carnegie Institution.)

A Sylow Factor Table of the First Twelve Thousand Numbers. By H. W. Stager. Pp. xii+120. (Washington: Carnegie Institution.)

The Elements of Reconstruction. Pp. 120. (London: Nisbet and Co., Ltd.) 1*s*. net.

Australasian Antarctic Expedition, 1911—1914. Scientific Reports. Series C. Zoology and Botany. Vol. iii., part i. Fishes. By E. R. Waite. Pp. 92+plates 5, etc. (Adelaide: R. E. E. Rogers.) 8*s*. 6*d*.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 16.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—*Informal Discussion*: Standardisation, so far as it affects the Mining and Metallurgical Industries: including the Question of the Adoption of the Metric System.

CHILD STUDY SOCIETY, at 6.—Experiments in Hand-writing in Schools: Speed Tests in Manuscript Writing: Dr. C. W. Kimmins.—The Artistic Aspect of Manuscript Writing: W. Scutt.—Manuscript Writing in a Central School: J. W. Samuel.—Manuscript Writing in a Boys' Elementary School: A. Sinclair.

LINNEAN SOCIETY, at 5.—(1) Pedanios Dioscorides of Anazarba; his Writings and his Commentators; (2) The New Cabinets for the Linnean Herbarium: The General Secretary.—A New Australian Genus of Hydrocharidaceæ: Dr. A. B. Rendle.—Some Collections of the Littoral Marine Fauna of the Cape Verde Islands, made by Cyril Crossland in the Summer of 1904: A. W. Waters.

CHEMICAL SOCIETY, at 8.—A Simple Method of Estimating Arsenic in Organic Derivatives: A. J. Ewins.—A New Method for the Preparation of Nitrosyl Tribromide: R. L. Datta and N. R. Chatterjee.—Neutral Potassium Persulphate as a Reagent in Organic Chemistry: R. L. Datta and J. N. Sen.—The Hydrolysis of Iron Ammonium Alum: W. N. Rae.

FRIDAY, NOVEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Report of the Hardness Tests Research Committee.

MONDAY, NOVEMBER 20.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Easter Island: Mr. and Mrs. W. Scoresby Routledge.

TUESDAY, NOVEMBER 21.

ZOOLOGICAL SOCIETY, at 5.30.—The Pectoral and Pelvic Arches of the London Specimen of Archæopteryx: Prof. B. Petronievics and Dr. A. Smith Woodward.—Studies on the Anoplura and Mallophaga, being a Report upon a Collection from the Mammals and Birds in the Society's Gardens. II.: B. F. Cummings.—Notes on a Collection of Heterocera made by Mr. W. Feather in British East Africa, 1911–13: Lieut.-Col. J. M. Fawcett.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Keadby Bridge: J. B. Ball.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Pyrogenesis of Hydrocarbons: E. L. Lomax, Dr. A. E. Dunstan, and Dr. F. B. Thole.

ROYAL STATISTICAL SOCIETY, at 5.15.—Presidential Address: The Organisation of Registration in its Bearing on Vital Statistics: Sir Bernard Mallet.

WEDNESDAY, NOVEMBER 22.

ROYAL SOCIETY OF ARTS, at 4.30.—The Economic Development of Russia and Britain's Share Therein: L. Urquhart.

GEOLOGICAL SOCIETY, at 5.30.

THURSDAY, NOVEMBER 23.

ROYAL SOCIETY, at 4.—Annual Report of Council.—At 4.30 *Probable Papers*: The Scattering of Plane Electric Waves by Spheres: Dr. T. J. I'a Bromwich.—Numerical Results of the Theory of the Diffraction of a Plane Electromagnetic Wave by a Perfectly Conducting Sphere: J. Proudman, A. T. Doodson, and G. Kennedy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Parallel Operation of Electric Power Stations: J. S. Peck.

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CHEMICAL SOCIETY RESEARCH FUND.

A meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the ASSISTANT SECRETARY, Chemical Society, Burlington House, W., must be received on, or before, Friday, December 8, 1916.

All persons who received grants in December, 1915, or in December of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be returned by Friday, December 1.

The Council wish to draw attention to the fact that the income arising from the donation of the Worshipful Company of Goldsmiths is to be more or less especially devoted to the encouragement of research in inorganic and metallurgical chemistry. Furthermore, that the income due to the sum accruing from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the coal-tar and allied industries.

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NATURE.

The number for **last week (Nov. 16)** contained:—

Northern Counties Lore.

A Composite American Text-book of Geology. By J. W. G.

Radiographic Methods.

Our Bookshelf.

Letters to the Editor:—

The Concilium Bibliographicum of Zürich. HERBERT HAVILAND FIELD.—Scarcity of Wasps. H. ST. GEORGE GRAY.—A Peculiar Thunderclap. Prof. GIOVANNI PLATANIA.—The Pollination of Toadflax. S. P.; Dr. C. E. MOSS.

Scientific Glassware—Prof. H. H. W. Pearson, F.R.S. By Prof. A. C. SEWARD, F.R.S.—Prof. Henrik Mohn. By Sir NAPIER SHAW, F.R.S.—Notes.—Our Astronomical Column.—Meteorology in War.—Education at the British Association.—The British Association at Newcastle: Section K.—Botany.—Opening Address (Abridged) by A. B. RENDLE, M.A., D.Sc., F.R.S., President of the Section. University and Educational Intelligence.—Societies and Academies.—Books Received.—Diary of Societies.

Copies can be obtained through any bookseller or newsagent, or post-free from the Publishers, St. Martin's Street, London, W.C., on receipt of 6½d. from residents in the British Isles, or of 7d. from residents abroad.

THURSDAY, NOVEMBER 23, 1916.

SIR HENRY ROSCOE.

The Right Honourable Sir Henry Enfield Roscoe. A Biographical Sketch. By Sir Edward Thorpe. Pp. viii+208. (Longmans, Green and Co., 1916.) Price 7s. 6d. net.

JUST over ten years ago "The Life and Experiences of Sir Henry Enfield Roscoe" was "written by himself." Now we have this "biographical sketch," a substantial volume, about half the size of the "Experiences," from the very competent pen of his distinguished former student and lifelong friend, Sir Edward Thorpe. Roscoe the chemist and the man is therefore shown as he appeared to himself on the one hand, and to his friends on the other. As for his enemies or detractors he had none, and therefore there is nothing further to be said. He has so recently been taken from us and his genial, kindly personality was so familiar that to the present generation this good man's memory will outlive his life so long as any who knew him remain. The present volume contains an excellent and characteristic photographic portrait of obviously recent date. For generations to come there are fortunately two good pictures which show him in the prime of life, one by Burgess in the Common Room at the Owens College, the other by Herkomer in the possession of the family.

Readers of the present volume are reminded that Henry Enfield Roscoe was born in London at 10 Powis Place, Great Ormond Street, on January 7, 1833. At the time of his death, December 18, 1915, he was, therefore, within a few days of his eighty-third birthday. His father died at the early age of thirty-eight, when the son was only four years old. The future chemist was brought up by his mother, to whose good sense he owed much in the encouragement she gave to his inclination towards scientific pursuits.

After working under Williamson at University College and taking his B.A. degree, he went to Heidelberg, accompanied by his mother and sister, and found a place in the laboratory of Bunsen, then at the height of his fame. The influence of the master served to emphasise Roscoe's natural bent towards what may be called operative chemistry, in preference to the theoretical or speculative aspects of the science. Returning to England after three years, having in the meantime secured his Ph.D., he set up a private laboratory in Bedford Place, Russell Square. But this venture was of short duration, for in the following year he was appointed to succeed Frankland, the first professor of chemistry in the newly founded Owens College in Manchester, and there he remained for thirty years.

From this time forward Roscoe was a diligent and successful investigator of chemical problems, and something over sixty papers stand in the catalogues to the credit of his name, alone or in association with some of his students. It is probable, however, that, interesting as were some of his subjects of inquiry, his name will be carried down to posterity less in connection with chemical discovery than with what must be regarded as the great achievement of his life, namely, the creation of the first provincial *school* of chemistry in this country. Previously to 1860 there had been great schools of medicine with which chemistry was associated in a subordinate position, and great individual professors, such as Graham, Williamson, and Frankland, but with the exception of Hofmann at the Royal College of Chemistry, they do not seem to have possessed that power of attraction which draws together a crowd of enthusiastic students. But this is what Roscoe did, for although not specially distinguished as a philosophical chemist, he had that remarkable gift of insight which enabled him to select for his students subjects of inquiry which always led to definite results. He had, moreover, some of the personal characteristics which belonged to Bunsen, his own teacher, of whom he speaks in glowing terms of respect and affection. As a man of science actively engaged in research Roscoe's career came practically to an end when he entered Parliament in 1886. As everyone knows, the remaining thirty years of his life were by no means idle or employed unprofitably, for he was busy in all sorts of educational movements, in the offices he held as treasurer and chairman of the Lister Institute and as Vice-Chancellor of the University of London, and in other directions in which he exercised his great influence to the benefit of science and of his country.

As to his home life, it is, indeed, true, as the author of the volume before us remarks, that "the hospitality of Woodcote is a treasured memory to numbers of Roscoe's friends." And there is one feature of his which is less noticed in the book than it deserves, and that is his quaint humour and love of a joke. It was great fun to hear him telling an amusing story to a certain lady visitor who, he knew quite well, would never see the point of it.

An incident may be mentioned which does not appear in the book. At the International Congress of Applied Chemistry in Rome in 1906 Roscoe was very naturally chosen as honorary president for the next meeting, to be held in London in 1909, Ramsay being the acting president. And being rightly recognised as the *doyen* of the English members of the Congress then in Rome, it was Roscoe who, among the King's guests at the Quirinal, had the honour of attending the Queen to dinner and sitting on her right hand. Moissan, the eminent French chemist, sat on her Majesty's left.

W. A. T.

GROUP-THEORY.

Theory and Applications of Finite Groups. By Profs. G. A. Miller, H. F. Blichfeldt, L. E. Dickson. Pp. xvii+390. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 17s. net.

THE English student is fortunate in having, in his own language, a series of excellent treatises on the difficult theory of groups. The

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present one is welcome as a record of progress, even in what may be called the elements of the subject, and as an original work by three distinguished experts. It is divided into three parts, for each of which one author is mainly responsible. Part i., by Prof. G. A. Miller, deals with the general properties of groups, beginning with substitution-groups, and going on to the abstract definition by generators; there are special chapters on Abelian groups, on groups of order p^m with p prime, on the polyhedral groups, on isomorphisms, and on solvable groups. Part ii., by Prof. H. F. Blichfeldt, is on linear groups, and a valuable summary of the present stage of that theory; in particular, there is a chapter on characteristics. Part iii., by Prof. L. E. Dickson, is on applications, and is naturally of a more elementary character; there are three chapters on the Galoisian theory of equations, one on rule and compass constructions, one on the inflexions of a plane cubic, one on the 27 lines of a cubic surface, and one which is a scrap on solutions of equations by a standard form $F(z, k)=0$, involving one parameter.

The outstanding novelty is the early proof of Sylow's theorem, which actually begins on p. 27. The proof is led up to by the definition and discussion of "double co-sets," which, it appears, were first used by Cauchy, and long afterwards taken up by Frobenius. In group-theory Sylow's theorem occupies a place something like that of the law of quadratic reciprocity in arithmetic; it is of a fundamental character, and each distinct proof of it marks an advance in the general theory. It may be noted, however, that the proof given by Prof. Miller assumes the group considered to be given in the form of a substitution-group; this is not a real limitation, because every group is isomorphic with a set of substitutions—a theorem proved on p. 63. We may, perhaps, be justified in thinking that the "genuine" proof of Sylow's theorem has yet to be discovered; that is to say, a proof based on the abstract definitions of a group, without using any special image of it, and also a proof which comes at the proper place in the sequence of the theory.

The authors give a considerable number of exercises, including some which are really easy. This is important, because every mathematical student ought to know the elements of group-theory; it is the only thing which gives unity to a host of scattered results in elementary algebra, trigonometry, and analytical geometry, and it is often a guide to us when we wish to estimate beforehand the complexity of a particular problem. In the case of some of the harder exercises hints are given to help the reader.

How far this treatise will suit a beginner, it is difficult to say. The subject is, for most students, a hard one, except in its very early stages, and Prof. Miller's contribution is concise as well as abstract. In any case, those who have made some progress in the theory, and wish to know its present condition, will find the work of great interest and value; a judicious skipper who begins at p. 321 or thereabout will perhaps enjoy himself more, and make more progress, than a conscientious plodder with a bookmark.

The treatise is appropriately dedicated to M. Camille Jordan, to whom the authors justly assign the credit of having mainly helped to establish group-theory as a leading branch of mathematics.

G. B. M.

AN INTERNATIONAL GEOGRAPHICAL EXCURSION.

Memorial Volume of the Transcontinental Excursion of 1912 of the American Geographical Society of New York. Pp. xi+407. (New York: American Geographical Society, 1915.) Price 3 dollars.

THE excursion of which this volume is a memorial was organised by Prof. W. M. Davis, of Harvard University, to celebrate two things—the sixtieth anniversary of the foundation of the American Geographical Society of New York, and the entry of that society into its new building in Broadway at 156th Street. The members of the excursion were mainly geographers invited from nearly every European country, and these were taken in a special train and by other means of communication over routes amounting in all to nearly 13,000 miles, first westwards through the northern tier of States to Seattle, thence south to San Francisco, and back through the middle States, but going so far south as Birmingham, Ala., in rounding the south of the Appalachians. Besides the European members of the party, there were about a dozen American geographers who went the whole round; and numerous other American geographers, geologists, and others capable of furnishing information about different parts of the United States joined the party for shorter or longer stages.

In the course of the excursion discussions were constantly being held with regard to the geographical features of the districts visited; and, seeing that Prof. Davis was the leader as well as the organiser of the party, it is only natural that those discussions should have frequently turned on the interpretation of the features according to the terminology which he has introduced so widely into geography. The contents of this volume are mainly made up of articles, written in German, English, French, and Italian, by members of the party, and it would have been interesting to find in one of these an example of the application of that terminology to geographical description, the purpose to which its author contends it is pre-eminently suited. But there is none. On the other hand, there are two or three in which the morphogenetic nomenclature of Davis is discussed, and more or less criticised, as by Prof. Ricchieri (pp. 63–5), Prof. Jaeger in his (somewhat maccaronic—intermingled German and English) article entitled "Bemerkungen zur systematischen Beschreibung der Landformen," and incidentally by Waldbaur in his "Bemerkungen über Stufenlandschaften" (bottom of p. 86, etc.). Even where critical, however, all these contributors are more or less sympathetic.

All the articles except one (by Prof. Werenskiöld on "The Surface of Central Norway") are more or less connected with the United States. A good many come under the head of economic or economico-political geography. Such, for example, are Prof. Brückner's on "The Settlement of the United States as Controlled by Climate and Climatic Oscillations"; that by Prof. Demangeon on Duluth; that by Prof. Partsch on "Die Nordpazifische Bahn"; those by Profs. Nussbaum and Oberhummer on American towns, the latter on American towns as compared with the towns of Europe; that by Herbette on "The Harbours of the Pacific North-west of the U.S."; and that by Vacher on "Les Environs de Phœnix et le Barrage Roosevelt." Several discuss the origin of land forms, as Prof. de Martonne's on "Le Parc National Yellowstone," and that of Machatschek on "Ein Profil durch die Sierra Nevada mit einem Vergleich mit der Schollenstruktur in Zentralasien." There are some interesting "Observations sur deux Petits Geysers du Yellowstone," by Prof. Chaix, of Geneva; and Mr. E. de Margerie contributes an article written in excellent and even fascinating English on "The Debt of Geographical Science to American Explorers." Prof. Davis furnishes a brief note on the origin of the excursion, and its history is written by Prof. A. P. Brigham, of Colgate University, Hamilton, N.Y. In addition to a map showing the route, there are numerous photographic, diagrammatic, and other illustrations, and photographs of most of the European members of the party as well as of Profs. Davis and Brigham. The guests would have liked to see also the photographs at least of all those American members who went the whole round.

G. G. C.

OUR BOOKSHELF.

Mentally Deficient Children: their Treatment and Training. By Dr. G. E. Shuttleworth and Dr. W. A. Potts. Pp. xix+284. Fourth edition. (London: H. K. Lewis and Co., Ltd., 1916.) Price 7s. 6d. net.

The mentally deficient are of considerable importance to the community; their behaviour may be offensive, they frequently exhibit criminal propensities, and they are a source of expense in that they need special care and are deficient as producers and wage-earners. The disability is of all grades, and frequently commences in childhood or may be congenital. The principal causes in children are maldevelopment of certain parts of the brain or retarded development of the brain and its functions from some intercurrent disease. The latter may be due to injury at or after birth, fevers, convulsions, epilepsy, and syphilis. There are also certain conditions of glandular inadequacy, as in the cretin whose thyroid gland is atrophied. Probably of children of school age some 1 per cent. or thereabouts are mentally feeble.

In this book the authors first detail the pathology of mental deficiency in childhood, its etiology, diagnosis, and prognosis. They then describe the methods to be adopted for the medical examination of mentally defective children, and devote considerable space to the medical treatment and educational, industrial, and moral training and recreation of mentally deficient children.

An important chapter deals with the results of treatment and training. Of the patients treated at the Royal Albert Institution about 50 per cent. do not improve or get worse, while of the remainder 10 per cent. become self-supporting, and the rest become of more or less value—surely a very encouraging record.

The book gives an excellent summary of the subject, and should be of considerable service to the medical practitioner and to the school officer and teacher, by whom the lesser cases of mental deficiency will first be recognised, and early recognition and treatment are very essential if any good result is to be obtained. The book is illustrated with a number of useful plates.

The Indo-Aryan Races. A Study of the Origin of Indo-Aryan People and Institutions. By Ramaprasad Chanda. Part i. Pp. xiii+274. (Rajshahi: The Varendra Research Society, 1916.) Price Rs.6 8a.

This book, we are told in the preface, was intended to provide "a monograph on the origin of the Bengali people," a useful project which has been supported by the newly founded Varendra Research Society. But his "notes," as the author modestly terms them, have developed into a series of essays on the religion, history, and ethnology of Ancient India. All that is provided as part of the original project is a short series of head measurements, published without commentary, which is intended to settle the question whether certain groups of Bengali Brahmans are, or are not, descendants of a few Brahmans imported from Kanauj. So far as we can judge from these scanty statistics the legend is without foundation; but the subject demands much more careful treatment before it can be finally settled.

The essays, modestly written and creditable to the scholarship of the author, traverse well-trodden ground. The great "Vedic Index" of Profs. Macdonell and Keith has already collected practically all the information that the Vedic literature supplies on Early India. But the byways of Sanskrit writings can still furnish some facts, and much still remains to be done, for the interpretation of these materials.

The author might with advantage return in his next venture to the original problem of the origin of the Bengalis. He would probably discard Risley's theory of Mongoloid infusion in favour of some early entry of an Alpine strain. If he can establish this doctrine he would do useful service to Indian ethnology.

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.]*

War Organisation.

In the article "'Preparedness': The American Way," in NATURE of November 2, the report of the Committee of the Naval Consulting Board, therein quoted, is in some respects open to criticism. That report says:—"Behind every man in the firing line in Europe, from three to five persons are employed to supply him with food, ammunition, and other needs." For the third step of the programme the committee lays it down that skilled mechanics in all lines of production must be kept from enrolment in the Army. Rather must bankers, clerks, shopkeepers, and professional men be sent. The skilled workers must be badged, and the only restriction imposed on them by the badge will be prevention of enlistment. Enrolment in the Industrial Reserve will be considered to carry with it honours equal to enrolment in the fighting forces.

From the above it appears that the American view is that, of the men of military age in the nation, one portion should work in safety and comfort while the other portion should do the fighting. To the latter would fall all the loss of life, disablement from wounds and sickness, and extreme hardship; meanwhile the former will live as in time of peace, and enjoy equal honours with the fighting group.

A scheme of preparation for war in which sacrifices and benefits are so unequally distributed does not appeal to one as being either just or admirable, and I shall show that it is not in the least necessary.

I will make the following assumptions, which are sufficiently accurate for the purpose of my argument:—

(*a*) I assume the best fighting age at from twenty to twenty-seven.

(*b*) I assume four supply workers as required for one soldier.

(*c*) Unskilled labour is necessary among the supply workers.

(*d*) Men will be efficient as supply workers and for the necessary subsidiary duties certainly up to the age of fifty.

(*e*) It is apparent that there will be at least three men above fighting age available for supply work for each man of fighting age; assume that this is so.

Let N be the number of men between twenty and twenty-seven: we cannot take all of these, for above that age only 3N workers are available. Let x be the number of men we *can* take; then $x(1+4)=4N$, therefore $x=0.8N$. Hence if we take *all* men up to twenty-five and a half as soldiers we shall have enough workers to keep them supplied. Doing this, we shall use some skilled workers in the ranks, but skilled work is also required at the front, and this is now provided for.

If to this proposition a clause be added whereby he who, either physically or mentally, is unfit to fight shall be held as unfit to vote, we shall have a scheme fair to all, which also does not offer the glorious opportunities for undue influence and shirkers so thoroughly provided in the report.

J. C. L. CAMPBELL.

Achalader, Blairgowrie, Perthshire.

Farmers and Wheat.

In your review of Messrs. Gray and Turner's "Eclipse or Empire?" (November 9, p. 185) the following passage occurs:—

"The third chapter, on 'The Slackening of Momentum,' shows by telling figures and statistics how serious has become our competition with better organised or more hard-working nations. . . . British production has increased at a far less rate than that in Germany or in the United States. As regards home-grown wheat, it has fallen by 20 per cent. in the last thirty years in England, and increased in Germany by 50 per cent."

Turning to p. 190 in the same number, I read: ". . . Without heavy protective duties, the chemical industry of the finer products, including dyestuffs, cannot possibly be built up and firmly established in this country."

The first of these quoted passages seems to impute the fall in production of wheat to "slackening of momentum," implying indolence, or at least want of spirit, on the part of British farmers. But what, it may be asked, might have been said of their intelligence if, instead of diverting their "momentum" to dairy farming and stock-feeding, they had persisted in growing wheat at a loss after it had fallen to 23*s.* a quarter? And how would it be consistent with prudence now to break up land for wheat-growing in the absence of any guarantee against a prospective ruinous fall in prices? We do not ask for the promise of "heavy protective duties," such as your correspondent describes as indispensable, as doubtless they are, for the establishment and maintenance of the finer chemical industry, but we do claim that, before investing heavily in wheat production, some assurance may be obtained against the farming industry being wrecked by indiscriminate freedom of imports.

HERBERT MAXWELL.

Monreith.

Greek as a Specialised Study.

As you have done me the honour of commenting (NATURE, November 16, p. 221) upon what would seem to have been an abbreviated report of what I said at the Hellenic Society's meeting on November 14, perhaps you would allow me a few lines to remove a misapprehension to which that report seems to have given rise.

It is quite true that I deprecate the study of Greek at preparatory schools, as I do not think the language can be begun before thirteen or fourteen years of age without narrowing unduly the basis of general education; but I did not in the least wish to suggest, nor do I think, that it need not be studied at public schools. To abandon it there would be, in my judgment, to abandon the finest part of that humane training which has created all the great traditions of English public life.

I contended, indeed, that students of special ability who had been thoroughly trained in Latin could study Greek fruitfully during their university course if that course extended above four years and were wholly devoted to classical work. This I urged as a reason for allowing clever boys from municipal schools a free choice of the subjects which they are to study by the aid of municipal leaving scholarships. But I believe it would be a national misfortune if the study of Greek in this country were confined to this comparatively small class of students. The affection felt for the study by those who know what it is, is so keen that I do not think there is much danger of this result.

I said nothing on the subject of compulsory Greek, but as my silence has been taken to imply complete assent to its abolition, let me say that while I have voted, and shall vote, against enforcing the study upon candidates for degrees in mathematics or natural science, I am convinced that the quality of any literary, historical, or philosophical study, whether in modern or ancient fields, is gravely injured wherever it is undertaken without a knowledge of Greek.

Manchester, November 20. R. S. CONWAY.

The Preservation of Natural Colour in Plants.

IN NATURE of November 9 Dr. Rendle directs attention to a method of producing compounds of chlorophyll and copper similar in colour to that of the natural pigments of the leaf and of a comparatively stable nature. It may be worth while to point out that the chemical changes underlying the method are fairly well known, as a result of Willstätter's investigations of chlorophyll and its derivatives. The knowledge derived from Willstätter's work forms a very profitable basis for an investigation of the problem of preserving the colour of herbarium specimens.

The chromogen complex of chlorophyll contains magnesium bound to nitrogen in a complex way. The chromogen group of chlorophyll *a* may be represented by the formula, $C_{32}H_{30}ON_4Mg$. The magnesium is easily removed by the action of acids, and the derivatives thus obtained, phæophytin, phytochlorin, etc., containing the group $C_{32}H_{32}ON_4$, have optical properties different from those of chlorophyll; in solutions they are of a yellowish-olive green colour, and they exhibit characteristic absorption spectra.

It is possible in many cases to introduce a metal into these magnesium-free derivatives whereby compounds with optical properties similar to those of chlorophyll are produced. A full discussion of the various methods for introducing the different metals is out of place here, but it may be pointed out that magnesium can be reintroduced into the chlorophyll molecule by treatment with methyl magnesium iodide. Some metals are very easily introduced—*e.g.* copper, zinc, and iron—by treating the magnesium-free derivative with the metallic acetates in acetic acid or alcohol; zinc acetate even acts in cold solution.

It is a remarkable fact that some of these metal compounds are more stable—for example, in relation to acids—than the original magnesium complex. It is possible to arrange the metals in a series according to the stability of the compound; the extremes of this series are potassium (very unstable) and copper (very stable). Magnesium occupies an intermediate position.

The procedure in the treatment of a specimen is thus the following:—

(1) *The Magnesium is removed from the Chlorophyll.*—This can easily be done in the case of plants with an acid cell-sap (*e.g. Oxalis acetosella*) by dipping them into boiling water. In other cases the tissues can be made permeable by treatment with alcohol or acetone (in such a concentration that chlorophyll is insoluble, *i.e.* 10–60 per cent.). Subsequent treatment with dilute acid removes the magnesium.

(2) *The Metal is introduced.*—It must be remembered that zinc, although a little less stable than copper, can be introduced without heating, and thus without the risk of injuring the specimen. The shade of colour obtained varies with the different metals.

Investigations on these two points will no doubt add to our knowledge of the most suitable methods of preserving the colours of museum specimens of plants. INGVAR JÖRGENSEN.

Department of Plant Physiology and Pathology,
Imperial College of Science and Technology,
London, November 14.

Artillery and Rainfall.

THE following quotation may help to settle the question as to the effect of artillery on the rainfall, at any rate so far as the present generation of your readers is concerned.

It is taken from a translation of "Plutarch's Lives," by John and William Langhorne, and occurs in the life of "Caius Marius," where Plutarch comments on a battle fought against the "Teutones" in 102 B.C.

"It is observed, indeed, that extraordinary rains generally fall after great battles; whether it be that some deity chooses to wash and purify the earth with water from above, or whether the blood and corruption, by the moist and heavy vapours they emit, thicken the air, which is liable to be altered by the smallest cause."

Now, since the battles and rainfall referred to occurred some 1500 years before artillery was invented, it is clear that artillery cannot be the cause of the rainfall. MORITURUS.

GOVERNMENT CONTROL OF FOOD SUPPLIES.

WHATEVER difference of opinion may exist in regard to the stimulus which has moved the Government to take control of our food supplies, all are agreed that it has not come about a moment too soon, and most will admit that we should now be much better off had it been taken in hand more than a year ago.

The provisions outlined will empower the Food Controller to take measures both preventive and regulatory; the former to prevent waste, the improper use of food, such as giving to animals food that ought to be reserved for human beings, and market manipulation, cornering, or holding up of food supplies. The regulatory measures apply to the production ot flour from grain, the sale and distribution of articles of food, and the fixation of prices.

If properly and intelligently applied, the scheme ought to work well. There can be no doubt that a great deal of food is still wasted, not alone by sections of the population who are earning more money than they have ever handled before, but also by public institutions; and many still believe in the catering for the Army, although this last has been improved. Nothing short, however, of some measure equivalent to "food tickets" will prevent over-consumption and waste on the part of those who, owing to the war, are better off than in normal times. But by a strict system of inspection it ought to be possible to reduce or abolish waste in public institutions and in the Services.

It is, perhaps, in respect to the application of the regulatory provisions that the public may harbour some misgivings, and particularly in respect to the manufacture of wheat-flour—a subject which is dealt with elsewhere in this issue.

The control of sale and distribution is certain to prove a difficult undertaking, but with suitable organisation it can in time be satisfactorily attained. The most delicate problem of all is, however, the fixation of prices, and here expert knowledge of food values will be indispensable if approximately the same amount of nourishment is to be obtained in different foods for a given sum of money. This applies in particular to staple articles of diet, such even as bread and potatoes. Thus, for instance, with bread at 3*d.* per lb., potatoes to yield an equal amount of nourishment should not exceed 1*s.* per stone.

But Government measures cannot stop with the mere regulation of food supplies. Powers must be taken to compel a greater production of home food and to ensure a larger acreage of wheat. Objection may be raised to the shortage of labour, but what adequate effort has been made to organise and instruct women to take part in agricultural labour, or to feed them properly when so employed? What effort has been made to increase tillage in Ireland, where the Military Service Acts do not apply? Lastly, why should prisoners of war not be utilised to the fullest degree possible in raising the home production of food? No considerations, political or otherwise, should be allowed to stand in the way of carrying any or all of these measures into effect without further delay.

STANDARD BREAD.

THE decision of the Government, which appears likely to result in the general consumption of "standard bread," will no doubt be received with varied feelings by various sections of the community. In view of the certainty that such differences of opinion are likely to arise, the following brief sketch of the facts of the case so far as they are known may be of general interest.

Under normal conditions at the present time the average practice of roller milling results in the recovery from cleaned wheat of rather more than 70 per cent. of its weight of flour, the remaining 28 or 29 per cent. of the wheat, consisting of various grades of "offals," being sold for feeding stock.

The changes announced last week would make it compulsory to recover 80 per cent. of flour from wheat, which would increase the amount of flour by about 8½ per cent. and decrease the amount of offals for stock-feeding by a like proportion, the percentage in both cases being calculated on the amount of cleaned wheat available for milling.[1]

On the basis of the amount of flour produced in the United Kingdom for home consumption in the years immediately before the war, the change announced would increase the amount of flour available for bread-making by very nearly 600,000 tons, which would provide an extra 2-lb. loaf for every inhabitant of the United Kingdom every three weeks, or seventeen extra 2-lb. loaves per head of the population per year. This is by no means a negligible increase in the bread supply, and it is doubtless considerations of this kind that have induced the Government to take action.

If, however, we examine the result rather more closely, we find that the increase in the nation's food supply may not be so great as the above figures indicate. In spite of repeated statements to the contrary, bread made from 80 per cent. flour is not so nutritious, weight for weight, as bread made from 70 per cent. flour—at any rate, for the supply of protein and energy for the general population. Although 80 per cent. bread contains on the average rather more protein than 70 per cent. bread, the digestibility of the protein in the former is rather lower, so that the actual weight of protein digested by the average individual from 1 lb. of 80 per cent. bread is rather less than the amount digested from 1 lb. of 70 per cent. bread. Again, the energy value of 80 per cent. bread is rather lower than that of 70 per cent. bread. Still one more correction must be made in order to arrive at the actual increase in the national food supply which will result from the general adoption of a milling standard of 80 per cent. It is pointed out above that the recovery of 80 per cent. of flour from cleaned wheat entails a decrease in the supply of the finer wheat offals for stock-feeding to the extent of about 600,000 tons. These finer offals are largely used for feeding pigs. Their transference to human consumption would therefore decrease the production of pork and bacon, and this must be allowed for in estimating the total effect of the proposed alterations in milling. After applying all these corrections it appears that the general adoption of an 80 per cent. standard would undoubtedly give a substantial increase in the amount of digestible food for the supply of protein and energy for the population of the United Kingdom.

The possibility that the food value of bread would be substantially increased by the adoption of the 80 per cent. standard, because the content of the mysterious constituents known as vitamines would be increased by the inclusion of a greater proportion of the germ and of the outer layers of the grain, is perhaps scarcely worth discussing in this connection. Such constituents are supplied by other items comprised in an ordinary mixed diet, so that the vitamine content of bread can have little practical significance except in the very few cases where bread forms the whole, or very nearly the whole, of the diet.

The price of wheat offals for feeding stock is now so high that the adoption of the 80 per cent. standard cannot be expected to make any considerable reduction in the price of bread. Even the compulsory admixture of a considerable proportion of other cereals, such as maize, oats, or barley, with wheat for bread-making would not greatly cheapen the loaf, because these cereals are not very much cheaper than wheat. The important point in raising the milling standard and in including other cereals among the breadstuffs is that it would widen the sources from which the national food supply is derived—a most desirable end under existing conditions. To summarise, the result of a compulsory 80 per cent. standard would be neither better bread nor cheaper bread, but more bread.

[1] The values here given require modification in the light of the Order just made by the Board of Trade (see p. 232).

PROF. PERCIVAL LOWELL.

By the death, on November 12, of Percival Lowell, who equipped the Observatory at Flagstaff, Arizona, and planned its work with such conspicuous success, astronomy loses one of its most ardent disciples and enthusiastic observers. Prof. Lowell was born in Boston on March 13, 1855, and took his degree at Harvard in 1876. He lived in Japan at intervals from 1883 to 1893, and in the former year was appointed Counsellor and Foreign Secretary to the Korean Special Mission to the United States. His experiences of Eastern life were described in several memorable volumes, namely, "Chosön: a Sketch of Korea," "The Soul of the Far East," "Noto: an Unexplored Corner of Japan," and "Occult Japan." His other publications include "Mars," published in 1895, "The Solar System," "Mars and its Canals," "Mars as the Abode of Life," "The Evolution of Worlds," and several fine volumes of "Annals of the Lowell Observatory." In 1902 he was appointed non-resident professor of astronomy of the Massachusetts Institute of Technology, and in 1904 he received the Janssen medal of the French Astronomical Society for his researches on Mars. He had many admirers in this country, and was always ready to assist enterprises having the advancement of knowledge as their object. An illustration of this characteristic was the support which he gave to the Hill Observatory, Sidmouth; and he had the distinction of being the only one outside Great Britain who contributed financially to the endowment of this new observatory.

Prof. Lowell's energy and confidence were infectious; he inspired many amateurs with worthy ambitions, and encouraged a wide interest in the results of observation. For the last twenty-five years he had given undivided attention to astronomy, and made a well-recognised reputation by his researches on planetary markings and by his insistence on the bold deductions that he considered his observations warranted. Whatever opinion may be held as to the deductions and interpretations to which he was led, astronomical science has benefited by the unflagging zeal with which he pursued his investigations, the undoubted sincerity which inspired his work, and the care he exercised to guard himself against self-deception.

Foremost among these precautions may be noted his care in selecting a suitable site for his observatory. He planned reconnoitring expeditions furnished with adequate and identical optical equipment to various continental and insular stations where favourable conditions might be anticipated, and worked for some time on the arid plains of Mexico before deciding that a somewhat inaccessible peak in Arizona, about 7000 ft. high, offered the ideal conditions for which he was in search. There he erected a 24-in. refractor, and began that series of observations on the surface of Mars and of other objects the critical examination of which offered great difficulties on account of minuteness or lack of definite detail. The interest awakened by these inquiries has only been equalled by the controversies to which they have given rise. The study of the surface of Mars in particular was rewarded by the confirmation of Schiaparelli's discovery of a canal system and by the existence of a complicated network of watercourses that assumed various distinct and regularly recurring appearances, depending on the seasonal conditions that obtained. Sometimes the tracks were duplicated, at others they revealed thickened patches, conjectured to resemble the fertile spots known to us as oases. A complete system of planetary meteorology was worked out, the migration of the heat equator was traced with great exactness, and the interchange of wind between the poles and the equator giving rise to cyclonic storms and diurnal effects was discussed with unusual fullness of attractive interpretation.

The ill-defined markings on Mercury and Venus were submitted to a scrutiny not less searching than those of Mars, and Prof. Lowell not only produced substantial evidence that these planets rotate once only in the course of their orbital motions about the sun, but he also determined with some accuracy the position of the axis of rotation, and constructed a trustworthy map of the topographical features of that hemisphere of Venus which is visible to us. The minute discs of Uranus and Neptune, as well as of the satellites of Jupiter, were alike made subjects of the closest study, and much interesting detail was collected. These, with other, researches were carried out with the 24-in. refractor, but quite recently Prof. Lowell added a 40-in. reflector to his observatory equipment, and with the larger aperture was able to confirm the accuracy of much of his previous observations. He was one of the most successful as well as one of the most indefatigable of observers, and we trust that those who have been so happily connected with him in the conduct of the Lowell Observatory will be able to carry on its activities and add fresh lustre to its history.

Prof. Lowell's Contributions to Astronomical Spectroscopy.

The work at the Lowell Observatory has by no means been restricted to the planet Mars, as may have been popularly supposed. Prof. Lowell provided the observatory with an equipment of the highest class for spectroscopic investigations of the heavenly bodies, and, with the capable cooperation of Dr. Slipher, some important contributions to the advancement of astrophysics have been made. Besides taking part in the general study of the radial velocities of stars, several new and difficult investigations of great interest were undertaken. One of the first problems attacked—in 1903—was that of the rotation of Venus, and although the actual period could not be assigned, the evidence was decidedly in favour of a period much greater than twenty-four hours. More recently the first authentic value of the rotation period of Uranus was determined by Lowell and

Slipher, the spectra in this case indicating rotation in 10h. 50m., in a direction contrary to that of the planets nearer the sun. Much attention was at one time given to the search for evidence of absorption due to water vapour in the atmosphere of Mars, first by Doppler effects due to relative motion of the earth and planet, and alternatively by observations of the relative intensities of the atmospheric bands in Mars and the moon. Although measurements of the plates suggested slight displacements, tending to prove the existence of a Martian atmosphere, Lowell frankly confessed that he could place no reliance on this result. On the other hand, Mr. Very's discussion of the intensities of the bands decided in favour of a Martian atmosphere containing water vapour, but this conclusion was not accepted by Campbell.

A further notable contribution to the spectroscopic study of planets was made by a beautiful series of photographs of the spectra of the major planets, showing the progressive increase of intensity of the characteristic planetary absorption bands in passing from Jupiter to Neptune. No satisfactory interpretation of these bands has yet been given, but the photographs provide very definite data for guidance in experimental research relating to them.

The spectroscopic investigations of comets undertaken at Flagstaff have been of more than ordinary interest in consequence of their inclusion of the red part of the spectrum, of which but little was previously known. Much remains to be done in connection with the interpretation of these observations, and in order to facilitate this work Lowell very generously placed copies of the photographs at the disposal of those who were in a position to undertake the necessary experiments. One important result obtained by Lowell, following from simultaneous photographs of the forms and spectra of comets, was that gaseous masses could in some cases be proved to be moving away from the head. This point deserves more attention than it has received. As Lowell put it: "As the incompetency of light-pressure to repel molecules in a comet's tail has been widely published, this observational proof that molecules in such a tail are repelled—whether they can be or not theoretically—is of considerable interest."

Spectroscopic investigations of the spiral nebulæ are extremely difficult and laborious on account of the feeble luminosity, but the Flagstaff observers provided themselves with well-designed instruments and boldly attempted to determine the radial velocity of one of these objects. In the first instance, the Andromeda nebula was found to be approaching the solar system with a velocity of 300 km. per sec., and the suspicion that spirals as a class have much higher velocities than stars has since been abundantly confirmed. The nebula N.G.C. 4594 was, in fact, afterwards found to be not only receding at the immense speed of 1100 km. per sec., but also to have a motion of rotation such that at a distance of 20″ from the nucleus the velocity is 100 km. per sec. These results are clearly of fundamental importance, and would seem to favour the view that the spiral nebulæ are to be regarded as stellar systems outside that to which the sun belongs.

Another difficult investigation undertaken at Flagstaff was that of the constitution of the extremely faint nebulæ surrounding the stars of the Pleiades. It was found that the characteristic lines of gaseous nebulæ were absent, and that the spectrum was identical with that of the associated stars, leading to the conclusion that the nebula shines by reflected starlight. A similar conclusion has since been reached from an investigation of the nebula about ρ Ophiuchi.

Those who have had the privilege of a visit to the Lowell Observatory cannot fail to have been impressed by the ample provision for a wide range of astronomical inquiries, and by the fine display of transparencies representative of the successful results which have rewarded the skill and patience of the observers. The inspiring enthusiasm of Lowell will doubtless be sadly missed in the future, but it is sincerely to be hoped that some means will be provided whereby the activity of the observatory may be maintained.

A. FOWLER.

NOTES.

UNDER the new regulations recently made with a view to the control of food supplies, the Board of Trade issued on Monday the following Order as to the milling of flour:—The Milling Order, 1916, fixes for the United Kingdom the percentages of flour that must be extracted from wheat of various qualities according to the following schedule:—English, 76; Choice Bombay, 78; Australian, 78; Blue Stem, 76; Walla Walla, 75; No. 2 Red Western, 76; No. 2 Red Winter, 74; No. 2 New Hard Winter (1916), 76; No. 1 Northern Duluth, 75; No. 1 Northern Manitoba Old Crop, 76; No. 2 Northern Manitoba Old Crop, 75; No. 3 Northern Manitoba Old Crop, 73; Choice White Karachi, 75; Soft Red Karachi, 75; Rosafe, 62 lb., 73; Baril, 61½ lb., 74; Barletta-Russo, 61½ lb., 74. The Order comes into force, as regards milling, on November 27 next; that is to say, on and after that date no wheat may be milled except in accordance with this schedule. On and after January 1, 1917, only flour milled in accordance with the schedule may be used for making bread or any other article of food. A subsequent Order will be issued requiring periodical returns of stocks of wheat received and of flour and offals milled and of all stocks in hand on the date of the Milling Order coming into operation—*i.e.* November 27.

THE statistics given in the half-yearly Review of the Movement of Fertilisers and Chemical Products just issued by the International Institute of Agriculture show very clearly the effects of the war on this branch of industry. Shipments of natural phosphates are diminishing both on account of the scarcity of labour and the high rates of freight. As regards superphosphate of lime, the small supply of raw phosphates and the ever-increasing demand for sulphuric acid for munitions of war have depressed the output in all countries, notably in France, where the latest figures show a decrease of 70 per cent. on the production of 1913. The increase in the exports of Chilean nitrate, which began in the latter half of last year, has continued, so that the figures are now much nearer to the normal than was the case earlier in the war. France is now importing three times as much nitrate as in 1915, and the same applies in various degrees to all the importing countries, but the increased demand is entirely for industrial purposes. The manufacturers of synthetic nitrogenous fertilisers have almost everywhere augmented their output considerably, either by development of existing plant or by new construction. Very little, if any, of the extra supplies are available for agricultural purposes; in some countries the State requirements absorb the whole output. The review includes a useful bibliography of the literature published during the first six months of 1916.

THE issue of the reports containing the scientific results of the Australasian Antarctic Expedition, 1911–14, under Sir Douglas Mawson, has been seriously delayed owing to the war and its effect upon assets, such as the popular book, film, and lectures which it was anticipated would realise sufficient to defray the cost of publication. We are glad to learn, therefore, that the Government of South Australia has come to the assistance of the expedition, and agreed to execute the printing at the Government Printing Office, Adelaide. The New South Wales State Government has also generously agreed to reproduce certain illustrative matter. The production will appear in royal quarto size, similar to like publications of other British Antarctic expeditions. The completed work will be voluminous, and several years must elapse before all is passed through the press. The plan of publication is to divide the subject-matter into the three series, as follows:—Series A, geography, geology, etc.; Series B, physical subjects; Series C, biology. Each series will be subdivided into volumes and parts. Prof. W. A. Haswell, of Sydney University, who organised the programme of the biological section of the expedition, is editing Series C, and has already made arrangements for the working out of most of the groups collected. Three parts, namely, Fishes, Mollusca, and Cephalopoda, are expected to appear this year.

THE death of Mr. Charles Smith, master of Sidney Sussex College, removes a well-known figure from Cambridge, and will be widely regretted. Mr. Smith was born in Huntingdon, and entered Sidney Sussex College as a scholar in 1864, graduated as third Wrangler in 1868, was elected a fellow of the college in the same year, and held the office of tutor from 1875 to 1890, in which year he was elected master on the death of Dr. Phelps. From 1896 to 1909 he was a governor of Eton College. During his tutorship Sidney Sussex increased greatly in numbers, and the influence of his teaching was seen in the successes of his pupils in the Mathematical Tripos. He was indefatigable in his efforts to promote the interests of his college. To him the erection of the new block of buildings there was due, and it was his ambition, unfortunately not realised, to complete the new court by the addition of a further range. To the general public he was best known as the writer of a series of text-books on mathematical subjects remarkable for their clearness of exposition. His books on conic sections and algebra in particular are probably known to most English mathematical students. They appeared at a time when a more thorough, and, at the same time, a more attractive, style of elementary mathematical teaching was greatly needed, and had immediately a large success. In private life Mr. Smith was a great lover of flowers, especially of delphiniums, roses, and chrysanthemums, which he grew in great profusion and with much success in his charming garden at the Master's Lodge.

AN exhibition and sale of water-colour sketches by the late Prof. Silvanus P. Thompson will be held (by permission of the Alpine Club) at the club rooms, 23 Savile Row, W., from November 27 to December 10.

THE Bradshaw Lecture of the Royal College of Surgeons of England will be delivered on December 15 by Col. C. J. Symonds upon "Gunshot Injuries of the Spinal Cord."

THE death on November 18 is announced in the *Morning Post* of November 20 of Mr. J. H. Merivale, the North of England mining engineer, who was secretary to the North of England Institute of Mining and Mechanical Engineers, and formerly professor of mining at Durham College of Science.

Engineering for November 17 contains an interesting article by Prof. Luiggi on the utilising of volcanic heat for power-production purposes. In Central Tuscany, near Volterra, there are numerous cracks in the ground from which powerful jets of very hot steam spout high in the air with great violence and constancy. Early experiments on the use of this steam for driving engines showed that the borax salts, sulphuretted hydrogen, and sulphuric acid present in the steam necessitated frequent repairs on account of the corrosive action. This difficulty has been overcome by applying the steam, not directly in the engine, but to a boiler instead of fuel; steam is thus produced in the boiler at a pressure of two atmospheres, then passed through a superheater, and so to the steam turbine used for driving electric generators. Prince Ginori-Conti, who has financed the undertaking throughout, has been responsible for three large installations on this system. One of the 3000-kw. units has been at work since January, 1916, the second since April, and the third has just been started. So far the first two groups have worked quite successfully, and have been a great boon to the industries of Tuscany, greatly crippled by the scarcity and high price of coal. Since the region available extends for many square miles around Larderello, there is nothing to prevent the system being developed to the production of hundreds of thousands of horse-power.

CAPT. W. B. GOURLAY writes us, from "somewhere in France," a brief but extremely interesting note on a phosphorescent centipede. He discovered the creature in a very unexpected manner, inasmuch as he was putting coals on a dying fire in an unlighted room when he immediately noticed on the coals a gleaming, wriggling object, which proved, by the light of a match, to be "a small yellow centipede." The fact is worth placing on record, since the occurrence of phosphorescence in this group is by no means generally known. Even by specialists, indeed, nothing seems to be known of the matter save that two species of Geophilus possess the power of emitting phosphorescent light; the source and use of the light are yet to be discovered. In one of these, *G. electricus*, the light has been described by Mr. G. S. Sinclair as brilliant, the creature emitting it leaving a trail of bright light behind it which lasts for some time. Of the other species, *G. phosphoreus*, still less seems to have been recorded. It was described by Linnæus on the authority of a Swedish sea-captain, who asserted that it dropped, shining like a glow-worm, upon the deck on his ship when he was sailing in the Indian Ocean a hundred miles from land. From this we may infer that it had been taken on board at the last port of call, and remained concealed, either on the deck or in the rigging, until it at last revealed itself as a "stowaway."

ONE of the most interesting phases of the work which the Young Men's Christian Association is undertaking on behalf of the general welfare of the men of his Majesty's Forces received Royal approbation on Friday, November 17, when H.R.H. Princess Christian opened a microscopical demonstration and conversazione at the Y.M.C.A. headquarters in Tottenham Court Road. Fellows and members of the Royal Microscopical Society, the Quekett Microscopical Club, and the Photomicrographic Society were present with eighty-six microscopes, and the large reading-room, lounge, and drawing-room were filled during the evening with a constant stream of men desirous of viewing interesting objects displayed. In addition, there was a series of lectures and kinematograph displays of living micro-organisms, Mr. F. Martin Duncan lecturing on "Some of Nature's Fly-traps," and Dr. G. H. Rodman giving a talk on "What the Microscope Reveals in a Few Objects of Everyday Occurrence." In introducing her Royal Highness, Col. Sir T. Sturmy Cave said the experiment of microscopical exhibitions was originated by Mr. J. W. Ogilvy, one of the Y.M.C.A. honorary secretaries, and the experiment had been a decided success. Princess Christian then declared the proceedings opened, expressing therein hope that they would be very successful. She afterwards made a tour of the various exhibits, spending more than half an hour among the microscopes, and showed particular interest in the apparatus demonstrating the process of photographing microscopic objects. It is interesting to note that a large number of exhibitions have already been given at the Y.M.C.A. huts in the Home Counties area, and even as far as Salisbury Plain. Great interest is invariably evinced in these as a variation from musical entertainments or kinema shows. The demonstrations deal with germ enemies to be guarded against, and, at the special request of a number of soldiers, special attention has been given to the question of venereal diseases.

A LARGE and enthusiastic meeting was held on November 9 in the University of Sheffield to discuss the formation of a Society of Glass Technology. The widespread interest in the scheme was demonstrated by the presence of representatives of cities as far apart as London, Edinburgh, and Cardiff, whilst every glass-manufacturing district was well represented. Mr. W. F. J. Wood, of Messrs. Wood Bros., Ltd., Barnsley, was elected to the chair, and the meeting opened with a cordial welcome from the Vice-Chancellor of the University, Dr. H. A. L. Fisher, who remarked that Sheffield had cause for legitimate pride in the knowledge that its University had been proposed as the headquarters of a society representing such an important industry. He emphasised the fact that this industry, among others, had suffered in the past owing to its detachment, wholly or partially, from its scientific aspects. The formation of the Department of Glass Technology in the University was serving to remedy this state of affairs, and the inauguration of this society was a distinct step in the same direction. Dr. W. E. S. Turner outlined the steps that had led up to the formation of the society, and spoke of the remarkable response from those interested in glass. Expressions of warm approval and promises of support had been received from all over the country. Dr. Turner pointed out that there was no intention of making the society a local institution, but that it was in every way a national one. The report of the Provisional Committee was adopted, and a formal resolution giving actual being to the society was passed unanimously. The following officers were then elected:—*President*, Mr. W. F. J. Wood; *Vice-Presidents*, Mr. S. B. Bagley, Mr. F. J. Cheshire, Sir William Crookes, Mr. A. S. Esslemont, Prof. H. Jackson, Mr. S. N. Jenkinson, Mr. H. J. Powell, Dr. W. Rosenhain, F.R.S., Mr. H. J. Stobart, Dr. M. W. Travers, F.R.S., Mr. Duncan Webb, and Mr. H. S. Williams-Thomas; *Council*, Mr. J. E. Barker, Mr. W. R. Barker, Dr. P. G. H. Boswell, Mr. F. W. Branson, Mr. W. Butler, Mr. F. G. Clark, Mr. J. Connolly, Mr. J. B. Coppock, Mr. J. H. Davidson, Prof. W. G. F. Fearnsides, Mr. J. James Hirst, Mr. F. Swann, Mr. F. P. Wainwright, Mr. A. D. Young; *Treasurer*, Mr. F. Sweeting; *Secretary*, Dr. W. E. S. Turner; *Assistant Secretary*, Mr. C. J. Peddle. It is hoped that the society will receive the support of all those interested in glass, either directly or indirectly. Information upon any points will be gladly supplied by Dr. W. E. S. Turner, the University, Sheffield, who will welcome inquiries and suggestions.

THE tendency to ascribe mechanistic principles to animate nature on the evidence of their applicability to inanimate nature, or to postulate a dualism which marks off the animate and the inanimate as lying in two separate realms, is subjected to a searching criticism on scientific grounds by L. M. Passano in an article entitled "Being and Becoming" (*Mind*, N.S., No. 100). He develops a scheme whereby he brings into relationship an atom and an act of will. He contends that the atom implies energy, and that mass is energy or a store of energy due to motion. Energy is life, and to live is to liberate stored-up energy, the liberation of energy being a subjective act. All things are living, the lowest form of life being gravitation. The descending scale of liberation of energy from man to the lower animals, to plants, to radio-active substances, to chemically active substances, to inert substances, the last possessing at least the energy of gravitation, is nowhere delimited. The materialism of W. K. Clifford depends upon his being unaware of radio-active substances, which activity and the facts of chemical affinity render, according to the writer, this point of view untenable. The paper is one involving the fundamental principles of several sciences, and will be interesting to many thinkers.

THE *Pioneer Mail* of September 2 gives an account of the Calcutta Health Officer's proposals for the future. We are strongly of the opinion of those who hold that before antimalaria measures are carried out we should determine exactly the malarial or endemic index of the district: (*a*) the anopheline carrier, (*b*) its distribution as shown by a spot map of the occurrence of larvæ. It would then be known what there is to undertake, viz. the eradication of malaria-carrying anophelines. It is difficult to agree with those who prefer to proceed against all mosquitoes. If time and money were no object this method might be permissible, but in Calcutta the proposed outlay for antimalaria measures for 1915–16 is only about five hundred pounds. It is evident that a small sum like this must be spent in a rational way, and not in endeavouring to destroy mosquitoes in "the many scores of miles" of breeding-places in Calcutta. It appears that it was only last year that it was proposed to obtain some of the necessary information to which we have alluded above. With the money available it would seem most practical to treat one area only in which the conditions are fully known and suitable. If the results are successful we believe that the path of the sanitary officer would be a happier one in the future. So far Calcutta has not distinguished itself in this matter.

ONCE more the formation of a Red Cross Museum is being seriously discussed. The need for such an institution, and the scope of its activities, are briefly and clearly set forth in the *Museums Journal* for November. Such a museum, of course, would appeal only to the expert. But it would provide him with a source of inspiration, and do much towards that standardisation of methods and equipment which is, in regard to many aspects, very urgently needed. A case in point is furnished by the different sizes adopted at the present time for stretchers and for ambulances, so that a stretcher that is brought up to place in an ambulance often cannot be taken in. If a standard gauge could be agreed on the work of handling the wounded would be greatly facilitated, and this agreement would be the more fruitful if such standardisation could be international. Where and by what body such a museum should be erected and controlled is a matter for debate. It has been suggested that the Royal Army Medical College might well undertake the task, as the French Army Medical Service has already done for France. The *Museums Journal* suggests that such a museum might well form an appendage to the Wellcome Medical Museum, or the Royal United Service Museum, Whitehall. But as the whole scheme is still very much in the air, the problem of housing can scarcely be said to have arisen, so much depending on the range of the activities which are to be undertaken.

THE old-fashioned plan of exhibiting stuffed birds in museums has, it is to be hoped, gone for ever. In place of it has come the practice of mounting selected types amid their natural surroundings during the breeding season. In some of the American museums it has become the custom to reproduce not merely the immediate surroundings of the nest, but, by the aid of skilfully painted scenic backgrounds and cunningly concealed artificial lights, also large areas of the general environment. Miles of landscape are apparently surveyed, and the teaching value of the exhibit is thus immensely increased. But the use of these spectacular effects must be strictly limited to this particular purpose, or there is a grave danger of our natural history museums degenerating into peep-shows. An example of the reality of this danger has just been furnished by the Brooklyn Museum, N.Y., where, according to the *Brooklyn Museum Quarterly*, vol. iii., No. 2, half a dozen Cape pigeons and three "whale-birds" have just been mounted as in full flight, and as seen from the deck and through the rigging of "some sailing vessel, off-shore, beating against a fresh Atlantic wind. Models of others, reduced to give the proper perspective, carry the vista back towards the faint sky-line." This is all very pretty, but it is of doubtful value from a scientific point of view. All the information the public will gain from such an exhibit is that petrels fly over the sea!

A PAMPHLET entitled "The Nicolson Observatory Bee-Hive, and How to Use It," by Mr. J. Anderson, issued by the North of Scotland College of Agriculture, is before us. The elephant and the sheepdog might smile sarcastically could they be confronted with Maeterlinck's opinion that the Hymenoptera, "of all the inhabitants of this globe, possess the highest degree of intellect after that of man." When the famous beemaster mentions "the intelligent substitution of flour for pollen, and of an artificial cement for propolis," one is tempted to think of the intellectual vegetables which also readily avail themselves of man's auxiliary devices. Apart from controversy, however, observation of the hive will always make a strong appeal to the curious for its own sake, to the teacher for its value as a lesson in biology, to men of research for the unknown possibilities of suggestiveness. Mr. Anderson's observatory hive claims, apparently with good reason, to make the business of the spy as little objectionable as possible, allowing the bees to perform their various tasks in a perfectly normal way while actually unconscious that they are being observed. His pamphlet describes the latest improvements, with all that is required in the way of superintendence. Among other things, "it is essential that the possessor of a Nicolson observatory should have charge also of one or more full-sized hives."

FOR several years experiments on the effect of overhead electrical discharges on crops have been carried out at Lincluden Mains, Dumfries, by Miss E. C. Dudgeon, with the scientific co-operation of Prof. J. H. Priestley and Mr. I. Jörgensen. The results obtained in 1915 with an oat crop on adjoining plots of 1½ acres each are briefly summarised by Mr. Jörgensen in the October issue of the *Journal of the Board of Agriculture*. The leakage of discharge over the control plot was largely, but not entirely, prevented by the interposition between the plots of a well-earthed wire screen reaching 3 ft. above the level of the charged network. Despite this leakage, the electrified plot showed the remarkable increase of 30 per cent. in grain and 58 per cent. in straw as the presumptive effect of the discharge, which was applied on the average five hours daily for 108 days. The crops were not heavy, but the superiority of the crop on the electrified plot was marked from the earliest stages of growth, and it suffered less from the dryness of the season.

DURING recent years trichloroethylene has been used to a limited extent for the extraction of the oil from soya beans. The résidual extracted meal has been disposed of as food for stock, and as trichloroethylene is not poisonous when given in comparatively large doses to cattle little risk would appear to be involved in the use as food of the extracted meal. Cases of poisoning of cattle attributed to soya meal have, however, been brought to the notice of the Board of Agriculture, and the results of their investigations, which are summarised in the October issue of the *Journal*, throw strong suspicion on the meal obtained by the use of trichloroethylene. The cases of poisoning, both on the farms and in the investigations, were limited entirely to cattle, and in no case was a sudden effect produced. Experience with soya extracted with naphtha makes it very improbable that the poisonous principle could have been inherent in the meal. It would appear more probable that it was either a non-volatile impurity present in the trichloroethylene or a product of interaction between the trichloroethylene and some ingredient of the soya beans.

La Nature of October 21 contains an article by M. Alfred Renouard directing attention to the interesting renaissance in the use of natural dyestuffs which the war has brought about. Certain of these dyestuffs, such as indigo, old fustic, logwood, red sandal wood, sapan wood, etc., have continued to be used, some of them in large quantities, in spite of the severe competition of synthetic dyes, and this use has increased greatly owing to the war. Most of the increase is due directly to the war, indigo being required for the cloth for naval uniforms, fustic for khaki, and logwood for black cloth. The area under indigo in India has increased, and special efforts are being made in the British West Indies and elsewhere to increase the output of fustic and logwood. Extremely high prices are being obtained for these dyestuffs, but the producer probably benefits but little from this increase owing to the enormous rise in freight rates. M. Renouard expresses the hope that some means will be found of retaining this increased trade in natural dyestuffs after the war.

AN interesting article in the issue of the *Engineer* for November 10 deals with the new water supply for Guayaquil, chief port and most important city of the Republic of Ecuador. The port stands upon an alluvial plain, on the banks of the river Guayas, and is frequented by ocean-going vessels up to 28 ft. in draught. The absence of a proper system of water supply, combined with ineffective drainage, has militated hitherto against the development of the town, but now that the Government has taken both these matters in hand there is every prospect, despite certain climatic disadvantages, of the attainment of a very serviceable degree of civic sanitation. The total estimated outlay is in the neighbourhood of 2,000,000*l.*, and the work is being carried out progressively, in instalments. A fresh system of water mains is already laid, and a storage reservoir of 6,000,000 gallons capacity is nearing completion. It has not yet been definitely decided whether the source of supply shall be the Daule river, with an intake some twenty miles upstream, or a group of mountain streams in the forests of the Cordillera de los Andes, some sixty miles distant from Guayaquil. The drawbacks in the former case are the pollution arising from settlements along the banks of the river, the high percentage of suspended matter in the water, and the low gradient, which would necessitate pumping. The mountain streams would readily admit of a gravitation supply, and are less likely to be polluted, but the construction of the pipeline would be a heavy initial expense. The Government has both schemes under consideration, and data and statistics are being obtained with a view to an early decision.

OUR ASTRONOMICAL COLUMN.

THE LEONIDS OF 1916.—With the parent comet (1866 I, Tempel) near aphelion an abundant shower of Leonids was not expected, but it was important to ascertain whether the display returned even in a minor character. Mr. Denning writes that on the morning of November 15 he saw only one Leonid in a watch of about an hour between 4 and 5.30 a.m. The next morning was overcast, but on November 17, between 3 and 6.15 a.m., notwithstanding wintry conditions and one of the keenest north-easterly winds experienced in recent years, Mrs. Fiammetta Wilson, of Totteridge, recorded fifteen meteors, including some brilliant objects. There were seven Leonids from a radiant point very sharply defined at $150°+22°$. This position appears to be identical with that usually found on the mornings of November 14 and 15, and apparently favours the view that there is no perceptible change in the place of radiation. But more exhaustive data are required in settlement of this interesting feature.

The brightest meteor seen by Mrs. Wilson was at 3h. 33m. a.m. (November 17). It was equal to Venus, and shot from $215°+58°$ to $245°+57\frac{1}{2}°$ evidently a fine Leonid. Bright meteors of the same shower were seen at 4h. 50m. and 5h. 42m. At 3h. 16m. a large Taurid, comparable with Jupiter, travelled from $188\frac{1}{2}°+57°$ to $204°+48°$. If duplicate observations of any of these objects were obtained at other stations, the records would be valuable for comparison.

THE SOLAR APEX DETERMINED BY MEANS OF BINARY STARS.—The method of determining the solar apex proposed by Bravais in 1843 has until lately not been used by any other investigator, no doubt because it assumes the distances of the stars to be known, and nobody has been inclined to follow Bravais in making them all equal. Some years ago Weersma applied the method to 3616 stars, taking the distances from Kapteyn's tables of mean parallaxes. His result, $267·7°+31·4°$, was in good accordance with the best previous determinations, though the velocity, 14·9 km., was smaller than the spectroscopic result. In a paper recently published in the Proceedings (*Oversigt*) of the Royal Danish Academy of Sciences, M. Luplau Janssen has applied the method to 180 double stars, the proper motions of which are given in the Preliminary General Catalogue of Boss. Assuming the mass of a binary star equal to that of the sun, well-known formulæ give a value of the parallax called the "hypothetical parallax." Hertzsprung has shown (*Astronomische Nachrichten* 4543) that where the annual change of position angle and distance is known, it is possible to find a minimum value of this hypothetical parallax of a binary star. From a comparison of thirty-six values of parallaxes actually measured with the computed values of the minimum hypothetical parallax M. Janssen finds that the latter may be put equal to half the real parallax. On this assumption he finds the apex to be $264·5°+26·1°$, and the velocity equal to 17·15 km. per sec. This result is in surprisingly good accordance with the best recent determinations, and this shows at any rate that the hypothetical minimum parallax is a quantity which is not without some value where there is no satisfactory value of the parallax resulting from measures.

SPECTRUM OF THE NEBULA ABOUT RHO OPHIUCHI.—At the Lowell Observatory, Dr. V. M. Slipher has lately attempted to photograph the spectrum of the remarkable nebula in the region of ρ Ophiuchi (*Popular Astronomy*, vol. xxiv., p. 542). A single-prism spectrograph of high light-power was used, and an image was formed on the slit by a simple lens of 20 cm. focal length. The total exposure, on four nights, was twenty hours, and by comparison with the exposures for direct photographs given by Barnard, it was estimated that this would give a good record of the spectrum if of the bright-line type, or would give a weak impression if the spectrum were continuous. The plate obtained was of the latter type, the spectrum of the nebula appearing faintly on either side of that of the star. So far as can be judged from the photograph, the spectrum is like that of the star about which the nebula clusters, and Dr. Slipher regards this as an indication that the nebula shines by reflected light, as he previously found reason to believe to be the case with the nebulæ in the Pleiades. In both these regions of the sky faint stars are conspicuously deficient in number, and it is suggested that their apparent scarcity may be due to their obscuration by nebulæ which may be otherwise invisible.

BRITISH INDUSTRY AND THE WAR.

THE advice of a recent ex-Minister of State that we might well leave after-the-war conditions to take care of themselves finds little response in the world of industry, whether in regard of employers or employed, who are alike viewing with deep concern the industrial and commercial problems that will surely arise on the advent of peace. This finds clear expression in a valuable memorandum issued in June last by the Garton Foundation entitled "The Industrial Situation after the War," which is fully and sympathetically further considered in the *Quarterly Review* for October by a member of the group which prepared it. This highly important memorandum has been drawn up by a group of men representative of the capitalist and employing classes, of organised labour, as well as by men familiar with finance, economics, and administration. It has further been circulated to, and discussed in draft by, large employers, trade union officials, and experts on social and economic questions with a view to their criticisms and suggestions. It is now published in the hope of stirring both employers and employed to action. The industrial problem, it declares, was with us before the war. The dangers of labour unrest and the cry for increased efficiency are familiar to all. But the war has profoundly affected both the circumstances and the minds of men, and has gravely accentuated the complexities of the situation and the peril in which our industries stand. It is strongly urged, since industry as a whole is inextricably interwoven with the social and political life of the nation, that we cannot too soon bring to bear upon the various intricate questions involved the best intelligence and experience at our command with the object of formulating a policy based upon a comprehensive survey of all aspects of industrial conditions.

A further article appears in the *Review* dealing with British trade and manufactures and the necessity for better organisation and more efficient methods of production if we are to succeed in maintaining not only our position in the markets of the world, but also our ability to meet the vast expenditure which the war has entailed. We have failed, says the writer, as compared with America and Germany, in our methods of production, transport, and marketing, in the neglect of co-operative effort, in fertility of design and invention and in adaptability to the needs of the foreign consumer, in our provision for commercial education, and, finally, in the support of the Government in aid of trade. Before the war German goods were extensively sold in this country, and the foreign trade of Germany, whilst not so large as our own, was extending much more rapidly. It is stated that there is not the slightest doubt that we have fallen behind Germany in efficiency of manufacture of certain products in respect of both design and price, and that in order to achieve success we must produce better and cheaper goods. So far as our home trade is concerned we may exclude German goods by high tariffs, but that will not help us in foreign markets, nor is it the true remedy, which can be found only in better provision for education and a higher standard of efficiency. A strong plea is put forward for the establishment of a Ministry of Commerce, the duty of which it shall be to foster and assist British trade both at home and abroad.

BOTANY AT THE BRITISH ASSOCIATION.

THE president in his address struck the economic note, which was sustained throughout the meeting, probably the most notable contributions being the discussions on plant disease; on the utilisation of waste lands; on the botanical aspects of coal; and on the medicinal plant industry.

The discussion on plant disease was opened by Prof. Potter, of Newcastle, who laid stress on the enormous importance of the subject in relation to the world's food supply and to many other commercial products. He stated that, on an average, about one-third of these crops are lost by disease, and that a loss of two and a half millions sterling occurred in Australia one year through "rust" of wheat alone. The destruction of timber, as of many Colonial products, such as sugar, rubber, coffee, etc., is very serious. He showed how manifold are the problems underlying the treatment of plant disease, and dwelt upon the importance of various aspects demanding investigation, not alone in mycology, but in the associated physiological and pathological relations of host and parasite, and host and soil. Prof. Potter suggested two desiderata: (1) the improvement of the training of the investigator; (2) the establishment of a British Central Institute for the supply of pure cultures, which, with aniline dyes and optical glass, ceased at the outbreak of war.

Mr. Brierley, in a separate contribution, elaborated a suggestion for the formation of an Imperial Bureau of Mycology comparable with that recently established in entomology, but providing, in addition, facilities for research and supply of pure cultures.

Mr. Ramsbottom alluded to the backward condition of British phytopathology, and spoke strongly of the lack of adequate training and subsequent support given to our investigators. He advocated a central station for research and advice.

Mr. Salmon and Dr. Eyre struck a hopeful note with regard to the readiness of farmers to make use of scientific results, which it therefore behoves us to produce. They referred to the necessity for co-operation between botanist, mycologist, and chemist for the elucidation of the very complex problem of plant disease and its treatment.

The discussion of the botanical aspects of coal was opened by Dr. Marie Stopes, who urged the importance of co-operation between palæobotanist, chemist, and ecologist for the discovery and right application of our coal resources. While Prof. Seward, who spoke later, was a little doubtful as to the great utilitarian value of botanical examination, the opener suggested that researches already indicated the possibility of association between the *parts* of plants making up the bulk of the coal and the particular by-product which it yielded. She pointed out the danger of confining investigation to Carboniferous fossils in view of the fact that the coal of India, for example, is for the most part Tertiary.

Prof. Weiss spoke of the correlation which had been demonstrated between the presence of spores and the chemical nature of the seams.

An interesting series of papers on utilisation of waste land was introduced by Prof. Oliver, who also gave a paper on the possibilities inherent in maritime waste land. He illustrated his remarks by special reference to sand dunes and to salt marshes, and showed that in both cases there are two modes of utilisation available: (1) to take advantage of the natural product; (2) to convert or reclaim, so that the land is available for more general purposes. In both habitats the natural product may be a grass capable of being cultivated at a profit for paper-making. But if capital and labour be spent on their reclamation, sand dunes add profitably to our timber area, and salt marshes are known to give very fertile soil. It might well be that in the time immediately following the war this would afford excellent transitional labour for our soldiers.

Mr. Martineau, of the Reafforesting Association, demonstrated by means of lantern-slides the success of the society's planting on pit mounds in the Black Country, and gave every reason to suppose that it would prove a sound financial undertaking.

Dr. W. E. Smith developed in some detail the complexity of the problem of improvement in utilisation of mountain and heath land. He showed, however, that improvement could be effected by more frequent burning, as recommended by the Grouse Committee, by inclusion of more cattle with sheep grazing, as well as by the more drastic measure of restriction of deer forest and grouse moor to the more inaccessible uplands.

The possibility of converting moorland into food-bearing soil by means of the application of bacterised peat was brought forward by Prof. Bottomley, who quoted successful laboratory and field experiments in support. He stated that at Entwistle, in Lancashire, the yield of oats and mangolds had been doubled by its application.

The discussion on the collection and cultivation of medicinal plants was opened by Prof. H. E. Greenish, of the Pharmaceutical Society of Great Britain, who outlined the steps that had been taken during the last two years to make good the shortage of drugs consequent upon the war, and to establish a permanent

British industry. At the present moment a scheme which had every chance of success was being put forward by a Federation of the Central Committee of National Patriotic Organisations, the Herb Growing Association, and the Agricultural Organisation Society. Mr. Holmes, also of the Pharmaceutical Society, brought forward some interesting suggestions for the scientific improvement of medicinal plants.

Sir Sydney Olivier, the secretary of the Board of Agriculture and Fisheries, pointed out how essential it was to success that the industry should be established on such lines that it took its place in the commercial world as a specialised market-garden crop, with the prospect of reasonable remuneration.

Dr. E. N. Thomas raised the question of the relative merit in certain cases of the extraction from fresh and from dried leaves.

Among the other contributions to the section was a very interesting paper by Sir John S. Stirling-Maxwell on afforestation after the war. He advocated that the British Empire, as a whole, should aim at becoming self-supporting in the matter of timber. Dr. Borthwick, in the subsequent discussion, laid stress on the necessity for the training of those engaged in forestry in adequately staffed and equipped institutions.

Miss E. R. Saunders presented a report on means of bringing into closer contact those engaged in scientific breeding experiments and those commercially interested in the results. She suggested that the trades concerned should be encouraged to organise research departments, while the scientific workers might well unite to form a genetics association. She further advocated the issue of a new and readily accessible vehicle for the publication of literature on genetics and the establishment of a sub-section of genetics to the British Association.

The first of these proposals was warmly supported by Prof. Bateson, who saw difficulties, however, with regard to a new publication, which he did not consider was needed.

As the result of these discussions a committee was appointed from Section K to consider provision for plant pathology, and a joint committee from the Sections of Botany, Zoology, and Agriculture to consider provision for the application of genetics.

The meetings of Section K were terminated by a very pleasant and instructive expedition on Saturday, September 9, to the salt marshes at Alnmouth.

E. N. THOMAS.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION L.

EDUCATIONAL SCIENCE.

OPENING ADDRESS (ABRIDGED) BY THE REV. W. TEMPLE, M.A., PRESIDENT OF THE SECTION.

THE spiritual side of human nature, the capacity for fellowship and for devotion, is best trained by the life of membership in a society. No instruction or study can take the place of this. This is the great inheritance that comes down to us, in England at any rate, from the Middle Ages. The side on which those great private institutions which are called public schools, and the older universities, are particularly strong is the social life which is their most leading characteristic. As the personality begins to develop it requires some society of which it may be a member other than the home on one side and the nation on the other. The nation is clearly far too big for the child to realise, or indeed to possess any effective membership in it; and the home, though not too small, is yet unsuitable in one respect, namely, that it is bound to be too much under the direction of the parents. Where life in a school-room is possible, and where there is a large family to share that life, some of the conditions which we require are present, but what is needed is a society which shall indeed be under general supervision, but of which the members actually determine the character and life, so that each feels that he is a member of this community in the fullest sense, that its welfare depends upon his loyalty, while his welfare depends upon its general character. I confess that I doubt the possibility of securing this fully realised membership otherwise than in a boarding school, but here I speak with great ignorance; at any rate I am sure that for the spiritual development of the rising generation we urgently need that corporate life in schools which the so-called public schools possess in so large a measure. Every member of one of these schools, or of one of our older universities, knows quite well that what has been most valuable to him in his training has been the whole life of the place, and not the specific teaching of the class-room or laboratory. It is probably true that the educational institutions which have especially cherished this ideal have tended to be slack, as they have certainly been amateurish, with regard to the intellectual or scientific life; but they have maintained this fundamental principle, that the spiritual nature is best developed through life as a member of a society, and that a society of such a kind that the membership can be real and effective.

Now, one main activity of a society composed of children or adolescents will necessarily be found in games. This is partly because physical growth is one of the main businesses of life at that stage, and it is right that the growing boy or girl should delight in developing and exercising the physical faculties. But it is also because a game is felt to be more communal than school work. With work arranged as it now is, it inevitably follows that school work is regarded as being done for one's own sake, while the boy who plays hard is regarded as serving the community; he does it for his house or the school as much as for himself. I shall suggest in a moment that experience shows that by changes, which are otherwise desirable, with regard to school work itself a good deal of this difficulty may be overcome, but it will still remain true, at any rate with boys, that games are the dominant interest, and athletic heroes more admired than boys of intellectual promise; and I desire to insist that this is a perfectly right thing provided only that the elders, whether parents or teachers, do not themselves adopt the boy's standard, and so fix it in the boy's mind, but while sympathising with the boyish interests, yet constantly lead the mind forward to a truer perspective.

We give too exclusive a place to books in school education. Many boys, not at all really stupid, are failures at school because they are bad at books. If manual work is given a larger place, it can be so arranged that the great moral difficulty about school work is removed—namely, its individualistic and competitive character. Co-operation cannot be carried far in book work. Learning from books must be done by each for himself. But manual work can be done in teams, so that a large co-operative element comes in, which is of great value as a training for citizenship.

It is possible to do something of this sort with regard to book work. At Repton a challenge-shield is at this time being presented, to be held by the house whose members together gain most marks according to a scheme which allots so many marks to a form prize, so many to a school prize, and so forth. This in so far as it is successful in its aim will bring the communal and co-operative spirit into the school work.

In discussing the general atmosphere in which teaching is given, and the effect which by its constant, though often unnoticed, influence it produces upon the character, something must be said about the suggestion implied and offered by our present educational system, and the changes which are needed to remedy its evils. In the first place it is clear that the system rests on the belief that for most people all that is really required is a beggarly minimum. This is most of all apparent in that curious regulation which permits clever children who might profit by continued education to leave school earlier than others, while those who are more slow-witted and less likely to profit by prolonged education are kept at school for the full time. Clearly this regulation rests on and suggests the belief that there is a definable minimum to which all citizens should attain, but beyond which there is no vital necessity that they should pass. The point selected is unfortunate in the last degree, and that in two ways. First, it releases children from the discipline of school just at the moment when discipline begins to be most essential. Down to the beginning of adolescence what we need is something that may more fitly be called supervision, and for myself I have great sympathy with those who hold that under a general supervision there should be the utmost possible freedom for the child. But with adolescence there comes a temporary chaos in the psychological make-up, and during that period there is an urgent need, not only for supervision, but expressly for discipline as that word is commonly understood, namely, the imposition of restraint, forcible if need be, in order that certain impulses may not break loose and destroy the harmony of the whole nature. But the school-leaving age is unfortunate in another respect also. We teach the child to read, and then send him away from school at a time when it is too early to have begun the training of his taste and judgment. We have made him a prey to all manner of chance influences, but have not supplied him with the power of selection between these, or the means of resisting those which his better judgment condemns.

Something no doubt can be done by means of continuation classes, provided that the time for them is taken out of the hours of employment, and not added on to these; but nothing will really meet the case except an all-round raising of the school-age. And even then we still need to get away from the conception of a necessary minimum. What we have to aim at is the maximum attainable by each scholar, not the minimum that will make him a tolerable member of a civilised community. If we aim at a minimum, that will be what most of the scholars also aim at. But how are we to make this change? The obvious method is a large system of exhibitions, maintenance grants, and the like. But here, again, we come to another false suggestion. Any system of scholarships and exhibitions is false in principle, because it inevitably suggests to the child that it is to pursue its studies for the sake of its own advancement; the whole system coheres with the ideal of the educational ladder, by means of which men and women may climb from one section of society to another. Now it is undoubtedly true that the State is bound to secure for its own interest that brain-capacity wherever found shall be fully developed, and that if a child of a dock labourer has capacities fitting him to be a great statesman or a great artist it is for the public interest that these capacities should be fully developed. But we have also to remember that when by education you lift a child from one section of society to another, you expose him to one of the most insidious of all temptations, the temptation to despise his own people. And if once his native sympathies are thus broken up, it is unlikely that he will grow any more. An educational system which depends upon the ladder is in a fair way to train a nation of self-seekers. Our demand, and here I know that I am speaking for the whole community of labour, must be for the educational highway. Our aim must be, not chiefly to lift gifted individuals to positions of eminence, but to carry the whole mass of the people forward, even though it be but a comparatively little way. We want the whole system to be all the while suggesting that the child's faculties are being trained, not for its own advancement, but for the benefit which the community is to receive. And the right way to suggest this, while also securing for the community the maximum benefit, is, as it seems to me, nothing less than a system of free education from the elementary school to the university, which, instead of offering exhibitions to enable those who are capable to proceed, will on the contrary exclude at certain wisely chosen stages those who are unable to benefit further by school education. At each of such stages there should be for those who are excluded from further advance some form of apprenticeship, and if the stage comes early this should be conducted so far as possible according to the principles of school life, with all its discipline as well as supervision.

The tutorial-class movement, which owes its origin to the Workers' Educational Association, and for a full account of which I must refer to Mr. Mansbridge's book, "University Tutorial Classes," has made two important discoveries. The first is that there is a very great amount of literally first-class ability in the country going to waste for lack of opportunity. That many of us had formerly been convinced must be the case; it is now proved. The other discovery is this. A man who has had no secondary education at all can take up work of the university type when he is of full age if his mind has remained alert. I believe many continuation classes fail through ignorance or neglect of this fact. We always tend to restart the teaching process at the exact point which the student had reached when he left school. That is a mistake. The man or woman whose education ends at fourteen or thirteen, and who becomes desirous of more at twenty-one or later, has lost much in the way of knowledge; but if the mind has remained alert the development of faculty has gone on and the appropriate method of study is that of the university, not that of the secondary school. This is of the utmost importance. We shall not for many years to come secure such a raising of the school-age or such a remodelling of our system as shall guarantee the full development of every child and adolescent. Thousands will continue to be dropped by our educational system at fifteen, if not sooner. Of course, a healthy-minded boy who leaves school at fifteen means to have done with his books. He promptly throws them away unless he is Scotch, and then he sells them. But six or more years later he may wake up to his need for more knowledge and intellectual training. Our tendency has been to give him school teaching; that is wrong; he is of the age to which university teaching is adapted, and only in that will he find what he is wanting.

Provided there has been established such a social life as I have described there will be less harm than otherwise resulting from some degree of specialisation in secondary schools. The students of different subjects will be mixing with one another, and will learn from one another a great deal of those subjects which they are not themselves definitely studying. Certainly one of the great advantages of the college system at the universities is that it gathers together in very intimate social intercourse students of different subjects. At the present time there is a great denunciation of the prevalence of classical studies and a demand for education in natural science. But it is worth while just now to insist that specialisation in mathematics or natural science, if divorced entirely from the more human studies, or from intercourse with those who are pursuing such studies, may be educationally disastrous in the last degree. Of course, it is sometimes suggested, as I remarked earlier, that the study of natural science produces a scientific type of mind. But this is one form of the confusion to which I alluded at the outset which results from our speaking of natural science by the general name of "science." The study of languages and history can be, and ought to be, just as scientific as the study of physics.

We may state the question perhaps in this way. In order that a man may live his life and discharge his responsibilities as a citizen he needs knowledge. What is the most important sort of knowledge to have? None can be put on a level with the knowledge of human nature. Whatever a man is going to do he will have to deal with his fellow-men and find his own place among them. This knowledge cannot be adequately obtained from books alone, and, as I have said already, training through membership in a social life is the best means to it. But it may be also fostered in a very high degree by what are called the humane studies: the study of the best that men have thought in philosophy, the study of their highest aspirations and deepest woes in literature, the study of their attempts and their achievements in history. This is the most serviceable of all scientific studies that a man can undertake. But it is no doubt true that we have allowed two evil things to happen. In the first place, we have not sufficiently recognised the value of natural science in education, and, still more disastrous, we have tended to identify the study of the humanities with the study of the classical languages.

The chief point that I wish to urge is that the classics are not the only available form of humane study. I should like to see an experiment conducted on the following lines. The staple of the school curriculum to be European history and English literature. At the bottom of the school there should be elementary Latin, which undoubtedly provides good mental gymnastics, and, of course, elementary mathematics and natural science. Perhaps also French, though of this I am more doubtful. Those boys who showed real facility in Latin should, if they so desired, begin to study Greek at about the age of sixteen or sixteen and a half. They should then have one term in which they do very little except Greek. Experiments suggest that in forms consisting only of boys who have already shown some aptitude for a classical language one term's concentrated study will bring them to the point reached by efforts of several years according to our present methods, and the devotion of a single term to this would not seriously interrupt the general course. There would not be a classical side and a modern side, for the staple study of the whole school would be history; but there would be, above the point indicated, divisions for Latin and Greek as there now are in classical schools for mathematics. These would have allotted to them all the hours on the time-table that were not required for the history and literature, for it is of no use, broadly speaking, to read classics after that time unless they are given almost the whole of the student's attention. The study of ancient civilisation, which is what the study of the classics ought to be, is itself something far too rich to come under any condemnation of specialism. Boys who do not take this classical course would take mathematics, science, and at least one modern language, the mathematics and the science being so far as possible combined; specialisation either in the linguistic or the scientific branch would be encouraged in the highest departments. There would also, of course, be opportunity for specialisation in history by means of divisions which would provide a course of study supplementary to that which formed the staple of the school curriculum.

Meanwhile there is one serious evil which could be remedied at once. It is the business of the universities to be the guardians and upholders of a true educational ideal against the natural utilitarianism of the man of affairs. By their scholarship system the universities exercise a far-reaching influence on secondary schools. They give far more scholarships for classics than there are deserving candidates; they do a good deal for natural science and mathematics; they do something, though absurdly little, for history; but they practically do nothing at all for modern languages. To this branch of study they give no encouragement such as might help the schools to treat it in a truly educational way. I want to see boys and girls who study modern languages reading the great literatures which constitute the value of those languages as boys at the top of a classical side read Æschylus and Plato. But we shall not reach that without help from the universities, and at present the universities refuse their help.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A Grace has passed the Senate sanctioning the admission of women to the first and second M.B. Examinations under conditions similar to those under which they are admitted to the Previous Examination and the Tripos Examinations.

The Appointments Board has just issued its third quinquennial report. It gives ample evidence of the valuable services which the board is rendering to graduates of the University, as well as to firms and public bodies who are in need of highly trained young men. The report shows that a large number of firms have employed Cambridge graduates on the administrative side of their business, and some forty firms are in the habit of applying to the board for scientific assistants. Among the industries represented by these latter firms are chemicals, iron and steel, coal-mining, dyeing, brewing, and the manufacture of paper, drugs, explosives, soap, and glass. Geologists, agricultural chemists, botanists, and mycologists have also found technical employment. Satisfactory as this record is, the board hopes that after the war the range of employment may be greatly increased. The engineering students have been appointed to mechanical, electrical, and civil engineering firms, iron and steel and shipbuilding firms, firms manufacturing aircraft, chemical engineering works, railways, and a number of public works departments in different parts of the Empire. The agricultural students also obtain employment over a large area, including various British Colonies. Of the work of the board during the war it is not yet time to speak in detail.

LONDON.—At a meeting of the Senate held on November 15 the Rogers prize of 100*l*. for 1916, for an essay on "The Nature of Pyrexia and its relation to Micro-organisms" was awarded to Dr. J. L. Jona.

IT is announced that Messrs. Baldwins, Ltd., have given 10,000*l*. to the Swansea Technical College for the endowment of a chair of metallurgy.

MR. C. FENNER, principal of the Ballarat School of Mines, has been appointed superintendent of technical education in South Australia, a position created under the South Australian Education Act.

OWING to the increasing interest shown by the public in hygiene and public health, more especially in the national question of the saving of "child and infant life," the governing body of the Battersea Polytechnic has decided to open the Hygiene Department for public inspection on Saturday, November 25, from 3 to 6 p.m. The lecture-rooms and laboratories, together with an exhibition of apparatus and models used for teaching purposes, will be on view. No tickets of admission are required.

IN consequence of so many probable competitors for the Fairchild Scholarship and prizes of the Pharmaceutical Society having been called to the colours, the trustees of the scholarship have decided that the examination for the awards shall not be held in 1917. It has also been decided that an arrangement shall be made by which those who are on service who would be eligible for the 1917 scholarship may, if they shall so desire, be admitted to an examination after the war.

IN August, 1915, the Board of Education gave notice that after 1916 the Lower General Examinations would no longer be held in any subjects of science and technology, but that the Higher General Examinations would for the present be continued. It is now announced that no Lower Examinations will be held in 1917, but that the Board of Education hopes to hold next year Higher Examinations in accordance with its regulations and syllabuses of 1916. After 1917 no Higher Examinations will be held in pure mathematics, theoretical mechanics, heat, magnetism and electricity, organic chemistry, coal-mining, and metallurgy.

RECENT issues of *Science* have recorded a number of bequests to higher education in the United States. The more important of these are as follows:—Yale University has received some 137,000*l.* from the estate of the late Mr. J. S. Hotchkiss; under the will of Mr. W. W. Lawrence, of Pittsburgh, Princeton University will ultimately receive 125,000*l.*; under the will of the late president of the University of Pennsylvania Museum, Mr. E. B. Coxe, junior, the University was bequeathed 100,000*l.* as an endowment of the museum, and 20,000*l.* towards increasing the salaries of professors; Columbia University has received 20,000*l.* from Mr. J. N. Jarvie for the new dental school; and the University of California 14,000*l.* from Prof. G. H. Howison and his wife. The General Education Board of the Rockefeller Foundation has undertaken to provide 40,000*l.* to complete the 200,000*l.* endowment fund which Vassar College is raising.

THE British Prisoners of War Book Scheme (Educational) makes an urgent appeal for books on natural history and scientific subjects generally, to meet actual requests received from British prisoners (soldiers, sailors, and civilians) interned in enemy or neutral countries. Among the special books asked for this week are:—"Cambridge Natural History"; "British Fresh-Water Algæ" (West); "Fungus Diseases of Trees" (Hartog); "History of European Fauna" (Scharff); "Mammalia" (Beddard); "Mammalia of India" (Blanford); and "Birds of India" (Jerdon). Books of a modern and advanced character are also needed in forestry, electrical engineering, motor engineering, telegraphy, wireless telegraphy, mineralogy, and veterinary science. Readers who may be able and willing to contribute one or more of the above works to this war charity are invited to forward to Mr. A. T. Davies, at the Board of Education, Whitehall, London, S.W., a list of the books they can offer. They will then be notified as to the acceptance of their gifts. Further particulars of the book scheme may also be had on application to Mr. Davies.

THE incidence of infant mortality, especially in urban districts, has emphasised the urgent need for greater efforts directed to the protection of infant life. Among the agencies for securing this aim systematic instruction in the hygiene of child-life occupies an important place. Voluntary societies exist through which much work has already been done, and the Local Government Board for Ireland has recently issued a circular letter outlining a scheme dealing with maternity and child welfare, in aid of which a grant of 5000*l.* has been made available. To ensure due co-operation between medical and other public officers on one hand and voluntary workers on the other, and to render the work of the latter efficient and effective, the Department of Agriculture and Technical Instruction for Ireland has prepared and circulated a syllabus of instruction in child hygiene. The Department is prepared to consider the recognition of classes in the syllabus conducted by local technical instruction, and other approved, committees, and in certain circumstances to pay grants in aid. The instruction must be under the direction of a qualified medical practitioner and a trained nurse, but recognition may be extended to other suitable persons. If desired, the Department is prepared to conduct an examination at the close of a course of instruction, and to award certificates of proficiency.

AN article on "Science in the School," in the *Times Educational Supplement*, by Sir Clifford Allbutt, may be commended to the thoughtful consideration of headmasters and others. The notion of some headmasters that it is sufficient to introduce science in a school as a "complementary" subject is unsparingly pilloried. The methods of science must permeate the curriculum, since, as the article urges, they pertain "to all spheres of knowledge and wisdom, natural and humane, a leaven rather than an ingredient." The cry of *what* is to be taught to boys is of less importance than the vision of *how* things are to be taught. In young boys "the brain-web is built, not by reflecting, but by doing." The qualities wanted of young men in the greater world are spontaneity, initiative, ready wits in tight places, all of which depend upon structures in the brain, organised, not by reading, but by former activities. Affirming these things, Sir Clifford Allbutt reiterates "science is a method, a method to inform, not our studies of material things only, but all studies, material, social, and spiritual." It is good to find the article insisting that before we can have good teaching we must have trained teachers; it would have been better if it had been added that we must have reasonably paid teachers. The suitable form of science teaching for various classes in the school is described, and altogether the essay should assist the anxious headmaster. It is a pity, however, that Sir Clifford Allbutt seems not to have acquainted himself with the work of the many secondary schools which have been developed since the Education Act of 1902. There at least the boys study mensuration in the practical way he suggests, and much work in experimental science of a sane kind is being accomplished.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 9.—Sir J. J. Thomson, president, in the chair. W. M. **Bayliss**: Methods of raising a low arterial pressure. When the arterial pressure is low from loss of blood it cannot be brought back, except to a certain degree, by the injection of saline solutions into the veins in quantity equal to that of the blood lost. But if the viscosity of such solutions is made equal to that of blood, a return to normal height is possible. The effect of saline injections containing gum or gelatine is also much more lasting than that of simple saline solutions. The difference in this respect is due to the osmotic pressure of the colloids added, by which loss of water by the kidneys or to the tissues is prevented. Solutions containing gum do not produce œdema in artificial perfusion of organs. When the fall of blood pressure is due to peripheral vaso-dilatation, then gum or gelatine solutions, although more effective than pure saline, produce a much less permanent rise than in cases of loss of blood.—A. J. **Brown** and F. **Tinker**: Selective permeability: the absorption of phenol and other solutions by the seeds of *Hordeum vulgare*. The paper deals with the concentrations in which solutions of various organic solutes diffuse into barley seeds across the semi-permeable membrane of the latter. It is found that the membrane and the starchy contents of the seeds act selectively towards the solutions in such a way that the concentration of an aniline or a phenol solution which enters the seeds is about three times as strong as the outside solution from which it has diffused. Somewhat similar results are obtained for the diffusion of acetic acid solutions into the seeds; but in this case it is found also that the "adsorbed" solution which enters the seeds becomes saturated at a concentration of 80 per cent. acid. The amount of solution which enters the seeds is determined by the relative concentrations of the solutions inside and outside. The research also brings out the fact that the permeability of the barley membrane is due to selective adsorption.—C. **Shearer**: The toxic action of dilute pure sodium chloride solutions on the meningococcus. —C. **Shearer** and H. W. **Crowe**: The *rôle* of the phagocyte in cerebro-spinal meningitis. Good evidence has been obtained for thinking that under certain conditions the meningococcus can be taken up by the leucocytes, but not killed by them. In the case of freshly isolated strains the leucocytes will not take them up at first. With old cultures, on the other hand, ingestion on the part of the phagocytes takes place with great rapidity. In a short time the germs are killed and completely digested by the leucocytes. This happens also with the majority of the nasal strains examined from chronic carriers, although they show great individual differences.—S. B. **Schryver** and Mary **Hewlett**: Investigation dealing with the phenomena of "clot" formations. Part IV. The diphasic erosive action of salts on the cholate gel.—I. **Jörgensen** and F. **Kidd**: Some photochemical experiments with pure chlorophyll and their bearing on theories of carbon assimilation.

Zoological Society, November 7.—Dr. S. F. Harmer, vice-president, in the chair.—Dr. F. E. **Beddard**: Two new species of Cestodes. The first species was obtained from a slow lemur and was referred to the genus Linstowia; the second occurred in a black-headed partridge, and was placed in the genus Cotugnia.—Dr. J. F. **Gemmill**: The development of some starfishes. The species of which the development was traced are:—*Asterias glacialis*, *Cribrella oculata*, *Solaster endeca*, and *Stichaster roseus*.

Geological Society, November 8.—Dr. Alfred Harker, president, in the chair.—Dr. S. **Smith**: *Aulina rotiformis*, gen. et sp. nov., *Phillipsastraea hennahi* (Lonsdale), and the genus Orionastræa. A description of a new coral genus of colonial habit, Aulina, obtained from the highest limestone associated with the Lower Carboniferous the Fell Top Limestone of Northumberland and its equivalent horizon in Teesdale, the Botany Beds.

Royal Meteorological Society, November 15.—Major H. G. Lyons, president, in the chair.—C. E. P. **Brooks**: A meteorologist in China. The work was described of the late Capt. L. H. Tamplin, who resided in eastern China from 1902 to 1915, and took very full and accurate meteorological observations, chiefly at Chinkiang, but for a time at Wuhu, and finally at Amoy. These observations are made the basis of a discussion of the climate of the coastal region of China and its controlling factors. In addition to his actual observations, Capt. Tamplin's close acquaintance with the Chinese enabled him to note some quaint weather superstitions, and he also made some important observations on the causes of flood and famine in China.—Lieut. A. E. M. **Geddes**: The storm of November 11–13, 1915, in its passage over the British Isles. This storm was remarkable for its close resemblance to a very severe storm which crossed the British Isles on November 11–13 in 1901. Both disturbances gave unusually heavy rainfall over Ireland and England, but in both cases there was very little precipitation over Scotland. All records available at the Meteorological Office have been examined, and from them weather maps have been constructed for intervals of two hours. From these maps the path of the centre of the storm has been traced with great detail. In this case the path skirted the southern coast of the British Isles, whereas in the case of 1901 it was from Galway to the Wash. The two-hourly maps have been used for working out the air circulation in the storm. Two distinct air supplies can be identified: (1) a supply of warm air from the south, and (2) a supply of much colder air from the east.

CAMBRIDGE.

Philosophical Society, October 30.—Annual general meeting.—Prof. Newall, president, in the chair.—C. T. R. **Wilson**: Methods of investigation in atmospheric electricity.—L. A. **Borradaile**: The functions of the mouth-parts of the common prawn. The author stated that food is seized by either pair of chelipeds or by the third maxillipeds, and by them placed within the grasp of the second maxillipeds, which direct it, according as it is finely divided or coarse, to the maxillules or to the incisor processes of the mandibles. By these two pairs of limbs it is further divided and passed into the chamber guarded by the lips, where the molar processes grind it still further. The first maxillipeds and maxillæ play subsidiary parts, if any, in the manipulation of the food.—J. T. **Saunders**: The growth of *Daphne pulex*. The author showed that at least two adult forms of *D. pulex* existed, differing only in size and fecundity. Both forms had embryos in the brood pouch, but the larger forms had more than the smaller. More than one adult form probably occurs in other Entomostraca, and this would account for the great difficulty, which is experienced in this group, of determining species.—W. A. D. **Rudge**: A self-recording electrometer for atmospheric electricity. —C. E. Van **Horn**: An axiom in symbolic logic.—S. **Ramanujan**: The expression of a number in the form $ax^2+by^2+cz^2+du^2$.—J. G. P. **Nicod**: A reduction in the number of primitive propositions of logic.

PARIS.

Academy of Sciences, November 6.—M. Camille Jordan in the chair.—The President announced the death of M. Léauté.—G. **Bigourdan**: The position and co-ordinates of the old observatory in the rue Vincenne. Important work was done at this observatory between 1666 and 1669, some details being given. The exact position of the instruments has been lost, but is now reconstructed by the author from old maps and contemporary documents.—M. Aries was elected a correspondant of the Academy in the section of mechanics in the place of the late M. Considère.—W. H. **Young** and Mme. Grace Chisholm **Young**: The normal frontier of a region or of an ensemble.—G. **Koenigs**:

A particular plane movement with two parameters. —Œ. de **Coninck** and M. **Gérard**: The atomic weight of lead. The method used was to determine the ratio of lead nitrate to the lead oxide obtained by ignition. For ordinary lead the value 206·98 is given, and for lead extracted from uranium minerals 206·71. —E. **Harlé** and J. **Harlé**: The continental dunes of the *landes* of Gascony.—R. **César-Franck**: The presence of forms of wind erosion in the Isle of Wight.—J. **Dedijer**: The traces of the Glacial period in Albania and New Serbia (upper basins of the Drim Noir and the Skumba).—C. **Sauvageau**: The plantules of some Laminaria.—L. **Daniel**: The effects of continual capillary watering. Various seeds and plants were kept continuously supplied with water by capillary siphons, the amounts of water required for each plant having been previously determined by studies of the transpiration of the plant and soil evaporation. The results were compared with ordinary intermittent watering, and showed distinct advantages for the capillary method.—L. **Roule**: The migration for spawning in lake trout, *Salmo fario lacustris*. The fish are shown to select streams in which the proportion of dissolved oxygen is highest. L. **Boutan**: The plane of equilibrium or of least effort of Teleostean fish with swimming bladder.—A. **Paillot**: The existence of several varieties and races of Coccobacilli in natural septicemia of the cockchafer.—J. **Courmont** and A. **Devic**: The leucocytosis resulting from antityphoid and antiparatyphoid vaccination.—J. **Danysz**: The causes of intolerance to the arsenobenzenes and the means of avoiding or preventing them.—G. **Sanarelli**: The pathogeny of cholera. Experimental reproduction of the disease.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings, No. 10, vol. ii.).—F. H. **Seares**: Preliminary results on the colour of nebulæ. Photographs of the spirals Messier 51, 94, 99 show that the nebulæ condensations have large negative colour indices. The knots of nebulosity are bluer than the bluest of the neighbouring stars. The spectral character of the outlying regions differs from that of the central nucleus. In the case of the planetary nebula N.G.C. 3242 no important differences of this sort are revealed.—K. G. **Falk**: The action of alkali in the production of lipolytically active protein. The author discusses inactivation of the enzymes by acid, by alkali, by alcohols, by acetone, by salts, and by heat; nature of the chemical changes involved in the inactivations; and activation of proteins by alkali. —A. R. **Haas**: The excretion of acids by roots. The author finds that no acid other than carbonic was excreted from the roots of corn seedlings. Similar results were obtained with wheat seedlings.—W. W. **Campbell** and J. H. **Moore**: Spectrographic observations of relative motions in the planetary nebulæ. Further observations indicating the probability of the hypothesis that the so-called ring nebulæ are in reality not ring forms, but ellipsoidal shells. Tentative conclusions are also drawn as to the probable masses of the nebulæ. —S. C. **Brooks**: New determinations of permeability. The determinations have been made by a new independent method and by improved older methods. The results agree in showing that living protoplasms are normally permeable to the salts studied, but salts of pure solutions may alter permeability, some causing an increase of permeability, while others cause a decrease, followed by an increase. In a properly balanced solution the permeability remains normal. Cell-walls may be semi-permeable to an extent which renders them important in such experiments.—A. A. **Coble**: Point sets and Cremona groups. Part iii. The group $G_{n,2}$ is used in the problem of determining the lines of a cubic surface. The determination differs from that of Klein.—C. **Barus**: The interferences of spectra, both reversed and inverted.—A. M. **Banta**: Sex intergrades in a species of Crustacea. The author has collected a large amount of data on several species of Cladocera, which is interesting because of the remarkable array of sex forms, the stock in general consisting of perhaps 40 per cent. normal males and about 8 per cent. normal females, the remainder being intergrades with almost every combination of sex characters.—G. H. **Hardy** and J. E. **Littlewood**: Some problems of Diophantine approximation: a remarkable trigonometrical series. A series is given which is never convergent or summable for any value of θ, and is accordingly not a Fourier's series; and further, a function which does not possess a finite differential coefficient for any value of θ.—G. N. **Lewis**: Steric hindrance and the existence of odd molecules (free radicals). It is contended that the hypothesis underlying the somewhat elusive phrase, "steric hindrance," should not be introduced until phenomena are known which cannot be so well explained in other ways. It is shown how the so-called free radical of organic chemistry may be explained independently of the hypothesis of steric hindrance.—A. A. **Bennett**: Newton's method in general analysis. An extension to general analysis of the special algebraic work of H. B. Fine.—W. D. **Harkins**, R. E. **Hall**, and W. A. **Roberts**: The cobaltammines. The authors have determined accurately the freezing-point lowerings caused by eight different cobaltammine salts, and have derived from the results the number of ions into which each salt dissociates. These are found to be in accordance with Werner's theory.—National Research Council: Report of the first meeting of the council; reports of meetings of the Executive Committee; organisation of the Research Council (as at present constituted).

NEW SOUTH WALES.

Linnean Society, August 30.—Mr. A. G. Hamilton, president, in the chair.—R. J. **Tillyard**: Further observations on the emergence of dragonfly larvæ from the egg, with special reference to the problem of respiration. The observations were made upon eggs of *Anax papuensis* (Anisoptera) and *Austrolestes leda* (Zygoptera). By curtailment of the oxygen supply during embryological development, larvæ of Anax were made to hatch from the eggs in a weakened condition, so that the pronymphal stage lasted three and a half hours instead of a few seconds. Results:—(1) The first gas to enter the tracheæ appears during the pronymphal stage, and enters simultaneously into dorsal and ventral trunks and their connecting tracheæ. (2) Experiments with a 10 per cent. solution of caustic potash, and with a 4 per cent. solution of azol, indicate that this gas is CO_2, and that it is replaced by a mixture of oxygen and nitrogen differing little from air. (3) Sections of a pronymph, made to discover the nature of the "cephalic heart," suggest that this is not a special organ, but merely a temporary development in the œsophagus. (4) The abnormal conditions imposed upon one egg, with an embryo which had not completed reversion, caused this embryo to continue its development head downwards, and, finally, to hatch tail foremost. (5) Newly hatched larvæ of Austrolestes practise rectal respiration regularly for the first half-hour of larval life, thenceonward intermittently. Practically all dragonfly larvæ must practise rectal respiration directly after hatching to replace the CO_2 in the tracheal system.—Dr. E. W. **Ferguson**: Revision of the Amycterides (Coleoptera), part v. This part deals with the genera Molochtus (four species, one new) and Cubicorrhynchus (twenty-eight species, seven new).—A. H. S. **Lucas**: Notes from the Botanic Gardens, Sydney. Parthenogenesis in aquatic phanerogams. *Elatine triandra*, Schrank (Elatinaceæ), and *Glossostigma spathulatum*, Arnott (Scrophulariaceæ), in a submerged state freely produced capsules only, but were induced to produce normal flowers by growing them in soil exposed to sunlight in the open air.—E. F. **Hallmann**: Revision of the genera with Microscleres, included, or provisionally included, in the family Axinellidæ (Porifera), part i. The first part treats of the peculiar and aberrant genus Trachycladus, hitherto represented only by the briefly described *T. laevispirulifer*, Carter, and two species imperfectly described by von Lendenfeld, under the generic names Spirophora and Spirophorella. Seven additional representatives are described, three of which are designated as varieties of *T. digitatus*, Lendenfeld. The genus appears to constitute a connecting link between the Axinellidæ and the Spirastrellidæ, thus pointing to the possibility that these supposedly quite unrelated families may be derived from a common stem.

CAPE TOWN.

Royal Society of South Africa, September 27.—Dr. L. Péringuey, president, in the chair.—H. H. W. **Pearson** and Mary R. H. **Thomson**: Some stages in the life-history of Gnetum. An account is given of an investigation of the ovule and embryo-sac of *Gnetum africanum* (West Africa) and *G. Gnemon* (Ceylon); the material studied included also *G. Buchholzianum* (West Africa) and *G. scandens* (Poona, Darjeeling, Penang, Singapore), and two species of doubtful identity, one from Singapore and one from Java.—H. **Bohle**: The theory of automatic regulators. Automatic regulators may be classified as sluggish and fast regulators. The theory of each form of regulator is explained in this paper.—T. F. **Dreyer**: Variation in the Mylabridæ illustrating a new theory of evolution based on Mendelism.

BOOKS RECEIVED.

The Portland Cement Industry. By W. A. Brown. Pp. x+158+plates xxxvi. (London: Crosby Lockwood and Son.) 7*s*. 6*d*. net.

Ministry of Finance, Egypt. Survey Department. The Geography and Geology of West-Central Sinai. By Dr. J. Ball. Pp. 219+plates xxiv. (Cairo: Government Press.) P.T.30.

Practical Experiments in Heat and Light. By W. St. B. Griffith and P. T. Petrie. Pp. viii+123+viii+112. (London: Rivingtons.) 3*s*. 6*d*. net.

Text-Book of Elementary Chemistry. By Dr. F. M. Perkin and E. M. Jaggers. Pp. vi+384. (London: Constable and Co., Ltd.) 3*s*. net.

Facts and Fallacies regarding the Bible. By W. Woods Smyth. New edition. Pp. vii+210+plates. (London: Elliot Stock.) 3*s*. 6*d*. net.

Janus and Vesta: A Study of the World Crisis and After. By B. Branford. Pp. xviii+316. (London: Chatto and Windus.) 6*s*. net.

An Outline of Theosophy. By C. W. Leadbeater. Third impression. Pp. 99. (London: The Theosophical Publishing Society.)

The Weather Map: An Introduction to Modern Meteorology. By Sir Napier Shaw. Pp. 94. (London: H.M.S.O.; the Meteorological Office.) 4*d*.

The Mirage: A Fantastic Study of Evolution in Australia. By Bunyip. Pp. 64. (London: W. H. and L. Collingridge.) 6*d*. net.

Aircraft of To-day. By C. C. Turner Pp. 315. (London: Seeley, Service, and Co., Ltd.) 5*s*. net.

The Origin of the Earth. By T. C. Chamberlin. Pp. xi+271. (Chicago: The University of Chicago Press; London: At the Cambridge University Press.) 6*s*. net.

Macmillan's Graphic Geographies. The British Isles. By B. C. Wallis. Pp. 32. (London: Macmillan and Co., Ltd.)

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 23.

ROYAL SOCIETY, at 4.—Annual Report of Council.—At 4.30.—The Corrosion and Electrical Properties of Steels: Sir Robert Hadfield and Dr. E. Newbery.—(1) Monoclinic Double Selenates of the Nickel Group; (2) X-ray Analysis and Topic Axes of the Alkali Sulphates and their Bearing on the Law of Valency Volumes: Dr. A. E. H. Tutton.—The Scattering of Plane Electric Waves by Spheres: Dr. T. J. I'a Bromwich.—Numerical Results of the Theory of the Diffraction of a Plane Electromagnetic Wave by a Perfectly Conducting Sphere: J. Proudman, A. T. Doodson, and G. Kennedy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Parallel Operation of Electric Power Stations: J. S. Peck.

FRIDAY, NOVEMBER 24.

PHYSICAL SOCIETY, at 5.—Measurement of the Thomson Effect in Wires: H. R. Nettleton.—Thermoelectric Properties of Fused Metals: C. R. Darling and A. W. Grace.

MONDAY, NOVEMBER 27.

ROYAL SOCIETY OF ARTS, at 5.—Howard Lecture—Coal and its Economic Utilisation: Prof. J. S. S. Brame.

TUESDAY, NOVEMBER 28.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—The Common Objections to the Reality of the Migrations of Early Culture, with Special Reference to the Dogma of the Similarity of the Working of the Human Mind: Prof. G. Elliot Smith.

WEDNESDAY, NOVEMBER 29.

ROYAL SOCIETY OF ARTS, at 4.30.—The Internal Combustion Engine: Dr. Dugald Clerk.

THURSDAY, NOVEMBER 30.

LINNEAN SOCIETY, at 5.—(1) The Floral Anatomy of some Compositæ; (2) Demonstration on the Force for Dispersal of Fruits: J. Small.—A Note on the Seed of *Iris pseudacorus*, Linn.: T. A. Dymes.

SATURDAY, DECEMBER 2.

GEOLOGISTS' ASSOCIATION, at 3.—The Palæoliths of Farnham: H. Bury.

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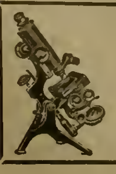

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THURSDAY, NOVEMBER 30, 1916.

AMERICAN BOOKS ON AGRICULTURE.

(1) *Field and Laboratory Studies of Soils.* An Elementary Manual for Students of Agriculture. By Prof. A. G. McCall. Pp. viii+77. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 2*s.* 6*d.* net.

(2) *The Principles of Plant Culture.* A Text-book for Beginners in Agriculture and Horticulture. By the late E. S. Goff. Revised by J. G. Moore and L. R. Jones. Eighth edition. Pp. xxiii+295. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1916.) Price 5*s.* 6*d.* net.

(3) *The Principles of Agronomy.* A Text-book of Crop Production for High Schools and Short Courses in Agricultural Colleges. By Prof. F. S. Harris and G. Stewart. Pp. xvi+451. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1915.) Price 6*s.* net.

(4) *The Marketing of Farm Products.* By Prof. L. D. H. Weld. Pp. xiv+483. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1916.) Price 6*s.* 6*d.* net.

(1) THE first book on the list is a little laboratory manual for the study of soils by Prof. McCall, of the Ohio State University. The appliances needed are simple, and the exercises are all within the scope of any reasonably intelligent pupil. As usual in American books, physical properties attract considerable attention, and most of the exercises are concerned with the water relationships of soils. Only two at the end deal with lime, and none of them with the biochemical processes, such as nitrification, that play so important a part in soil fertility. But within the limits the author has set he has given an interesting course of experiments which the teacher might well use in the study of soils.

(2) This book first appeared in 1896, and has been so successful that it is now in its eighth edition; it may fairly claim, therefore, to be a standard text-book on the other side of the Atlantic; one of the revisers is professor of plant pathology and the other professor of horticulture in the University of Wisconsin. The book was originally intended for agricultural students who had had no preliminary training in botany, and it is written in a way which will appeal to them, all the illustrations being taken from agricultural or horticultural practice. Other authors, both in England and America, have shown that the method is feasible, and that the farm and garden can be made to furnish all the material and illustrations wanted for a very useful course of botany. The drawback is the great difficulty of keeping within some sort of limits, and there is a great temptation, which the authors have not been altogether able to resist, to wander into other fields. This has resulted in several rather surprising errors. On both p. 146 and p. 148 the authors refer to rain and snow as contributing useful amounts of nitrogenous substances to the soil. This view was formerly held by chemists, but has long been given up by them. Again, wood ashes are stated to be a commercial source of phosphates; surely the authors must mean potassium. There is some confusion between "potash" and "potassium" which ought to have been put right before now: "Potassium is used by plants in the form of potash, *i.e.* potassium combined with oxygen. Potash exists in the soil mainly in combination with chlorin (chlorid or muriate of potash), with sulfuric acid (sulfate of potash), or with nitric acid (nitrate of potash)." Now, apart from the fact that the statements are incorrect, most of the potassium being there as complex silicates, and little, if any, as chloride or sulphate, it is misleading to say that muriate of potash is a combination of chlorine and potash, and that potash is a combination of potassium and oxygen. Old terms like muriate of potash still survive in the fertiliser trade, and may perhaps be defended on the ground that they denote a certain trade product; but in explaining them to the student it only adds to the difficulty to use old chemical nomenclature. Much of this chapter might well have been omitted.

(3) Agronomy is a new word for the English language, introduced some years ago in America to stand for field husbandry, but already, according to the authors, it is beginning to be used rather loosely. It covers plant growth and soil management, a branch of knowledge which, as experience has shown, can be brought into a compact subject and dealt with by ordinary scientific methods. But, as has often been remarked, there is a great temptation to wander when a man is dealing with a field or garden subject, and it has become almost a convention that books on "agronomy" should include chapters on botany, geology, engineering, bacteriology, and sometimes other subjects as well. Obviously this leads to very unequal treatment, and we cannot help thinking that the time has come when the "agronomist" should think out his position a little more clearly, give a definite meaning to his name, agree to leave out chapters on other things, and confine himself to his own subject, which is already big enough. If we do this with the book before us we get an interesting account of crop production in the United States, obviously written by men who know what they are talking about. The illustrations in particular are to be commended, some of those dealing with field conditions being unusually good.

(4) The last book on the list deals with a very old subject, which, however, is only just beginning to get a literature of its own. The author acknowledges in the preface his indebtedness to the authorities of the University of Minnesota, who were sufficiently far-seeing to allot funds for a scientific investigation into the marketing of farm produce. The result is very satisfactory,

and the author has succeeded in bringing together a mass of useful information and presenting it in an interesting form to the reader. A valuable feature in so new a subject is that full references are given for all the data, and at the end there is a bibliography. E. J. R.

MATTER AND THE STRUCTURE OF THE ETHER.

The Universe and the Atom. By M. Erwin. Pp. 314. (London: Constable and Co., Ltd., 1915.) Price 8*s.* 6*d.* net.

THIS work is divided into two parts, the first being devoted to a general discussion of wave motion, and the second to a special theory as to the structure of the ether and its consequences. The theory called "the pan-cycle hypothesis" deals with "invisible composition light waves, the warp and woof of the ether structure and of all things material."

In spite of some inaccuracies, the first part contains quite an interesting account of the nature of wave motion, although the long and frequent quotations from other text-books make the style somewhat disjointed. In some places too much stress is laid on the obvious, which indeed at times is so over-elaborated as to lead to absurdities. It is worth quoting one such passage, for the deductions drawn are used later to explain the theory of the mechanical structure of the ether. "Thus if a force of 5 units is operating in one direction, and another force of 3 units is operating on the same particle in the opposite direction, we say they are equivalent to a force of $5-3=2$ units of force operating in the first direction. We mean by that the particle would move from its first position, in the direction impelled by the greater force, and behave as if it were acted on only by a force of 2 units. This is all that composition of force gives us, but it does not speak the full event. It makes 3 of the greater units of force annihilate the 3 units of force operating in the opposite direction. Now force represents energy, and energy is never destroyed" (p. 74).

The second part deals with a new theory of ether structure, the nature of electrons, atomic theories, gravitation, and other fundamental questions based on a conception of the ether organised by so-called "force rays" resulting from trains of waves proceeding in different directions through the ether and producing stationary waves. The ideas involved do not seem very helpful in throwing light on these fundamental questions, and in many cases there is a marked lack of adequate discussion of existing theories. Thus the modern attempts to explain the Balmer series is dismissed with the following short paragraph:—"This formula by Balmer was derived entirely by trial from the observed wave lengths of the first fifteen lines of the hydrogen series. It has so far been regarded as entirely an empirical formula which expresses a fact, without anyone being able to state why the relation expressed by the formula should exist" (p. 102). The recent work of Bohr and others in this field might at least have been mentioned. Even facts are sometimes misstated, as will be seen from the two following passages: "The amplitude of some rays, such as X-rays, goes down to the infinitesimal" (p. 84); and ". . . gravitation itself has its limitations, in respect of the distance through which it can effectively operate, and its power is also affected by the internal heat or temperature of the body" (p. 125). Many of the fundamental conceptions in the theory are at fault, and these insecure foundations cannot support the elaborate superstructure built upon them.

FLOTATION OF ORES.

(1) *Concentrating Ores by Flotation.* By T. J. Hoover. Pp. vi+320. Third edition. (London: *The Mining Magazine*, 1916.) Price 12*s.* 6*d.* net.

(2) *The Flotation Process.* Compiled and edited by T. A. Rickard. Pp. 364. (San Francisco: *Mining and Scientific Press*, 1916.) Price 8*s.* 6*d.* net.

THE subject treated in these two books is one of great and rapidly increasing importance. The practical application of flotation methods is only about thirteen years old, and already the quantity of ore treated by them must amount to little, if any, less than 30,000,000 tons. When it is borne in mind that a large proportion of this quantity consists of slimes and complex ores that had defied all known methods of treatment until flotation processes were introduced, the economic importance of the subject can be readily appreciated. Furthermore, as Mr. Hoover points out in his book, this method is still in some respects in its experimental stage, and its limits of applicability are being rapidly widened, so that there are very good grounds for the opinion expressed by him:—"It would seem at the present time a justifiable prophecy that flotation methods of concentration will in the not distant future very largely displace gravity methods."

(1) The mere fact that the third edition of Mr. Hoover's work has been called for within four years of the appearance of the first edition is sufficient testimony to the value attached to it by the mining profession. It has from the first been accepted, and still remains to-day the standard work on the concentration of minerals by flotation methods.

As regards this third edition now before us, this has simply been produced by reprinting the second edition just as it was, without even attempting to correct any mistakes, but merely with the addition of a new chapter, so as to bring it up to date. It is difficult to justify such a method, seeing that some of the mistakes that have been allowed to stand are really serious. Thus it comes as a severe shock to find that Mr. Hoover should not only have written, but have allowed to remain, such a wholly indefensible chemical equation as "$KCy+Au=KAuCy$"; or to find him stating that "the horizontal surface of a liquid at rest" may be considered "the limiting surface of a bubble of infinite radius," whereas it is really a portion of what is practically a sphere, with radius equal to its distance from the earth's centre, and hence quite definite.

Advantage should have been taken of a new edition to correct such mistakes, but, even as it is, Mr. Hoover's work still remains the authoritative text-book on this subject. Like all text-books dealing with a branch of technology in active development, it suffers from the fact that it falls behind the times even whilst it is passing through the press, but this is a disadvantage that the writer of such books must make up his mind to endure. His chief consolation is that it is the production of such books which contributes as much as anything else to the rapid advance of the art that leaves the written page behind.

(2) With true journalistic instinct Mr. Rickard has produced his book on "The Flotation Process" at a moment when this method is attracting a very large share of attention from the mining profession; the book cannot, however, be said to form a contribution of any real value to the literature of the subject, seeing that it is a typical example of a form of book-making that appears to be in some favour on the other side of the Atlantic, though fortunately not in this country. It consists of a series of miscellaneous articles on the subject of flotation by a number of different writers, gathered from various sources, though all have appeared already in the pages of the *Mining and Scientific Press*; these have been strung together on no particular system, forming just such a scrap-book as anyone interested in flotation might put together for himself—very useful, no doubt, to the man who had compiled it for his own purpose, far less so to anyone else, and practically useless to the student who demands a systematic presentment of the subject. The articles vary in length from a few lines to many pages, and are as unequal in value as they are in extent. The best article in the book is probably Mr. Rickard's own introductory chapter, which is itself a paper presented at a meeting of the Canadian Mining Institute.

Whilst Mr. Hoover's book can be recommended to the student who wishes to know what the various flotation processes are, how they are carried out, and what results are obtained by them, Mr. Rickard's compilation gives information on none of these points, but exhibits the different and often widely divergent opinions of a number of writers who approach the subject of flotation from very varied points of view, and most of which possess little more than an ephemeral interest.

H. L.

OUR BOOKSHELF.

The Drink Problem of To-day in its Medico-Sociological Aspects. Edited by Dr. T. N. Kelynack. Pp. xii+318. (London: Methuen and Co., Ltd., 1916.) Price 7*s.* 6*d.* net.

THIS book comprises a number of essays by well-known authorities dealing with various aspects of the alcohol question. Dr. Harry Campbell discusses the biology of alcoholism, and asks, What is the nature of the peculiar attraction which alcohol exercises over mankind? He considers that the essential factor is the power to intoxicate and narcotise. Doubtless this is so for the drunkard, but as regards the moderate drinker we do not believe it: it is the flavour, and the flavour alone, and it is noteworthy that no non-alcoholic drink has yet been manufactured which reproduces to any extent the flavour of an alcoholic one. Prof. Woodhead deals with the pathology, and Dr. Claye Shaw with the psychology, of alcoholism, Mrs. Sharlieb with alcoholism in relation to women and children, Sir Thomas Oliver with alcohol and work, and the Rev. J. C. Pringle, of the Charity Organisation Society, with alcohol and poverty. In the last essay Dr. Kelynack, the editor, discusses the arrest of alcoholism, and considers that the most effective work in limiting the worst manifestations of intemperance has been accomplished by the action of the Central Control Board, and certainly the statistics of the decline of drunkenness in London since it has been at work bear this out.

The book is largely a partisan one, but, with this limitation, all the social problems connected with the consumption of alcohol seem to be covered by it. The vexed question of moderate drinking is not altogether burked, and Dr. Claye Shaw admits that in the present war the teetotalers do not appear to have come out of the ordeal better than those who have a preference for alcohol. "Moderate drinking" is an elastic term: we would lay down that the maximum daily consumption of alcoholic drink should not exceed an equivalent of two fluid ounces of absolute alcohol for a weight of ten stones, and that it should be taken in a dilution not stronger than 10 per cent. It is interesting to note that a weighty committee of the French Academy of Medicine has advocated a moderate ration of wine in the French Army on the ground that it replaces a certain amount of meat (protein) and actually diminishes the risk of alcoholism!

Results of Meteorological Observations in the Five Years 1911–1915, also of Underground Temperatures in the Twelve Years 1898–1910. Made at the Radcliffe Observatory, Oxford. Vol. li. Pp. xv+215. (Oxford: Humphrey Milford, 1916.) Price 15*s.* net.

THE first part of this volume contains daily meteorological data, for the five years 1911 to 1915, in regard to barometric pressure, temperature, wind, cloud, sunshine, rain, ozone, weather notes, and occasional phenomena, according to a plan adopted in previous years. The figures relating to wind are from two instruments of different dimensions, and a detailed comparison would be interesting, as the instruments are at very nearly the same height above ground, though not quite so nearly as the table makes them appear, since the higher one, given at 114 ft. in all the tables, is really at 116 ft. For this comparison, however, we must wait, as it cannot be made from the figures in the volume before us.

In the appendix, which forms the third section of the volume, are two complete 35-year tables of sunshine and wind, and 26-year continuations (1890 to 1915) of eight other tables. It is rather unsatisfactory to find upon investigation that the monthly maximum and minimum temperatures thus tabulated do not, as might be reasonably expected, come from the eye-readings of the maximum and minimum thermometers, but from the thermograph registers. Discordances ranging up to rather more than five degrees suggest that the Radcliffe thermograph is no more free from error than others, and no shadow of excuse is made for thus regarding it as a standard instrument.

But the main interest of the volume is, like that of the sandwich, in the middle section, which is devoted to a complete series of twelve years' daily readings of a set of five platinum resistance thermometers sunk in the ground at depths ranging from 6 in. to 10 ft. Dr. Rambaut has successfully resisted the temptation to extend the series indefinitely, and twelve years is very likely quite long enough for this particular purpose. Full accounts are given of the difficulties encountered and the precautions adopted, and a comparison is made of the resulting permeation coefficient with those obtained at Edinburgh and Greenwich. W. W. B.

The Involuntary Nervous System. By Dr. W. H. Gaskell. Pp. ix+178. (London: Longmans, Green and Co., 1916.) Price 6s. net.

IT would be difficult to find anything in the literature of physiology quite comparable to this work of Gaskell's. The book is of great scientific value, and at the same time an unintended record of the distinctive qualities of a valuable section of English life and thought.

Nowhere in this volume is there the slightest chance of contact with either "superman" or "missionary," but everywhere a gentle man is busy quietly recounting the important business of a valuable lifetime, and setting his intellectual affairs in order so that they may be found clearly expressed and arranged for the advantage of knowledge. His sustained effort has been completely successful, and his son's valuable aid, which in places he takes quiet pains to put clearly on record, has enabled this posthumous publication of a small volume of outstanding value.

No student of physiology will neglect to possess a work in which the meaning of the outlying streamers of the central nervous system is defined every whit as clearly as it was undoubtedly understood by this master of the subject. Nor, probably, will many morphologists afford to be without this rare testament to the value of their science written by one whom time may well reveal to them as also "master."

The opening chapter has in an odd way—pity that this was not seen and corrected—absorbed for itself the title that should more properly have been given to the book as a whole, "History of the Involuntary Nervous System." The work is, in fact, such a history, viewed clearly most persistently elucidated, and deftly explained.

LETTERS TO THE EDITOR.

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

A Further Probable Case of Sex-Limited Transmission in the Lepidoptera.

IN pursuit of my investigations of the past few years in hybridising Lepidoptera, two of the species chosen for experiments were *Oporabia dilutata* and *O. autumnata*. Both possible crosses between these two forms were made and fertile ova secured. These ova, as in the pure species, remained as such over the winter, and hatched in the spring of the following year. The larvæ fed up rapidly and well, with but little loss, and pupated in May and June.

Here, however, an abnormality stepped in; the females of the *autumnata* ♀ × *dilutata* ♂ cross emerged a few days after pupation. Dissection revealed that they lacked ovaries or possessed rudimentary ones. This, nevertheless, was not the most important feature. Instead of being distinctly intermediate between the original species, as were the males which emerged later, they were of the paternal type—*i.e.* they displayed the specific characters of *dilutata* ♀ only.

In October, accompanied by the males of the former hybrid, both sexes of the reciprocal cross *dilutata* ♀ × *autumnata* ♂ made their appearance; again the males were clearly intermediate, but the females displayed paternal characters only, being exactly of the *autumnata* type.

I had some suspicion that the matter was a case of sex-limited inheritance, but would not form any definite opinion as the result was seriously complicated by abnormal behaviour in the inheritance of the melanism which characterises all Middlesbrough races of *dilutata* and that race of *autumnata* used in the experiment. Preparations were therefore made for further trials; to nullify any possible interaction of the melanism a stock of pupæ from a local, non-melanic, birch-feeding microgene of *autumnata* was amassed. Local material of a similar form of *dilutata* not being available, ova of white *dilutata* from Enniskillen, Ireland, were obtained and reared.

Utilising these stocks, once more I made the crosses and secured precisely the same results. In both cases the hybrid females were manifestly of paternal type only.

To confirm and analyse these facts a further set of crosses, both of the hybrids (when possible) *inter se*, and back with the parents, has been made, the outcome of which will be detailed later.

Still, there can be but little doubt that these observations show that, in these two species, as in *Abraxas grossulariata*, the female passes on the typical characters of her species to her male offspring only.

J. W. H. HARRISON.

181 Abingdon Road, Middlesbrough, November 3.

Scarcity of Wasps.

THE distribution of wasps this summer would seem to have been rather local, for this village is less than two miles from Christon, where Mr. St. George Gray was plagued with wasps (see NATURE, November 16, p. 209), yet here they have been very scarce, small, and apparently starvelings, though a few full-sized queens have been caught recently. Christon lies on a sunny slope, and this village is at the foot of the north side of a hill, yet that could not account for all the difference, for we have had more wasps than enough in recent years. C. S. TAYLOR.

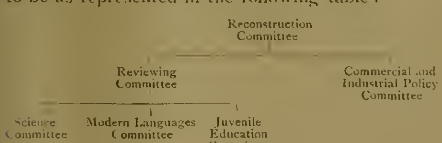
Banwell Vicarage, Somerset, November 17.

THE RECONSTRUCTION COMMITTEE AND ITS SUB-COMMITTEES.

THE Prime Minister, in March last, appointed a Committee of the Cabinet, of which he is Chairman, to consider and advise upon the problems that will arise on the conclusion of peace, and to co-ordinate the work which has already been done by various Departments of the Government in this direction. The constitution of this committee has not been announced, and possibly will not be, but four educational committees connected with it have been appointed, to deal respectively with (1) education as a whole; (2) teaching of science; (3) teaching of modern languages; (4) education of children and young persons after the war. In addition to these committees, there is a committee on commercial and industrial policy, and this also is a sub-committee of the Reconstruction Committee. No further particulars of sub-committees are available for publication.

Announcement was made in June last that any suggestions or other communications from individuals or organisations bearing upon these questions should be addressed to Mr. Vaughan Nash, C.V.O., C.B., Secretary of the Reconstruction Committee, 6A Dean's Yard, Westminster. It was stated that they would be considered and referred in suitable cases to the Department concerned, or to one of the sub-committees to which particular subjects or groups of subjects have been referred by the Reconstruction Committee.

Mr. Vaughan Nash has furnished us with copies of the terms of reference of the several committees mentioned above, and also lists of the members, except in the case of the sub-committee for the review of education, the composition of which, he informs us, is not yet available for publication. The relationship of the various committees to the Reconstruction Committee seems to be as represented in the following table:—



The terms of reference and membership of the committees are as follows:—

REVIEW OF EDUCATION SUB-COMMITTEE.—To consider the system of education as a whole; to review and formulate from that point of view proposals for developing it, particularly in directions indicated as desirable or necessary by experience gained during the war, and with special reference to:—

(*a*) Proposals prepared before the war for the development of the national system of education;

(*b*) The memoranda already submitted by the Education Departments for the consideration of the Reconstruction Committee;

(*c*) Any proposals submitted hereafter from the Departments, or from special committees, or from other responsible organisations;

and to recommend from time to time such action, whether by way of legislation or otherwise, as may be practicable.

COMMITTEE ON THE TEACHING OF SCIENCE.—To inquire into the position occupied by natural science in the educational systems of Great Britain, especially in secondary schools and universities; and to advise what measures are needed to promote its study, regard being had to the requirements of a liberal education, to the advancement of pure science, and to the interests of the trades, industries, and professions which particularly depend upon applied science.

In considering the provision of scholarships, bursaries, etc., the committee will take into account the report of the Consultative Committee of the Board of Education on this subject.

Members: Sir J. J. Thomson, O.M., F.R.S. (chairman), the Right Hon. F. D. Acland, M.P., Prof. H. B. Baker, F.R.S., Mr. Graham Balfour, Sir W. Beardmore, Bart., Sir G. H. Claughton, Bart., Mr. C. W. Crook, Miss E. R. Gwatkin, Mr. A. D. Hall, F.R.S., Sir H. Hibbert, M.P., Mr. D. H. Nagel, Mr. W. Neagle, Dr. F. G. Ogilvie, C.B., Dr. Michael Sadler, C.B., Prof. E. H. Starling, F.R.S., Mr. W. W. Vaughan, Mr. F. B. Stead, Inspector, Board of Education (secretary).

COMMITTEE ON THE TEACHING OF MODERN LANGUAGES.—To inquire into the position occupied by the study of modern languages in the educational systems of Great Britain, especially in secondary schools and universities, and to advise what measures are required to promote their study, regard being had to the requirements of a liberal education, including an appreciation of the history, literature, and civilisation of other countries, and to the interests of commerce and public service.

In considering the provision of scholarships, bursaries, etc., the committee will take into account the report of the Consultative Committee of the Board of Education on this subject.

Members: Mr. Stanley Leathes, C.B. (chairman), Mr. C. A. Montague Barlow, M.P., Mr. E. Bullough, Mr. A. C. Coffin, the Right Hon. Sir Maurice de Bunsen, G.C.M.G., G.C.V.O., Dr. H. A. L. Fisher, Miss Margaret Gilliland, Mr. H. C. Gooch, Mr. J. W. Headlam, Mr. Laurence D. Holt, Dr. Walter Leaf, Dr. George Macdonald, C.B., Mr. Albert Mansbridge, Mr. Nowell Smith, Miss M. J. Tuke, Sir James Yoxall, M.P., Mr. A. E. Twentyman, Board of Education (secretary).

BOARD OF EDUCATION COMMITTEE ON JUVENILE EDUCATION IN RELATION TO EMPLOYMENT AFTER THE WAR.—To consider what steps should be taken to make provision for the education and instruction of children and young persons after the war, regard being paid particularly to the interests of those—

(1) Who have been abnormally employed during the war;

(2) Who cannot immediately find advantageous employment;

(3) Who require special training for employment.

Members: The Right Hon. J. Herbert Lewis, M.P. (chairman), Mr. W. A. Appleton, Mr. R. A. Bray, L.C.C., Mr. F. W. Goldstone, M.P., Mr. Spurley Hey, Alderman Hinchliffe, Miss C. Martineau, Mr. J. F. P. Rawlinson, K.C., M.P., Lady Edmund Talbot, Mr. H. M. Thompson, Mr. Christopher H. Turnor, together with the following representatives of the Government Departments concerned:—Mr. A. B. Bruce, of the Board of Agriculture; Mr. E. K. Chambers, C.B., of the Board of Education; Mr. F. Lavington, of the Board of Trade; Mr. F. Pullinger, C.B., of the Board of Education; Mr. C. E. B. Russell, of the Home Office; Mr. J. Owen, Board of Education (secretary); Mr. G. McFarlane, Board of Education (assistant secretary).

COMMERCIAL AND INDUSTRIAL POLICY COMMITTEE.—To consider the commercial and industrial policy to be adopted after the war, with special reference to the conclusions reached at the Economic Conference of the Allies, and to the following questions:—

(a) What industries are essential to the future safety of the nation, and what steps should be taken to maintain or establish them.

(b) What steps should be taken to recover home and foreign trade lost during the war, and to secure new markets.

(c) To what extent, and by what means, the resources of the Empire should and can be developed.

(d) To what extent, and by what means, the sources of supply within the Empire can be prevented from falling under foreign control.

Members: The Lord Balfour of Burleigh, K.T., G.C.M.G. (chairman), Mr. Arthur Balfour, Mr. H. Gosling, Mr. Richard Hazleton, M.P., Mr. W. A. S. Hewins, M.P., Mr. A. H. Illingworth, M.P., Sir William McCormick, Mr. A. McDowell, Sir J. P. Maclay, Bart., the Rt. Hon. Sir A. Mond, Bart., M.P., Mr. John O'Neill, Mr. Arthur Pease, Mr. R. E. Prothero, M.V.O., M.P., Sir Frederick H. Smith, Bart., Mr. G. J. Wardle, M.P., together with the following gentlemen, who are presiding over Board of Trade committees on the position of important industries after the war:—Sir H. Birchenough, K.C.M.G., Sir A. A. Booth, Bart., the Lord Faringdon, Sir Clarendon Golding Hyde, Sir Gerard A. Muntz, Bart., the Hon. Sir C. A. Parsons, K.C.B., F.R.S., the Lord Rhondda, Mr. G. Scoby-Smith; secretaries, Mr. Percy Ashley, Board of Trade, and Mr. G. C. Upcott, Treasury.

BOARD OF TRADE COMMITTEES.

In NATURE of January 6 (vol. xcvi., p. 525) particulars were given of a number of Government and other committees appointed to consider national scientific problems. In addition to these committees and the sub-committees of the Reconstruction Committee, the following have been appointed in connection with the Board of Trade "to consider the position of" the various trades in question "after the war, with special reference to international competition, and to report what measures, if any, are necessary or desirable to safeguard that position."

ELECTRICAL COMMITTEE.—The Hon. Sir Charles A. Parsons, K.C.B., F.R.S., Mr. J. Annan Bryce, M.P., Mr. T. O. Callender, Mr. J. Devonshire, Sir John Snell, Mr. P. Ashley, Prof. S. J. Chapman, Mr. B. M. Drake.

TEXTILES INDUSTRIES COMMITTEE.—Sir Henry Birchenough, K.C.M.G., Sir Frank Forbes Adam, C.I.E., Mr. J. Beattie, Mr. T. Craig-Brown, Mr. E. B. Fielden, Mr. J. W. Hill, Mr. A. H. Illingworth, M.P., Mr. J. H. Kaye, Mr. E. H. Langdon, Mr. J. W. McConnel, Mr. H. Norman Rae, Sir Fredk. H. Smith, Bart., Mr. T. C. Taylor, M.P., the Rt. Hon. Robert Thompson, M.P., Mr. C. T. Smith, Mr. Frank Warner, Mr. T. M. Ainscough (secretary).

SHIPPING AND SHIPBUILDING INDUSTRIES COMMITTEE.—Sir Alfred A. Booth, Bart., Sir Archibald Denny, Bart., Prof. W. S. Abell, Sir Edward Hain, Capt. H. B. Hooper, Mr. Summers Hunter, Sir Joseph Maclay, Bart., Mr. J. Readhead, Mr. O. Sanderson, Mr. J. Brown.

NON-FERROUS METALS COMMITTEE.—Sir Gerard Albert Muntz, Bart. (chairman), Mr. C. L. Budd, Mr. C. Cookson, Mr. C. W. Fielding, Lieut.-Col. A. J. Foster, Mr. A. W. Tait, Mr. A. H. Wiggin, J.P.

COAL TRADE COMMITTEE.—Messrs. Cory Brothers and Co., Ltd., Messrs. Mann, George, and Co., Messrs. Hull, Blyth, and Co., Messrs. William Mathwin and Son, Messrs. Mackenzie and Phylson, Ltd., Messrs. Pyman, Bell, and Co., Mr. T. E. Watson, Sir Richard Mackie, Mr. A. E. Bowen, Mr. N. Dunn, Mr. F. J. Jones, Mr. A. Nimmo, Mr. A. F. Pease, Sir Daniel M. Stevenson, Bart., Mr. R. Warham, the Rt. Hon. Lord Rhondda.

ENGINEERING COMMITTEE.—Sir Clarendon Hyde (chairman), Mr. Arthur Balfour, Mr. A. J. Hobson, Mr. W. B. Lang, Sir Hallewell Rogers, Mr. H. B. Rowell, Mr. Douglas Vickers.

IRON AND STEEL INDUSTRIES COMMITTEE.—Mr. G. Scoby Smith (chairman), Sir Hugh Bell, Bart., Mr. A. Colville, Mr. J. E. Davison, Mr. J. Gavin, Mr. J. Hodge, Mr. J. King, Mr. G. Mure Ritchie, Mr. H. Summers, Mr. B. Talbot, Mr. C. R. Woods (secretary).

GOVERNMENT CONTROL OVER FLOUR.

IN view of the shortage of wheat, steps have been taken by the Government to ensure a larger yield of flour from the same quantity of grain. The actual proportion of wheat endosperm that can be extracted as commercial flour varies with the nature of the wheat, but may be taken as approximately 70 per cent. The remainder consists of what are known in the milling trade as "offals"; these are subdivided according to the fineness of the particles into bran, pollard, and sharps or middlings. For some time millers have been more than usually careful in thoroughly separating the flour from offal, and have succeeded in lengthening their flour yield from 70 to about $71\frac{1}{2}$ per cent. It was intimated in Parliament in the first place that directions were likely to be given for an increase of yield of $8\frac{1}{2}$ per cent. From this it was foreshadowed that 80 per cent. war-flour would be the rule in the immediate future.

On promulgation, the Board of Trade Order as to the milling of flour was found to be much more moderate in its demands. A fairly exhaustive schedule of wheats is given, together with the percentage of flour that must be extracted from each. This has been made to vary with the natural white-flour yield of each variety. A reference to the Dictionary of Wheats given on pp. 284–289 of the writer's "Technology of Breadmaking" shows that the wheats mentioned in the schedule have collectively an average white-flour yield of 70 per cent., whereas the average now required by the Government to be extracted is 75·3 per cent. This means an average extra yield of 5·3 per cent., with a maximum of 8 per cent. in the case of "Red Western" and a minimum of 4 per cent. with "No. 3 Manitoba." The Dictionary averages quoted are those of the respective wheats for a number of years, while no doubt the figures in the Government Order are based on actual current crops. It is further enacted that after January 1, 1917, no bread or other article of food shall be manufactured from any wheaten flour of a lower amount of yield than that quoted in the schedule.

The first problem which arises is the saving in-wheat which is thereby effected. Taking the increased yield of flour at 5·3 per cent., the new regulation will result in only 93 parts of wheat being required instead of 100 in order to yield the same amount of flour and bread as hitherto produced. This is a saving in wheat requirements of 7 per cent. Against this must be placed the loss of offals production. This will be diminished in two ways: first, by the actual milling of less wheat for the same amount of flour, and, secondly, by a less percentage of offals from the quantity of wheat milled. The result will be a diminution of the output of offals by 23 per cent. Their feeding value will also be reduced by the abstraction of the most nutritive portion and its transference to the flour-sack.

It will be observed that the new regulations cover two distinct points: the first is that of length of flour yield; the second is that all the flour is to be straight-run—that is, there is to be only one even quality. It would be quite possible to prescribe the proportion of flour to be extracted and still to permit the miller to subdivide such flour into two or more qualities. If this were done, the whole of the offal would be concentrated in the lower grade. There would thus be a white flour of the present "patents" or "supers" type, and a very dark flour. Possibly there is a fear that the darker flour would be so accentuated in character as to be objectionable. There would, however, be one benefit: as a result of the higher price that could be obtained for the better quality, the lower grade could be sold very much more cheaply, and so the extremely poor would reap an advantage.

This leads us, naturally, to the question of quality of the new straight-run flour. The writer has already had the opportunity of examining and testing samples submitted by various millers. Such flours are not quite so good commercially as the 70 per cent. straight-run flour, but are better than present ordinary household grades. Compared with the latter, the new flour contains the small proportion of included offal, but this is more than balanced by the retention of the whole of the patent flour. Properly milled from sound wheats, this flour should be found suitable for the manufacture of all forms of bread and cakes, and also for general home-cooking requirements.

The question is being asked: But if 70 per cent. can be increased to 75 per cent., why not an 80 per cent., or even an 85 per cent. flour? In reply it may be well to put on record the reasons why both the makers and users of flour have gravitated to adoption of the whiter sorts. The miller finds that the freer a flour is from offal, the better it keeps. This especially holds with regard to germ, which very quickly causes deterioration in the flour. Then both the germ and the offal are powerfully diastatic in character, and flours in which they are present tend to make a much more sodden and clammy loaf than does a white flour. But a yet more serious objection is the greater bacteriological impurity of the darker flour. Acidity develops during fermentation to a much greater extent in dark than in white flours; in consequence the darker flour is much more liable to produce sour bread. Again, such organisms as *B. coli communis* are frequently present on wheat, with the result in milling that they are absent from the highest-grade flour, present in small quantity in that of medium grade, and abundant in wholemeal.

The general consensus of scientific opinion goes to show that the bread from white flour is superior in nutritive value to that from the darker kinds. This is vouched for by physicians such as the late Sir Lauder Brunton, and such physiological investigators as Rubner of Munich, Snyder of Minnesota, and Hutchison of the London Hospital. The general demand of the public is for white bread, and Hutchison sums up most pertinently the great importance which must be attached to its decision on problems of nutrition:—"In the last resort, therefore, we are driven for guidance to the results yielded by actual analysis of the diets selected by healthy persons. The value of such results must not be underestimated. Men have found out by long experience what is the best diet, better, perhaps, than science can tell them."

For these reasons any further step in the direction of an additional increase in the flour to be extracted from wheat, and consequently darker bread, should not be taken unless from absolute necessity. The resultant flour would be less nutritious, darker in colour, and more difficult to bake into a sound and satisfactory loaf. It would be less attractive and appetising; and in proportion as bread forms the principal article of diet the change would be the more keenly felt. The poorest classes would therefore be the most adversely affected of the whole of the community.

William Jago.

SCIENCE AND THE CIVIL SERVICE.

The Lords Commissioners of his Majesty's Treasury have appointed a Committee to consider and report upon the existing scheme of examination for Class I. of the Home Civil Service. The terms of reference are:—

To submit for the consideration of the Lords Commissioners of his Majesty's Treasury a revised scheme such as they may judge to be best adapted for the selection of the type of officer required for that class of the Civil Service, and at the same time most advantageous to the higher education of this country; and, in framing such a scheme, to take into account, so far as possible, the various other purposes which the scheme in question has hitherto served, and to consult the India Office, the Foreign Office, and the Colonial Office as to their requirements, in so far as they differ from those of the Home Civil Service.

The members of the Committee are as follows:—

Mr. Stanley Leathes, C.B., First Civil Service Commissioner (chairman).

Sir Alfred Ewing, K.C.B., F.R.S., Vice-Chancellor of the University of Edinburgh.

Sir Henry A. Miers, F.R.S., Vice-Chancellor of the University of Manchester.

Mr. H. A. L. Fisher, Vice-Chancellor of the University of Sheffield.

Prof. W. G. Adams, Gladstone Professor of Political Theory and Institutions in the University of Oxford.

The secretary to the Committee is Mr. D. B. Mair, Civil Service Commission, Burlington Gardens, W.

The Royal Commission on the Civil Service recommended in 1914 the appointment of a committee of this kind to ascertain whether there is any substantial foundation for the view that the scheme of examination for Class I. clerkships unduly favours the curricula of the older universities and handicaps those of the newer. It was suggested that, should it be found that any change is desirable, the Committee, while maintaining the high standard necessary for the examination, should revise and rearrange the syllabus, weighing the educational value of classical learning against those of modern and scientific studies. It will be remembered that the need for change in the present system of allocating marks, by which a premium is placed upon knowledge of the Greek and Latin languages and literature, was one of the main subjects brought forward at the meeting on "The Neglect of Science" held in May last (see NATURE, May 11, p. 230).

In connection with this matter, particular interest attaches to the appeal recently addressed by the Institution of German Engineers to the Chancellor, Herr von Bethmann-Hollweg, a translation of which was published in the *Times Educational Supplement* of November 23. The appeal, which urged that steps should be taken to extend the avenues of admission to the higher posts in the German Civil Service, with especial regard to graduates completing their courses of study at the technical high schools, will be read with deep interest and not without surprise. Having regard to the important part which science in its various applications has played in the manufacturing and economic development of Germany, it might have been expected that its claims to due recognition as an essential factor in the equipment of men destined for high administrative posts in the Civil Service would long ago have been fully admitted. The many and new problems evolved by the war have demanded the services of the best intellects in various departments of life, and, in the opinion of the Institution of German Engineers, made manifest that much more than a merely legal or classical training is essential to the effective staffing of the service. It is admitted by the German Government that "the training of the higher Civil Service does not correspond with the requirements of the day," but such is the force of tradition that, despite years of debate and agitation, the reform is yet to seek alike in Germany and with us.

It is obviously not a matter of importance to us in this country whether or not the German Civil Service is thrown open to duly qualified scientific men, but it is interesting to note that a nation, whose advent to the front rank of industry and commerce is due almost entirely to its devotion to science in its various economic aspects and to the encouragement given to research and to the establishment of schools of high rank for this purpose, should shut out from its highest administrative posts the very men best calculated by their training to enhance the position it has gained. It is not only in industry and commerce, but in every department of civil life, that science is playing an increasingly important part in the well-being of the community, and therefore demands the trained scientific mind in the administrator and the knowledge and sympathy essential to the successful treatment required for the right solution of the complex problems of our time, both domestic and imperial. If it be true that Germany suffers so much from this want of recognition of her ablest intellects devoted to science and its applications, how much more must it be true of us with far greater responsibilities and where our higher Civil Service has for generations been recruited almost exclusively from a few public schools through the classical and mathematical sides of the ancient universities with which they are associated.

POSSIBLE POTASSIC FERTILISERS.

IN view of the present serious shortage of potassic fertilisers, great efforts are being made to find new sources of supply. A possible source has been indicated by Sir Thomas Mackenzie in a recent issue of the *Times*. It appears that South Island, New Zealand, possesses extensive deposits of a mica schist containing on an average 3 per cent. of potash; the material is soft—indeed, it is said to be the easiest mineral to mine in the whole world. Over great areas it lies on the surface and simply has to be picked up, while when it requires to be blasted it shatters so easily that a single charge will blow out tons at once. When brought to the mill it grinds down very easily; indeed, much of it is already broken up and already lies in a state of powder. Mr. Aston, the chemist to the New Zealand Department of Agriculture, writes enthusiastically about the deposit, stating that at Otago alone there are literally millions of tons of pure potash to the square mile; while Mr. A. D. Bell, another New Zealand chemist, goes so far as to say that these new deposits may reduce the famous Stassfurt mines, on which the world entirely depends at present, to the relative importance of a "bottle of potash on a druggist's shelf." This view, however, is controverted by Prof. Wyndham Dunstan, who states that there is not in view any deposit of potash in any country of the Empire comparable in nature, extent, or value with those of Stassfurt.

Agriculturists will want to know what is the fertilising value of the new deposit, as they have learned by experience that chemical analysis sometimes overrates minerals as fertilisers. The ordinary potassic fertilisers are the sulphate, which is very soluble and available, and contains

48·5 per cent. of K_2O, and kainit, a mixture of the chlorides and sulphites of potassium, magnesium, and sodium, containing on an average 12 per cent. of K_2O. Against these, a mica schist with only 3 per cent. of K_2O does not look very promising at first sight, and nothing but well-conducted vegetation experiments will show exactly what value the mineral does possess. Of course, if the technical chemist can find some easy way of making the sulphate or chloride, the whole aspect of the problem changes. Dr. Voelcker has experimented at Woburn since 1911 with various potassic minerals, felspars, phonolite, granite, etc., to see if any of them possessed fertilising value, but so far the experiments have been without success. There is no experimental foundation for the suggestion sometimes made that these minerals might prove useful on poor soils by the slow liberation of potash. As a matter of fact, potash is most needed by plants on light, dry soils, and in these the decomposition of a complex silicate could scarcely be expected to proceed rapidly.

NOTES.

THE death of the Rt. Hon. Charles Booth, F.R.S., in his seventy-seventh year, is a loss to the community of a munificent and judicious philanthropist, a pioneer in statistical and sociological work, a writer and speaker of force and attraction, and a sympathetic and practical economist. He published in 1889 the first volume of his series of studies of "Life and Labour of the People," a work which (as the *Times* truly says) "for nearly a generation profoundly affected public opinion on social questions." His method was to employ trained investigators, who should ascertain the precise facts about the means of living and the general conditions of labour in each part of the district under consideration, and to group the results into classes, graduated according to the resources possessed and the manner in which those resources were applied. The task occupied him seventeen years, and called for an elaborate organisation and a large expenditure of time and money. His services to statistical science were recognised by the award by the Royal Statistical Society of its gold medal in 1892, by his election to the presidency of that society from 1892 to 1894, and by the fellowship of the Royal Society. His services to the public were recognised by the coveted honour of a summons to the Privy Council, and by honorary degrees from the universities of Oxford, Cambridge, and Liverpool. He was an original member of the Sociological Society, and presided at two meetings when Prof. Geddes developed his views on civics. He advocated a scheme of universal non-contributory pensions, and when he was asked to help Sir Edward Hamilton's Committee on that subject he readily consented, and attended a meeting of that committee, giving advice which was found of great practical value.

SIR HIRAM S. MAXIM, one of our greatest inventors, died on November 24, at his home at Streatham, after a short illness. Born in 1840, in the State of Maine, he had a childhood and youth of hard work, like the majority of young Americans of that time. In his autobiography he recounts with pride how he picked up many trades and became skilful in the use of tools. Everything gave him occasion for thought and invention, and it was of his early inventions that he was proudest. Before the age of forty he invented mouse-traps, gas machines, fire sprinklers, a steam-trap, locomotive headlights, electric lights, dynamo machines, and many other things. It is by the first automatic gun—the Maxim—a gun with a single barrel which discharged more than 600 ordinary rifle shots per minute, exhibited thirty-two years ago, that he is best known to the general public. For the next twenty years his time was mainly taken up in developing automatic guns of much greater size, and these are now used by all the nations. He had a good working knowledge of physics and chemistry. He made discoveries about explosives, and seems to have been the first inventor of a smokeless gunpowder. He seems also to have been the first to see clearly the principle on which aeroplanes are worked, and he spent a great deal of money in finding out the horizontal speed required to give to inclined planes a definite amount of lifting power. His difficulty lay in the great weight of the necessary steam-engine and boiler. The later invention of the petrol engine easily made the aeroplane a real flight machine. He made his permanent home in England in 1882, and became a British subject. He was knighted in 1901. A review of his autobiography will be found in NATURE of April 22, 1915. Scientific men, engineers, and inventors used all to start as amateurs; Maxim was nearly the last of these men of great originality. It will be interesting for our successors to notice whether the more orthodox training now in vogue tends better to develop originality or to destroy it.

THE second annual report of the Medical Research Committee, National Health Insurance, has just been issued, and deals with the year ending September 30, 1916. In the introduction it is stated that the schemes for medical research in special directions, framed originally with a view to peace conditions, have for the greater part been suspended, and almost the whole of the available funds and scientific resources have been applied to the solution of medical questions of immediate national urgency in war-time. The summary of research work carried out is divided into three sections—that of the Central Research Institute, Mount Vernon Building, Hampstead, and affiliated laboratories, pre-war schemes for research, and work in connection with the war. In the department of biochemistry much work has been done on the treatment of amœbic dysentery with emetine, and as an outcome a double iodide of emetine and bismuth has been introduced by Dr. Dale, and appears to be a valuable drug in the treatment of carriers. Investigations are also in progress by Dr. Barger and Dr. Ewins on organic arsenic compounds with a view to improvement of such remedies as atoxyl and salvarsan. Dr. Leonard Hill and his staff have carried out investigations on the hygiene of munition factories, on dangerous dusts and vapours, and on poison gases. Several pre-war researches on tuberculosis have been continued, and rickets, diabetes, diseases of the heart, anaphylaxis, and the sterilisation and contamination of milk are being investigated at several centres. As regards work in connection with the war, the Army medical statistics are being compiled by the committee at their statistical department under the direction of Dr. Brownlee. The treatment of infected wounds and the study of antiseptics are being carried out by the staff of the bacteriological department under the direction of Sir Almroth Wright. Dr. Dakin devised his antiseptic solution of sodium hypochlorite, and as a result of his work on this substance and in collaboration with Prof. Cohen introduced chloroamine T (toluene sodium sulphochloroamide), a new and potent antiseptic. Typhoid, paratyphoid, and dysentery infections, trench nephritis, cerebro-spinal fever, and disorders of the soldier's heart are a few of the other subjects dealt with. The report gives an excellent summary of the researches, and is all the more useful as full references are given to the original papers in which they appear. Lord Moulton, Sir Clifford Allbutt, and Prof. Hay retire from the committee, and their places are taken by Viscount Goschen, Dr. Chalmers, and Prof. Murray, and Major Waldorf Astor, M.P., becomes chairman.

THE death is announced from Paris of the Vicomte M. de Vogüé, a member of the French Academy, and a well-known writer and diplomat. Born in 1848, the late Vicomte served in the war of 1870, and afterwards entered the diplomatic service, and held appointments successively at Constantinople, Cairo, and Petrograd. In 1873 his "Voyage en Syrie et en Palestine," published in the *Revue des Deux Mondes*, attracted much attention. He also edited a posthumous work of the Duc de Luynes entitled "Voyage d'exploration à la Mer morte, à Petra, et sur la rive gauche du Jourdain." The Vicomte de Vogüé was the author of several historical and other volumes, and did much to awaken French interest in the intellectual life of Russia. Since the outbreak of war he had been president of the Société de Secours aux Blessés.

THE French Academy of Sciences has just lost a member by the death of M. Léauté. Born in 1847, M. Léauté left the Polytechnic School as a Government industrial engineer (*ingénieur des manufactures de l'Etat*), and eventually became Director of Telephones. After writing some early papers on pure mathematics, he devoted himself to theoretical mechanics, and wrote important papers on linkages, transmission of power by cables, and regulators of hydraulic and other machines. By means of a differential equation and an associated graph, he successfully attacked the problem of the dangerous long-period oscillations of hydraulic machinery. In announcing his death to the Academy, the president directed attention to the fact that "his work is the best reply to those who fancy that theory and practice are irreconcilable, and that 'savants' cannot render any useful service for the advance of industry, even if it is granted that they do not actually retard it."

A SMALL committee has been formed in Glasgow for the procuring of a suitable local memorial of the late Sir William Ramsay. It is proposed that the memorial shall be placed in the University buildings, perhaps in the Department of Chemistry. Ramsay was born in Glasgow, and received his education at the Academy and the University. For eight years he held, in succession, the posts of assistant in the Young Laboratory of Technical Chemistry, and tutorial assistant to the Regius professor of chemistry, the late Dr. John Ferguson. He left Glasgow in 1880 to become professor in University College, Bristol, but he always maintained close relations with the city and with the University, from which he received the honorary degree of Doctor of Laws. Lady Ramsay is a member of a well-known Glasgow family. The proposal of the Memorial Committee has received a large measure of support, and it has been thought expedient to limit the subscription to two guineas. Mr. H. B. Fyfe, B.L., of 115 St. Vincent Street, Glasgow, is acting as treasurer of the fund.

APPLICATIONS for the Government grant for scientific investigations for 1917 must be made on printed forms obtainable from the clerk to the Government Grant Committee, Royal Society, Burlington House, W., and returned to reach the offices of the society by, at latest, January 1.

To commemorate the fiftieth birthday of Dr. Sam. Eyde, the Norwegian inventor, the sum of 100,000 kroner has been set aside by the Norwegian Hydro-Electric Nitrogen Company for the formation of a Sam. Eyde Fund to be devoted to the advancement of chemical and physical research. The fund is to be administered by the Board of the Nansen Fund.

THE death, on November 20, is announced, from wounds received on October 1, of Lieut. Corin H. B. Cooper, R.E. Mr. Cooper, after graduating in science at McGill College and University, Montreal, specialised in geology, and acted for a time as demonstrator under Profs. Adams and Bancroft at McGill University. At the outbreak of the war he was engaged on Government survey work in the oilfields of the Rocky Mountains.

WE regret to see the announcement of the death on November 23 of Mr. Charles Umney, the pharmaceutical chemist, in his seventy-fourth year. He was chairman of the Chemical Section of the London Chamber of Commerce, and we learn from the *Chemist and Druggist* that a measure of his ability and power was then afforded when he took Revenue representatives into his firm's laboratories in order to watch the experiments that he devised and carried out for the purpose of ascertaining the loss of spirit in making liquid galenicals. Upon these experiments was based the rebate on exportation of spirituous medicinal preparations under drawback. As a pharmacist pure and simple his history may be found in the records of the Pharmaceutical Society and the British Pharmaceutical Conference. For many years he was one of the society's examiners. He worked for the conference as a paper contributor, a debater, member of the committee, and in 1884 he became the treasurer, holding that office until, in 1888, he was appointed president of the body, holding the office at Newcastle-upon-Tyne in 1889 and at Leeds in 1890.

THE death of Mr. R. F. Mann, at the age of thirty-five, occurred on November 17. Mr. Mann had been an X-ray operator at the Middlesex Hospital during the last seventeen years. He was the inventor of one of the earliest forms of localisers for use in the removal of foreign bodies from the limbs. In the years when the effects of X-rays upon malignant disease were being investigated, the risks to which the operators were subject were not known, and it was during this period that he contracted X-ray dermatitis, which had a malignant termination. He underwent numerous operations during the last eight years, but bravely and loyally held to his work. Since the outbreak of war he had, in fact, added to his work by undertaking the radiographic work at the Branch Military Hospital at Clacton (Middlesex Hospital), and later in connection with the Duchess of Bedford's Military Hospital at Woburn.

THE death, by accident, at Hadley Wood railway station, is announced of Capt. W. H. Jaques, of the United States Navy, known for his scientific work in connection with ordnance engineering and the production of early submarines. Capt. Jaques was born in Pennsylvania on December 24, 1848, and graduated at the U.S. Naval Academy in 1867. He was an assistant on the U.S. Coast Survey in 1870–74; with the New York Board of Education, 1874–78; secretary of the U.S. Gun Foundry Board, 1883–85; and secretary of the Senate Commission on Ordnance and Warships, 1886–87, when he became superintendent of the gun factory at the Bethlehem works of the Carnegie Steel Co. Capt. Jaques was a member of the Institution of Civil Engineers, the Institution of Mechanical Engineers, and the Iron and Steel Institute, and an associate member of the Institution of Naval Architects. His scientific work was concerned chiefly with the manufacture of heavy ordnance, armour, torpedoes, and solar evaporators, and he invented the double-forging process of armour and other improvements in its manufacture.

The President of the Board of Agriculture desires to direct public attention to the urgent need that exists for the assistance of women, not already connected with agricultural industry, in the work that is required for food production on the land, and to replace agricultural labourers who have been called up for military service. Hundreds of women have already rendered valuable service in maintaining the home-grown food supply, but thousands are now needed to meet the national emergency. Educated women are especially invited to offer their services, and short courses of training can be provided for them. Application should be made to the secretaries of the Women's War Agricultural Committees in the various counties, or to the Women's National Land Service Corps, 50 Upper Baker Street, London, N.W.

The collections of the State Natural History Museum of Sweden have for some time past been in process of transference from their old quarters in Drottninggatan, Stockholm, to the fine new building in the suburb of Frescati, where they have been rearranged in accordance with modern ideas, special attention being paid to the education of the public. At intervals during the present year the palæontological, zoological, and mineralogical collections have been made accessible. The botanical galleries have just been completed. On November 13, in the presence of the Crown Prince and other royalties and many notabilities, the whole of the public galleries were declared open by the King of Sweden, who conferred distinctions upon the director of the museum, Prof. Einar Lönnberg, the vice-director, Prof. Hjalmar Sjögren, and the architect of the museum, Mr. A. J. Anderberg.

The first meeting of the current session of the Royal Society of Arts was held on November 15, when Dr. Dugald Clerk, the chairman of the council, delivered his inaugural address on some conditions of the stability of the British Empire. Dr. Clerk illustrated the economic strength of the United Kingdom by the growth of her trade, her capital, and her income; he indicated the relative weakness of Germany by comparative statistics of a similar character. While honouring Mr Hughes, the Premier of Australia, for his courage and his enthusiasm, he urged a broader and bolder policy. "No, the Colonies are wrong in the idea of a self-contained Commonwealth, and Britain is right in her idea of expansion in trade over every part of the world." Then turning to the fountain-head of the prosperity he anticipates, he urged with strength and conviction the necessity of two things, generous payment of labour, and generous work by labour. Both his optimism and his courage were inspiring, and it would, perhaps, have been an artistic error to have pared the imperfections from a fact or modified the meaning of a figure. But in our moments of cooler thought it is well to remember that figures showing the growth of a country's wealth must be read together with the curve of money values, that the national incomes of any two countries are dangerous insimilitudes, and that, whatever our income in war-time may be in terms of money, it is, in fact, what Mr. Flux has well called "an inflated expression in money of a reduced income in goods."

Dr. Elsie Clews Parsons describes, in the November issue of *Man*, a method for the detection of crime among the Zunis. Anyone could use this method with the curious condition that he had never been bitten, a disqualification which appears in other Zuni rites. The detective, who is by profession a seer, takes a dose of a narcotic, and during the trance which follows a picture of the situation or incidents by which a missing article has been mislaid or stolen will unfold itself to him. So fully is this believed that a thief will smoke during the act of stealing so that the smoke may surround his head and prevent identification. The narcotic used is known as the Jamestown weed (*Datura meteloides*). An overdose is exceedingly dangerous, and the seer who takes it for the purpose of detection suffers for some time; his head and eyes are heavy, his nerves on edge, and though the fee charged for his services is considerable, one practitioner has retired from business, and recently declined to act in the case of a lost horse.

While it has long been known that the woodcock carries its young, not merely under the spur of sudden emergency, but as a matter of everyday practice, when the feeding ground is distant from the nest, this does not appear to be the case with the snipe. At need, however, it is clear that this species will also bear its young aloft to a place of safety. A brief but vivid description of the manner in which this is done appears in the *Irish Naturalist* for October, by Mr. W. J. Nash, who saw a snipe rise from a mud-bank in a bog drain near Lissoy carrying a young one, which was set down some thirty yards off. It seemed to fly with considerable difficulty, and before it alighted the young one was dangling down, held, apparently, by the head only, and seemed to be slipping from its parent's grasp. The burden seemed to be supported by both bill and feet. Another nestling of about three days old was discovered, just dead from drowning, beside the spot from which the first had been rescued. The young birds had, it is surmised, been driven into the water by fright, caused by a dog which was hunting near the spot alone when the narrator arrived. From the evident labour of the parent in the performance of this rescue work it seems clear that such flights are but rarely undertaken, while the woodcock is an adept from long practice.

The fifth and last of Mr. J. H. Owen's valuable series of notes on the breeding habits of the sparrow-hawk appears in the October issue of *British Birds*. These notes are the result of long and patient observations from a concealed hut, and are illustrated by some very remarkable photographs. While it is a matter of common knowledge that this bird will use the deserted nest of another hawk, of a crow, or of a wood-pigeon, this is the case only when its own nest has been destroyed, and not, as is generally supposed, as a matter of caprice. As soon as the young are hatched it seems to be a common practice for the female to eat the empty eggshells, though as often perhaps they are carried away and dropped at a distance from the nest. How greatly fertility is reduced by the strain of increased egg production is shown by the author's observations to the effect that if the first clutch be removed more than 25 per cent. of the second will prove infertile, while the number of eggs in the clutch is also reduced. Late in December, or early in January, these birds will often build flimsy platforms, which are supposed to be used solely for the purpose of dining-tables, though in many cases, it would seem, they serve neither this nor any other purpose. Possibly it would be more correct to regard them as indications of an incipient sexual activity.

The timber resources of South America are discussed by Mr. Raphael Zon in the *Geographical Review* for October, 1916 (vol. ii., No. 4). South America is principally rich in hardwoods, of which the so-called

Spanish cedar (*Cedrela odorata*) and the *quebracho* are the most important. These are more than sufficient to meet the home demand, and are largely exported, but at the same time short-sighted exploitation bids fair to impair seriously this industry. On the other hand, it is, of course, quite possible that further study of the timber resources will result in the discovery of other hardwoods of commercial value. Of more economic importance is the supply of softwoods. The Parana pine (*Araucaria brasiliensis*) of southern Brazil and the Chilean pine (*A. imbricata*) seem to be the only two species of importance, and are being increasingly used in place of imported coniferous wood from the northern hemisphere. But the limited area of these softwoods and the growing demand for cheap timber make it improbable that South America can ever dispense with her timber imports, and certainly there is no hope of her being able to export softwoods. In view of this paucity of timber there is urgent need of the South American States instituting scientific management of their forests and the prevention of undue exploitation. South America is far less rich in commercial timber than might be supposed, and her resources are not inexhaustible.

THE retreat of the Barry glacier in Prince William Sound, Alaska, has been studied for many years. In 1910 the National Geographic Society's expedition showed that the face had withdrawn three miles since 1899. This expedition gave an exhaustive account of all observations previous to 1910. Later observations are contained in a brief paper by Mr. B. L. Johnson, published as Professional Paper 98 C of the United States Geological Survey. Mr. Johnson visited the glacier in 1913 and 1914, and found in both years that the rate of retreat had been maintained. Between 1910 and 1914 the rate of retreat was 8200 ft. on the eastern side, and about 2500 ft. on the western side. The rate on the western side seems to have decreased after the uncovering of bedrock on that side. The paper is illustrated with several photographs of the glacier in various stages of its retreat.

SOME details of the Indo-Russian triangulation connection are given in the *Geographical Journal* for November (vol. xlviii., No. 5). By 1911 Gilgit had been connected with the Indian system, and the Russians on their side had reached Pamirski port in about lat. 38° 13′ N., long. 75° E. But the connection of Gilgit with the Russian survey across a strip of Afghan territory presented difficulties of a formidable nature, as it involved the crossing of the Karakorams. The only feasible route was from Gilgit up the Hunza valley to the Kilik Pass, involving the survey of about one hundred miles up a narrow, precipitous-sided gorge, flanked by mountains rising 6000–7000 ft. above the valley floor. The number of stations in this survey was thirty-three, and their average height is 16,222 ft. The work was carried out in the face of great difficulties and hardships by the late Lieut. H. Bell, R.E., in 1911 and 1912, and completed by Lieut. Mason in 1913. A report of the work is contained in the Records of the Survey of India, vol. vi. Capt. R. W. Hingston, I.M.S., has some notes of the geology and climate, as well as a valuable paper on his observations of blood at high altitudes.

SOME observations on the *bai*, or so-called "sand-mist," a phenomenon of frequent occurrence in the Far East, are contributed by Prof. Yuji Wada to *Temmon Geppo*, the organ of the Astronomical Society of Japan (vol. ix., No. 6, August, 1916). The mist, which is ascribed to an atmospheric depression over the sandy Tsai-pih district of Central China, is prevalent in spring. In winter the ground is frozen, and in summer it is knit together by grass, but between these seasons the loose surface is churned up by the wind, and clouds of sand rise to a great height and are carried eastward, afterwards collecting moisture and falling as a coloured mist. During the fall the sun is obscured and objects assume a yellow or ashy hue, the conditions closely resembling those attending a solar eclipse, for which the phenomenon was often mistaken by ancient chroniclers. Characteristic of the *bai* is the thick coating of very fine yellow dust which settles everywhere. During a sand-mist at Chemulpo on March 4, 1915, the author measured a fall of sand on a sheet of glass in an underground chamber protected from the wind. A twenty-four hours' deposit on 118·6 sq. cm. weighed one centigram. On the same day a fall of $\frac{1}{4}$ in. was recorded in Etchu province, Japan. Sometimes the sand descends in a rainstorm. An instance is cited of a violent storm of orange-coloured rain in 1306, which caused the deaths of many persons and cattle. The author concludes that the *bai* is akin to the "blood rain" and "red snow" familiar to European meteorologists.

THE July issue of the *Agricultural Journal of India* (vol. xi., part 3) contains an article on "Photographic Illustration," by Mr. C. M. Hutchinson, which will be very helpful to the many scientific workers whose imperfect acquaintance with the limitations of the half-tone process of reproduction of photographic illustrations has so often led to unexpected disappointment. The questions of lighting, exposure, development, class of plate, and use of light filters are discussed and well illustrated by an excellent series of reproductions.

THE last two parts of the Edinburgh Mathematical Society's Proceedings (May and September, 1916) contain the usual amount of interesting matter. Perhaps the most important paper is that of Dr. J. Dougall on the solution of Mathieu's differential equation; this equation is important for physical applications, and Dr. Dougall has found solutions adapted for computation. Possibly they are not the proper analytical forms; these may be quotients of integral functions, as in the case of the proper representation of the elliptic functions; but the paper certainly shows an advance on the practical side. Other papers deserving attention are Mr. Brown's on Fourier's integral, Mr. Milne's on differential equations, Mr. D. G. Taylor's on linear substitutions, and Mr. Tinto's on space transformations. We have also received Nos. 19 and 20 of the same society's *Mathematical Notes*; they show that the study of mathematics at Edinburgh is in a very healthy condition, and contain a number of elegant demonstrations.

THE researches of Prof. Kamerlingh Onnes have shown that at temperatures below 4° or 5° on the absolute scale mercury, tin, and lead have extremely small electrical resistances. If the temperature of a wire of either of these materials in this super-conducting state is gradually increased, at a certain temperature known as "the critical temperature" the resistance rapidly increases. If the wire is subjected to a magnetic field this critical temperature is lower than it is in the absence of a field. If the current used in testing the resistance is increased, the critical temperature is also lowered. In the Journal of the Washington Academy of Sciences for October 19 Mr. F. B. Silsbee, of the Bureau of Standards, makes use of the experimental data available to show that the effect of the increase of the testing current on the critical temperature is due entirely to the magnetic field that current produces. This accounts for the differences observed in the effect of the current according to whether the wire used in the tests is straight or coiled. If further work supports Mr. Silsbee's theory, it should afford a clue to a more satisfactory explanation of the super-conducting state.

WE have received a little book by Mr. J. W. Giltay dealing with bow instruments from a physical point of view ("De Strijkinstrumenten uit een natuurkundig oogpunt beschouwd"; Leyden, 1916, pp. xi+103, illustrated). It is a simple description of the action of the various parts of the violin, with a reference here and there to other bowed instruments. An elementary knowledge of acoustics is assumed. The book should appeal in the first place to musicians taking a scientific interest in their instruments, and in the second place to physicists. For the most part the author describes and discusses the results of earlier workers, especially those of Savart, Helmholtz, and Sir William Huggins, but he has also included a number of his own experiments, particularly on the effect of the air volume enclosed in the sounding-box. He is not convinced that a violin improves by being played upon.

THE "Catalogue (No. 369) of Miscellaneous Literature" just issued by Mr. F. Edwards, of High Street, Marylebone, though mainly consisting of books of general interest, contains particulars of several works appealing to readers of NATURE—on botany, travel, and, notably, natural history. The catalogue directs attention to many publications of the Zoological Society of London, offered, for the most part, at greatly reduced prices.

OUR ASTRONOMICAL COLUMN.

EPHEMERIS OF COMET 1916*b* (WOLF).—After having passed conjunction, this comet will again be in a favourable position for observation as a morning star during the winter and spring. The following ephemeris for Greenwich midnight is given by Mr. R. T. Crawford in Lick Observatory Bulletin No. 286:—

	R.A. h. m. s.	Decl. ° ′		R.A. h. m. s.	Decl. ° ′
Dec. 1	15 10 4	−5 13	Jan. 29	16 59 56	−5 15
10	25 10	5 37	Feb. 8	17 21 2	4 28
20	42 39	5 56	18	42 49	3 24
30	16 0 53	6 5	28	18 5 13	2 1
Jan. 9	19 50	6 2	Mar. 5	16 38	1 12
19	39 32	5 46			

The values of log Δ on December 1, December 31, February 1, March 1, are 0·5829, 0·5237, 0·4434, 0·3623 respectively. Taking the brightness at discovery on May 10 as unity, the theoretical brightness on these dates is 3·0, 4·9, 8·8, and 15·6. The path of the comet during the above period is mainly through Ophiuchus.

THE GREAT RED SPOT ON JUPITER.—This planet being now favourably visible in the evening sky, observations can be conveniently made of the surface markings, which are very abundant and diversified at the present time. The red spot is smaller than formerly, and the hollow in the great S. equatorial belt less prominent. The first-named object will be central at about the following times:

	h. m		h. m.
Dec. 3 ...	9 35	Dec. 13 ...	7 50
4 ...	5 20	15 ...	9 28
6 ...	7 4	18 ...	6 59
8 ...	8 43	20 ...	8 37
10 ...	10 21	27 ...	9 23
11 ...	6 12	30 ...	6 52

Mr. F. Sargent, of Bristol, who has been observing this planet with considerable success in recent years, informs Mr. Denning that the large dark spot in the S. tropical zone, known as the "south tropical disturbance," is now about 120° long, so that it extends over one-third of the circumference of Jupiter. The middle of this "disturbance" follows the middle of the red spot about two and a half hours, and the preceding end of the former may be expected to overtake the following end of the latter at the end of January. Since June, 1914, the rate of rotation of the red spot has been about 9h. 55m. 37s., and this rate may be expected to exhibit an acceleration next year when involved with the S. tropical disturbance.

THE METEORIC SHOWER FROM BIELA'S COMET.—Though no rich display occurred this year, it is interesting to note that this shower visibly returned. Between November 20 and 24 ten slow meteors were recorded giving a fairly well-defined radiant at 27°+42° near γ Andromedæ. These meteors were seen by various observers, including Mr. Denning at Bristol, Mrs. Wilson at Totteridge, Miss Cook at Stowmarket, and Miss Strover at Bexley Heath. It seems probable that a few of these Andromedids are visible every year, and that meteors are distributed completely around the cometary orbit, though sparingly in sections of it.

THE COLOURS OF STARS IN GLOBULAR CLUSTERS.—Dr. Shapley has recently obtained further important data relating to the colour-indices of stars included in globular clusters (Proc. Nat. Acad. Sciences, vol. ii., p. 525). The stars in a cluster of this type may be supposed to be at sensibly the same distance from the earth, and apparent magnitudes may accordingly be assumed to be directly proportional to the total light emitted. In four clusters which have now been fully investigated, it has been found that the average colour-index is distinctly greater for the brighter stars than for the fainter ones, or that relatively high luminosity is accompanied by greater redness. The total light emission of the bluer stars, for which the surface temperature is presumably in excess of 10,000° C., thus appears to be less than that of many of the redder stars, which have surface temperatures only half as great. Since the emission per unit area is much less for the red than for the bluer stars, it follows that in the clusters investigated the volumes of the bright redder stars are very great in comparison with those of the stars which are fainter and relatively blue. The ancestral relationships of the two classes must be accounted for in any satisfactory hypothesis of the evolutionary sequence of spectral types.

FOSSIL VERTEBRATE ANIMALS.

THE American Museum of Natural History, New York, has lately issued a fifth volume of papers on fossil vertebrata, reprinted from the Bulletin of the museum for the years 1913–14. It has long taken a leading place in researches of the kind here detailed, and the new contributions to our knowledge of many groups of extinct vertebrate animals are of the usual interest and importance. Besides the members of the staff, the authors include other well-known American palæontologists, while Dr. Robert Broom and Baron F. von Huene make specially interesting contributions, having studied the American fossils after their long experience of corresponding specimens from South Africa and Europe. Dr. Broom has, indeed, furnished the American Museum with a large collection of South Africa Permo-Triassic reptiles for comparison with the contemporaneous American groups, and he describes many of his specimens in the volume before us.

Several studies of the early reptiles and labyrinthodonts are appropriately followed by Dr. Broom's discussion of the structure and affinities of the Mesozoic multituberculate mammals and their rare Eocene successors. His description of a new skull of Polymastodon is especially interesting, and he agrees with the usual opinion that some of the herbivorous multituberculates were the ancestors of the existing monotremes. The latest forms of extinct land-reptiles from the Upper Cretaceous of Alberta, Canada, are also described in several papers by Mr. Barnum Brown, who discusses chiefly the Trachodontidæ (related to Iguanodon) and the horned dinosaurs or Ceratopsia. Among other observations he makes specially valuable notes on the brain-cavities of these two groups. It appears that just before their extinction the dinosaurs in North America exhibited almost incredible variety and eccentricity.

When the first Tertiary mammals were discovered in North America, too little attention was paid to the geology of the deposits whence they were obtained. The American Museum has always recognised this deficiency, and the new collection of papers includes some valuable contributions to our knowledge of the lowest Tertiary formations. Of the mammals themselves, Prof. H. F. Osborn describes the skull of Bathyopsis, a supposed ancestor of the Dinocerata, and a skull with other remains of Eomoropus, a new genus ancestral to the anomalous hoofed animals known as Chalicotheriidæ. Dr. W. J. Sinclair gives technical descriptions of the rare pieces of jaws of pig-like artiodactyls from the Eocene of North America, and Dr. R. W. Shufeldt discusses many fragmentary remains of birds. Dr. W. D. Matthew also describes the important discovery in the lowest Eocene of New Mexico of the skull of an insectivore related both to the existing Chrysochloris of South Africa and to the extinct Necrolestes of South America, thus proving that the close affinities of these two genera do not imply any former direct connection between the two southern continents in which they occur. All the papers are well illustrated with text-figures and plates, and the American Museum is to be congratulated on the manner as well as the matter of its publications. A. S. W.

STUDIES OF HYMENOPTERA.

SOME small hymenopterous parasites of the notorious Hessian fly form the subject of a paper by C. M. Packard in the *Journal of Agricultural Research*, vi., No. 10. The life-histories of three species belonging to the genera Eupelmus, Merisus, and Micromelus are described, and the figures of eggs, larvæ, and pupæ are especially valuable. The author concludes that never more than a single individual of either of these parasites can mature in a single cecid puparium. Where more than one egg was placed on the same host, one larva only survived; "the rest were killed by that one or starved to death . . . whether the two or more larvæ were of the same or different species."

It is well known that certain species of the Chalcididæ—small Hymenoptera that are typically parasitic in their habits—lay their eggs in plant tissues on which their larvæ feed, and the genus Megastigmus has been noticed as injurious to fir seeds. J. M. Miller (*Journ. Agric. Research*, vi., No. 2) is the first to describe the actual operation of egg-laying by these minute flies; the female pierces the scales of the young cones with her long ovipositor and lays the eggs close to the developing seeds. The process is well illustrated by Mr. Miller's photographs.

The literature of the honey-bee is ever increasing. A noteworthy paper on the sense-organs on the mouth-parts of the bee is published by Dr. N. E. McIndoo in the Smithsonian Misc. Collections (lxv., No. 14); he gives the results of experiments by feeding bees on various substances, and describes with clear figures the minute structure of the sense-organs under discussion. When "undesirable substances" were added to the bees' food, the insects were found to refuse such "after eating more or less of them," and the author concludes that "the olfactory sense in the honey-bee is highly developed, and that it serves as an olfactory and gustatory perception combined."

Systematic work on the ants claims the attention of entomologists in distant regions. In the Ann. South African Museum (xiv., part 2), G. Arnold continues his extensive "Monograph of the Formicidæ of South Africa." A. Gallardo publishes a monograph of the Dolichoderinæ as a contribution to "Las Hormigas de la República Argentina," in the *Ann. Mus. Nat. de Hist. Nat. de Buenos Aires* (xxviii., 1916, pp. 1–130), a praiseworthy feature of which is the addition of at least one clear structural figure to the description of each species. The Argentine ant, *Iridomyrmex humilis*, is discussed at length, the description of its varieties and habits occupying sixteen pages. This insect has in recent years become a serious pest in parts of the United States; colonies have also been introduced into southern Europe, and some time ago these ants gained a temporary footing in a garden near Belfast, whence they invaded the adjacent dwelling-house, with the result of considerable alarm and inconvenience to the inhabitants. G. H. C.

OBSERVATIONS ON RECENTLY DISCOVERED FOSSIL HUMAN SKULLS.[1]

THE announcements made in NATURE last year (1915, August 5, p. 615; September 9, p. 52; and December 2, p. 389) of the discovery of fossil human skulls in Australia (Talgai) and South Africa (Boskop) suggest certain observations concerning the problems relating to early mankind. For not only do they add to the number of the distinct types of early humanity with which we are acquainted, but they also force upon us the further consideration of the question of early migrations, of the reality of which the widespread distribution of certain definite types of stone implements already afforded convincing testimony for all who were willing to accept the plain significance of positive evidence.

There are reasons for believing that when *Homo sapiens* first became differentiated from other human species many human strains other than those which made their way into western Europe in the Upper Palæolithic (which may be called the Early Neoanthropic, see NATURE, August 17, 1916, p. 514) age were also budded off from the original parent stock. Some of these diversely specialised strains were the ancestors of the Australians, others of negroes, others again of the Mongolian race, and yet others of the brachycephalic types of humanity, none of which were represented in Europe, excepting possibly the last of the groups mentioned, which began to filter into eastern Europe in Azilian times, but did not become at all common in the West until the closing phases of the Neolithic. Some of these various strains wandered far from their area of characterisation; and when brought into contact with other stocks were able to transmit their culture. Thus it is possible to explain how, even in the remote period usually called Palæolithic, identical methods of chipping stone implements in widely separated localities can be regarded as certain evidence of the derivation of the technique from a common source, though the actual makers of the weapons may be of different races. Nor can the source of the inspiration be in doubt even if certain peoples may continue to follow the distinctive methods in the twentieth century.

Further, a particular culture-complex may have been built up of practices and customs derived from varied sources: the particular set of them which becomes intermingled in one area, and the type of culture which develops as the result of the blending of these in-

[1] Abstract of a paper read before he Manchester Literary and Philosophical Society on October 31 by Prof. G. Elliot Smith, F.R.S.

gredients, are peculiar to, and distinctive of, that area. For example, the well-defined culture-complex which is commonly called Neolithic (see NATURE, May 11, 1916) is characteristic of Europe and the immediate neighbourhood; nor, in fact, was it synchronous or of identical composition in different parts of Europe. But when one passes to the East or the South, although all the ingredients out of which the European Neolithic was compounded may be found, there is no phase of culture which can justly be labelled Neolithic in the same sense as the term is applied in Europe.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION M.

AGRICULTURE.

OPENING ADDRESS (ABRIDGED) BY E. J. RUSSELL, D.Sc., PRESIDENT OF THE SECTION.

I AM going to deal to-day with the possibilities and the prospects of increased crop production, which, both in its narrow aspect as a source of national wealth, and in its wider significance as the material basis of rural civilisation, must always remain one of the most important of human activities.

The main obstacles to increased plant-growth lie in the climate and in the soil. Climate apparently cannot be altered; so we have to adapt ourselves to it by growing crops and varieties suiting the conditions that happen to obtain. But soil can be altered, and it is possible to do a good deal in the way of changing it to suit the crops that are wanted.

On light soil the two great obstacles to be overcome are the lack of water and the poverty in plant nutrients. Both arise from the same cause, the lack of colloidal substances, such as clay and humus, which have the power of absorbing and retaining water and plant nutrients. There are two ways of dealing with the problem; one is to get round it by increasing the depth of soil through which the roots can range, and the other is to remedy the defect by adding the necessary colloidal substances—clay, marl, or organic matter. In practice it is not possible to add sufficient to overcome the defect entirely, and therefore both methods have to be used.

Depth of soil is perhaps the most important single test that can be applied to light sands. If the soil is shallow, and is underlain by solid rock, pebbles, or gravel, the case has hitherto been hopeless, excepting where the climate is persistently moist. I know of no instance of successful treatment in tolerably dry regions; the areas are generally left alone. They form picturesque heaths, some are used as rabbit-warrens or golf courses, some are recommended for afforestation.

If the rock, instead of being solid, is simply a thin layer separating the sand above from a great depth of sand below, then the improvement can be effected by removing it.

Once the light soil is made deeper it can be still further improved. The most permanent improvement is to add clay, or preferably marl; this used to be done in many parts of England, but it now only survives on certain fen or peaty soils.

The usual method of increasing the absorptive power of light sandy soils is to add organic matter, by dressings of farmyard manure, by feeding crops to sheep on the land, or by a method that wants much further investigation, ploughing crops or crop residues straight into the soil. But the organic matter disappears at a very rapid rate, so that the process needs repeating in one form or another every second or third year. The addition of organic matter must generally be accompanied by the addition of lime or limestone, otherwise the soil may become "sour"—a remarkable condition, detrimental to plant-growing, but not yet fully understood by chemists, and therefore more easily detected by the vegetation than by analysis. Few light-land farmers use lime or chalk as regularly as they should for the best results.

Further, it is necessary to add all the plant-nutrients, for sand is usually deficient in these, excepting in places calcium phosphate. The common English practice is to import feeding-stuffs to be eaten by sheep on the land, so that the great proportion of the nitrogen, potash, and phosphates thus brought on to the farm shall get straight into the soil. This is not sufficient, however, and artificial manures should be used as well and far more extensively than at present; nitrogen, potash, and phosphates are all wanted.

These additions do not end the matter. Light sandy soils are very prone to weeds, and constant cultivation is necessary to keep them down. Fortunately the cultivation serves another purpose as well; it helps to retain the moisture content of the soil.

Thus the management of a light sandy soil is a constant struggle; it demands constant surface cultivations, frequent additions of fertilisers, of organic matter and lime, and periodical deep ploughings to check any tendency to pan formation. When all this is done these light soils become very productive; they will grow almost any crops, and they can be cultivated easily and at almost, but not quite, any time. One of their chief defects is that cereal crops do not produce so much grain as might be expected; in the words of the practical man, they will not "corn out." This phenomenon requires further investigation.

On the other hand, neglect in any of these directions soon leads to failure.

These are the conditions for the successful management of light soils; how far can they be attained? This is a purely economic question. It is obvious that success is only possible if the gross returns are sufficient to cover the costs. Now, a very great deal of experience has shown that the ordinary farm-crops—wheat, barley, swedes, etc.—do not bring in sufficient gross return to encourage good farming. Numerous instances occur on the tracts of light Bagshot sands. Some of the old four-course farms still survive—wretched little affairs, the tenants of which are constantly struggling against chronic poverty. Again, considerable areas of light land in Hertfordshire caused their cultivators to go bankrupt in the 'nineties when only these ordinary crops were grown. The old Townshend and Coke method of feeding sheep on the land is satisfactory, but it requires the triple, and not very common, qualifications of capital, good knowledge of sheep, and of crop management. The situation in Hertfordshire was saved by the potato-crop, which, on these farms, brings in a gross return of 25*l.* or more per acre, against a return of 7*l.* from wheat at pre-war prices. Of course, the expenditure on potatoes is much greater than on wheat, but that does not matter; the point is that the expenditure has to be incurred in any case if the land is to be kept in good cultivation, and potatoes bring in the necessary return, while wheat does not. Potatoes are the commonest of money-finding crops, but they are not the only one. Greens are in some places very successful, bringing in 17*l.* or more gross return. In North Kent various market-garden crops are used. In parts of Norfolk blue peas have answered satisfactorily. Clover-seed is a useful adjunct in places, but it is not sufficiently trustworthy as the chief money-maker.

It is not necessary to take the money-finding crop very often; once in four years may prove sufficient. But the system is capable of considerable intensification if the farmer has sufficient capital, or if his holding is so small that his capital can be more intensively used. It is possible to grow nothing but crops bringing in a large gross return; in districts round Sandy, Biggleswade, etc., the market-garden crops have been exclusively grown for very many years with great success; this method also proves very successful on the Bagshot sands. It is not clear, however, that this type of farming could be indefinitely extended.

The best hope for improvement of these light soils lies in increasing the number of money-finding crops, improving the methods of growing them—*e.g.* the introduction of the boxing and spraying of potatoes—and their relation to the other crops or the live stock, and improving the organisation for disposing of them, so that farmers will feel justified in spending the rather considerable sums of money without which light soils cannot be successfully managed.

We can now leave these light soils and pass to the opposite extreme—the heavy clay soils. These suffer from the fundamental defect that the clay easily deflocculates and assumes a sticky, pasty condition when wet, and a hard, lumpy condition when dry. In spite of a good deal of laboratory work, deflocculation is not well understood; it is known, however, to be a special case of a very general phenomenon—flocculation of suspended colloids—and it will presumably succumb to treatment when the general problem is solved. Important advances have been made in the last few years by Perrin, and it would be interesting to apply his methods to clay.

For the time being the only feasible method of flocculating clay is to add lime or chalk, but experience shows that liming and chalking must be accompanied by drainage to be a complete success. Any attempt to improve crop production on heavy lands involves these as the first steps.

Where clay soils are drained and limed it is possible to begin to do something with them. Wheat, beans, mangolds, cabbages, and grass can all be produced. But, when all is said and done, clays still suffer from two disadvantages: they are only suited to a limited number of crops, and they are difficult to cultivate. The land may be too hard in autumn to be ploughed for winter corn; too wet in winter to be ploughed for spring corn; and too dry in spring to be prepared for mangolds. There are times in between when something can be done, but only the man who is skilful enough to take full advantage of these intervals has any hope of success. Most men, therefore, prefer not to run the risk of cultivation, and lay the land down to permanent grass.

There are two directions in which the risk can be reduced, though it will still remain a serious factor.

The great difficulty of cultivation arises largely from the circumstance that only on a relatively small number of days are both soil and weather suitable for ploughing. The result is that much of the work is left until late, and late work tends to be bad work. This can only be overcome by speeding up the process of ploughing during the favourable opportunities, and so far as I can see this is only possible by the use of motors. I believe, therefore, that motor-ploughs and cultivating implements will play a considerable part in the improvement of heavy land.

A second direction in which the risk can be reduced is by keeping up the supply of organic matter in the soil. Probably the cheapest and most satisfactory way of doing this is by ploughing in crop residues, such as, for example, are left by a seeds mixture, a clover ley, or ploughed-up grass-land.

Once these great fundamental things have received attention, all these soils—loams, sands, and clays—can be further improved by proper treatment with fertilisers. A great deal of good work has been done on this subject, and the results are steadily being diffused among farmers.

In most field experiments there is no indication of any end-point, and apparently the more the crop is fed the larger would be the yield. But the process does come to an end. The final limit is reached by the inability of the plant to stand up any longer or to grow any bigger. When the corn-crop gets beyond a certain size it is almost invariably beaten down by the wind and rain, so that the difficulty of getting it in becomes considerable. Heavy dressings of nitrogenous manures also predispose the crop to fungoid disease, attacks apparently being facilitated by the thinning of the cell-walls and the change in composition of the cell-sap.

The way for further progress is then to seek new varieties that can stand up and resist disease. And here a good deal has been done. Biffen has shown how desirable properties may be transferred from one wheat to another, and his investigations are revealing the limits within which it is possible to construct a variety of wheat according to the grower's specification. Similar work is badly wanted for other crops. Fortunately our great seedsmen are fully alive to the possibilities in this direction, and have already done much useful work. It is not only in the case of cereals and potatoes that new varieties can be sought; there is great scope also for new varieties of all other crops.

But there is another way in which science can further the problems of crop-production. Instead of aiming solely at increased yields per acre, attempts may be made to reduce the cost and increase the certainty of production per acre.

One of the most hopeful ways of attacking this problem is to increase the efficiency of the manurial treatment. No manurial scheme is perfect; no farmer ever recovers in his crop the whole of the fertilising constituents applied to the soil; there is always a loss. In our Broadbalk experiments, where wheat is grown year after year on the same land and large dressings of artificials are used, we do not recover in the crop more than about 30 to 40 per cent. of the added nitrogen.

Now, whilst we can never hope for perfect efficiency, *i.e.* for 100 per cent. recovery, we can hope to do better than this. On our own fields we improve considerably on it every year by the adoption of a proper rotation.

Further experiments on the relationship between the efficiency of fertiliser action and the rotation are very desirable.

Another great direction in which economy is possible is in the management of farmyard manure. It has been a common complaint against agricultural investigators that they have concerned themselves exclusively with artificials, and left untouched the greater problem of the manure-heap. For farmyard manure is the staple manure of the countryside, about 37 million tons being made per annum in this country. The value at 5*s.* per ton is 9,250,000*l.*; all the artificial manures consumed in Great Britain probably do not much exceed 6,500,000*l.* in value each year.

Through the generosity of the Hon. Rupert Guinness we have been able at Rothamsted to attack this important subject, and Mr. Richards has obtained some striking results, showing what losses may take place and indicating methods of avoiding them.

Another direction in which saving is possible is in the soil itself. It is now forty-six years since Lawes and Gilbert built those remarkable drain gauges at Rothamsted which for the first time enabled chemists to determine precisely the quantity of fertilising material washed out from the soil by rain. When there was no crop on the ground the soil lost by drainage about 40 lb. of nitrogen in the form of valuable nitrates, a quantity as great as is contained in a 24-lb. bushel crop of wheat.

It appears that this wastage of nitrates in winter can be greatly reduced, but the process requires suitable crops and rapid cultivation methods. Neither of these ought to be beyond the power of the agriculturist to provide. The possibilities are many. Wibberley has discussed several schemes of continuous cropping that satisfy these requirements, giving a succession of crops which cover the land at the critical time when losses would occur. And our implement-makers are steadily increasing the number and effectiveness of the implements, while motor traction promises also to increase the speed of working.

A further direction in which improvement is possible is in cultivation. Reference has already been made to the necessity for increasing the speed of ploughing so as to get the work forward and enable the farmer to plough just as much as he likes in autumn, or, if he wishes, to get in a bastard fallow or a catch-crop. The motor-plough seems the only solution, and as soon as the difficulties of engine construction are got over and the price becomes sufficiently low, I think it must displace the horse-plough as inevitably as the railway displaced the stage-coach. Both the soil and the human factors tend this way. So long as a man and two horses, and in some parts of the country a man and a boy and three horses, can only manage to plough an acre a day, it is obvious that the farmer cannot afford to pay more than a small wage for the work; but when a man on a motor-plough can do se[illegible] acres a day a considerably higher wage becomes possible.

The last economy to which I shall refer is the choice of crops. The farmer grows his crops for profit, and clearly ought to select the most profitable for the purpose. This can only be done by keeping accounts. No crop ought to be grown that does not pay its way; it should be displaced by one that does. On our own farm we find that wheat, oats, and barley are about equally profitable; but the crops in the root- or fallow-break vary enormously—potatoes bringing in most profit, while swedes, on the other hand, are invariably grown at a loss on our land. I believe this would be found not uncommon in the southern part of England. Amos and Oldershaw have recently gone into the cost of silage crops in these conditions. More experiments and inquiries are greatly needed to widen the range of this class of crops, and give us something that will be as useful as swedes but more profitable.

Besides these improvements in crop-production which affect all farmers, even the best, there are two other ways in which we can hope for further developments.

One is to raise up the ordinary farmer to the level of the good one. The average crop of wheat for the country is officially reported to be 32 bushels, but no good farmer would be content with less than 40. If we accept the official average there must be a good amount of wheat grown at much less than the best that is possible even now. A vast amount of educational work has to be done to spread the knowledge of the best methods, varieties, manures, etc.

The other is to extend the area of land under cultivation. There are still wastes to be reclaimed, as Mr. Hall is reminding us, while even on farmed land the proportion under the plough each year is only small, and is constantly decreasing. Grass-land only produces about one-half of what arable-land yields, and it is imperative to the proper development of the country that some of it should be broken up. The farmer knows this, but he does not put his knowledge into practice. He cannot always afford the risk. There is a fundamental distinction between farming and manufacturing that is often overlooked in discussions on the subject. Except in rare cases—sugar beet and some kinds of seeds—the farmer does not grow for contracts, but always for what manufacturers would call "stock." The manufacturer makes a contract to supply certain goods at a certain price; he knows what his machinery will do, he can insure against many of his risks, and get out of the contract if others befall him. He knows to a penny how much he will be paid, and so he can calculate to a nicety how much he can afford to spend, and how far he can go in introducing new methods. Now the farmer cannot do this. He cannot be certain what yield or what price he will get. He starts spending money in August on a crop that will not be sold for fifteen months, and he has no idea how much money he will receive in return. The whole thing is a hazard which cannot be covered by insurance. Obviously, then, the farmer must leave a big margin for safety, so he balances his risks by laying down some of his land to grass, where the risks are at a minimum. But when you ask him to intensify his methods, and, as a necessary corollary, to break up some of his grass-land, he has a perfect right to ask who is going to bear the extra risk.

The problem has been burked in the past, but must be faced in the future. It is essentially a question of distribution of risk, and it ought not to be beyond the political insight and economic wisdom of those whose business it is to settle these matters.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Sheffield.—Dr. W. E. S. Turner has been appointed lecturer in charge of the new department of glass technology. Mr. G. A. Birkett, formerly of the University of Liverpool, has been appointed to the new Vickers lectureship in Russian. A permanent appointment is deferred until the conclusion of the war.

The council has nominated Mr. A. J. Hobson, J.P., to be a pro-chancellor of the University in succession to the late Sir George Franklin.

Miss H. de Pennington, assistant lecturer in chemistry at the Blackburn Technical School, has been appointed research assistant to Prof. J. B. Cohen at the University of Leeds.

We learn from the *Münchener Medizin. Wochenschrift* that the medical faculty of the University of Göttingen has received two legacies, each of 10,000 marks, under the wills of the late Prof. von Esmarck and of the late Prof. Paul Ehrlich, of Frankfurt. The money will form a fund for assisting needy medical students.

In connection with the present campaign for the preservation of infant and child life, the governing body of the Battersea Polytechnic has arranged for a public lecture to be given by Dr. C. W. Saleeby. The lecture will be entitled "The Saving of the Future," and will be held at the Battersea Polytechnic, Battersea Park Road, S.W., on Thursday, December 7, at 7.30 p.m. No tickets of admission are required.

The fifth annual Conference of Educational Associations is to be held in the University of London on January 1–6 next. The inaugural address is to be delivered on January 1 at 3 p.m. by Mr. A. L. Smith, master of Balliol. Among the associations taking part in the conference this year are the School Nature Study Union, the Child Study Union, the Committee for the Development of Regional Survey, the Association of Science Teachers, and the National Association for Manual Training. Among the large number of addresses arranged for may be mentioned the following:—The possible educational value of kinemas, by

Prof. R. A. Gregory; the response of plants to light, by Dr. Harold Wager; nitrates from the air, by Mr. E. K. Scott; and handwork as character training, by Mr. A. H. Angus and Dr. P. B. Ballard. Full particulars of the arrangements can be obtained from the conference secretary, Mr. Frank Fairman, 9 Brunswick Square, London, W.C.

LORD MILNER presided at a lecture on November 22 at King's College, by Dr. Fisher, Vice-Chancellor of the University of Sheffield, on "The Intellectual Groundwork of Politics." In moving a vote of thanks to Dr. Fisher, Lord Milner referred to recent discussions on the place which science should occupy in the school curriculum. He expressed the opinion that the great progress which the human race has made in recent times has given such an enormous importance to applied science that a man is now scarcely at home with the problems of the day—certainly not with the economic questions—without some knowledge of the sciences, and consequently not fully able to master the political problems which depend upon them. The training in physical science is not, he said, so much book learning as actual science and practical acquaintance with some form of science. Whatever the effort, an important share in the educational life of every boy and young man in future should be to bring him into close relation with the great achievements of science. That he believes is essential, and as important to men who are going to devote themselves to a political career as to men who are going to devote themselves either to scientific research or to the pursuit of some business which largely depends on the results of science.

A LECTURE delivered at Stellenbosch, by Prof. S. J. Shand, of Victoria College, on the occasion of the passing of the University of Stellenbosch Act, is published in the Stellenbosch *Students' Quarterly* for June last. Prof. Shand took as his subject the making of a university, and drew distinctions between colleges and universities. The aim of college teaching, he said, is the imparting of existing knowledge with the specific object of enabling a man to pass certain tests and to satisfy necessary conditions in order that he may advance his prospects in life. The only aim of a university, he urged, is, or ought to be, the advancement of learning in the widest sense. When a professor does not work at his subject and is content merely to teach it, he may find a useful place in a school or college, but there is no room for him in a university. It is perhaps, Prof. Shand continued, the most serious charge that can be brought against the South African colleges that they have done nothing to encourage research and discovery. It should be the business of the newly constituted universities to remedy this state of affairs by recognising that the advancement of knowledge is the most important service they owe to the State. It should be insisted upon, therefore, that the professors shall not be regarded simply as teachers; their business is the advancement of knowledge no less than the spreading of it, and that this object may be pursued they must not be too much burdened with formal teaching.

THE council of the Institution of Naval Architects offers for competition the "Martell Scholarship in Naval Architecture" of the annual value of 100*l*., and tenable for three years. Candidates must forward a written application to the secretary of the institution, 5 Adelphi Terrace, W.C., by January 15, 1917. They must not be less than eighteen or more than twenty-one years of age on March 1, 1917, and must at that date have been continuously employed for at least two years upon naval architecture or marine engineering. The scholarship will be awarded in connection with the competitive examinations for scholarships held by the Board of Education next May and June, in the following subjects:—Naval architecture, pure mathematics, applied mechanics (materials and structures), and either machines and hydraulics or heat engines. Candidates will be required to furnish by January 15 next evidence that they have passed some literary test in English. If a candidate can produce similar evidence of a knowledge of French, German, or Spanish, credit will be given for such knowledge. Successful candidates will be required to undergo a three years' course of study in naval architecture in a college approved by the council, and this course will be combined with practical training in a shipyard or marine engine works. The council of the institution administers other scholarships which are offered for competition among students of the institution, particulars concerning which may be obtained from the secretary.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 10.—Prof. C. V. Boys, president, in the chair.—B. W. **Clack**: Diffusion in liquids. The paper contains the results of the experiments described by the author in Proc. Phys. Soc. Lond., xxi., p. 374, 1908; xxiv., p. 40, 1911; and xxvii., p. 56, 1914, collected and recalculated in accordance with a theoretical correction recently communicated by Dr. Griffiths (Proc. Phys. Soc., xxviii., p. 255, 1916). It is found that in the solutions employed the correction is not considerable, except in the case of the strongest solutions of KCl (2·7 normal), where it amounts to 6 per cent. The paper contains the corrected theory of the method, and the value of the coefficient of diffusion is tabulated at different limiting concentrations and at various temperatures.—Prof. H. **Nagaoka**: The regularity in the distribution of the satellites of spectrum lines, with a note on the structure of the green line of mercury, and terms of correction in using a concave grating. The paper describes a further development of the work done by the author and Mr. Takamine on the distribution of the satellites of the mercury lines. It is shown that much of the discord between the results of various observers of these satellites is due to the unsatisfactory nature of the principal line as a datum from which to define their positions, and that if the distances be measured from one of the distinct satellites good agreement is obtained. If these separations be expressed as differences of wave-number, instead of wave-length, a remarkable symmetry in their distribution becomes apparent. For example, among the satellites of the green line, 5461, can be found three groups of symmetrical triplets, of which the wave-number differences are in the simple ratios 1 : 3 : 12. Similar results are obtained for other lines, the principal component of λ 4359 being shown for the first time to consist of a triplet, of which the middle component is relatively weak. A similarity in the distribution of the satellites exists for all the lines examined, and certain wave-number intervals are common to all.

CAMBRIDGE.

Philosophical Society, November 13.—Dr. Marr, president, in the chair.—Prof. **Wood**: The surface law of heat loss in animals. Figures expressing in pounds of starch equivalent a number of successful and economical rations for fattening cattle were shown within the limits of error of experiment to fall on a curve expressing the theoretical food requirements calculated according to Rubner's surface law for live-weights varying from 80 lb. to 1400 lb.—Prof. **Punnett** and Capt. P. G. **Bailey**: Inheritance of henny plumage in cocks. Experiments on the inheritance of henny feathering in cocks were begun in 1910, the original cross being between a gold-pencilled Hamburgh cock and a silver Sebright hen. Both cock-feathered and hen-feathered male offspring resulted from this cross, and the later work has shown that hen-feathering in the male behaves as a dominant character which can be transmitted by either sex.—Dr. **Marshall** and K. J. J. **Mackenzie**: Extra mammary glands and the reabsorption of milk sugar. The authors observed that the shape of the udder has been held for some considerable time to be correlated with capacity for milk production in the cow. In three cases examined in which supernumerary glands were in a state of apparently complete functional activity (the milk not being withdrawn from them) there was proof of the occurrence of reabsorption of milk sugar, since such could be detected in the urine, in one instance in very considerable quantity, and in the middle of the lactation period.—A. **Amos**: Experimental work on clover sickness. In the past "clover sickness" has been ascribed to a variety of causes, *e.g.* exhaustion of plant food, production of toxic substances, lack of lime, plant diseases. Under present conditions in England "clover sickness" is due in most cases to one of two plant diseases: eelworm (*Tylenchus devastatrix*), clover rot (*Sclerotinia trifoliorum*). Observations on life-history of *Sclerotinia trifoliorum*:—*First Appearance on Clover.*—As early as October, or as late as January. *Active Growing Period.*—From date of appearance until mid-April, especially during moist, dewy weather. Slow growth may be continued through the summer. *Formation of Sclerotia.*—To a small extent on stems during winter months; chiefly on dead roots in April and May. *Germination of Sclerotia.*—In October after ground is cooled and moistened by first autumn rains. To a less extent in November, and one case recorded on May 3. *Depth of Germination of Sclerotia.*—The Sclerotia germinates more freely on or near the surface than when buried one inch. *Distribution of Spores.*—The ascospores, formed in the apothecia, are shot into the air and carried by wind. *Other Hosts.*—By infection: Beans, peas, alsike, lucerne, white clover, trefoil, sainfoin. By observation in the field: Beans, alsike, lucerne, trefoil, sainfoin. *Methods of Control.*—Avoid growing two clover crops in quick succession. Other methods of control are being tested.—G. N. **Watson**: Bessel's functions of equal order and argument.

PETROGRAD.

Imperial Academy of Sciences, October 1.—O. **Backlund**: Chandler's period of variation of latitude.—A. **Krištafovič**: Some Chinese forms in the Sarmatian flora of South Russia.—E. F. **Liskun**: The meat problem under existing economic conditions.—R. E. **Regel**: The mushroom fungus industry. The value of beardless barley as horse fodder.—B. P. **Gerasimovič**: The two groups of helium stars.—S. K. **Kostinskij**: The probable motions in the spiral nebula of Canes Venaticorum observed with the stereocomparator.—B. N. **Gorodkov**: Biological study of *Pinus sibirica*, Mayr, in East Siberia.—S. S. **Ganešin**: Contributions to the flora of the Government of Irkutsk.—P. N. **Cirvinskij**: Quantitative chemical composition of the pallasites and the application to them of Avogadro's law.—E. **Burkser**: The radio-activity of the lakes and springs of South Russia.—P. **Zemiatčenskij**: The absorptive capacity of Russian clays. Part i. Experimental.—V. **Mokrinskij**: Geology of the Kerč Peninsula. The sulphur deposit of Čekur-Kojaš (Crimea).—V. M. **Rylov**: Contributions to the fauna of the free fresh-water Copepodes of North Russia.—Vl. N. **Šnitnikov**: Itineraries of the excursions in the province of Semirěčie from 1907–15.—N. N. **Adelung**: Contributions to the knowledge of Palæarctic Blattoides. I. Genus Ectobius, Steph. General considerations: new forms of western Europe.—I. A. **Smorodincev**: The organic bases of pork.—B. P. **Babkin**: The natural chemical stimulants of the movements of the small intestines.—I. S. **Plotnikov**: The addition of bromine to non-saturated hydrocarbons under the influence of light.

October 15.—E. S. **Fedorov**: Systems of planigons as technical isohedra in the plane.—G. A. **Tichov**: New researches on the problem of the cosmic dispersion of light.—N. N. **Kalitin**: The variable RT Persei.—N. N. **Monteverde**: Development and present state of the medicinal plant industry in the Poltava Government.—Ja. V. **Samoilov**: Sources of pyrites in Russia.—F. A. **Satsyperov**: Russia's medicinal plants.—S. F. **Žemčužnij**: Preparation and properties of pure platinum.—K. A. **Flaksberg**: Russia's wheats.—E. **Miakinen**: The discovery of some rare chemical elements in Finland.—E. D. **Revutska**: Russian sources of Iceland spar.—V. I. **Vernadskij**: Notes on the distribution of the chemical elements in the earth's crust. VII. Bismuth.—V. I. **Vernadskij**: The simple relations found by Prof. Moureu between certain natural gases.—O. O. **Backlund**: Scapolite from the river Kanda.—K. I. **Skriabin**: Materials for a monograph on avian Nematodes.—D. **Rubinstein**: Note on the Sagittæ of the Black Sea.—A. N. **Kiričenko**: Notes on some Reduviidæ (Hemiptera-Heteroptera).—P. I. **Valden**: Sir William Ramsay.

PARIS.

Academy of Sciences, November 13.—M. Camille Jordan in the chair.—The President announced the death of Oscar Backlund, correspondant in the section of astronomy.—G. **Bigourdan**: An old observation of an eclipse of the sun, made at Paris in 1630. A reproduction of a manuscript found in the National Library. It is anonymous, but is probably due to Gassendi.—C. **Guichard**: Triple orthogonal systems such that a system of Lamé curves may be formed of spherical lines, the centres of the spheres which contain them being on a sphere, or a paraboloid, of revolution.—W. **Kilian** and J. **Révil**: The breccias (conglomerates) of Tarentaise.—G. **Vasseur**: (Posthumous note.) Discovery of remains of Anthracotherium in the Sannoisian formations of the basin of Aix-en-Provence.—L. **Hartmann**: Systematic variation of the value of the kinetic energy in the elastic shock of bodies.—R. **Guillery**: A new system of transmission by a ball joint. The new joint, described and illustrated, gives a flexible transmission, and is economical in construction, as except for one pair of faces rough castings can be utilised.—E. **Belot**: The exponential law of the distances of the planets and satellites. New approximations.—H. **Bordier** and G. **Roy**: Colloidal iodine. In an earlier paper it has been shown that certain characters of solutions of iodine in water indicate that the iodine is in the colloidal state. The amount in solution is too small for the cryoscopic method to give decisive information. Experiments with the ultra-microscope lead to the conclusion that iodine in pure water is in the colloidal state, but in the form of granules too small to be seen with the ultra-microscope. In the presence of gelatin larger particles, visible in the instrument, are formed.—M. **Molliard**: The catalytic action of potassium nitrate in the alcoholic fermentation produced by *Sterigmatocystis nigra*. The presence of the nitrate prolongs the alcoholic fermentation and gives an increased yield of alcohol. The proportion exerting the maximum effect is much less than with yeasts, 4 per 1000 instead of 50 per 1000.—F. **Vincens**: The development and structure of the perithecium of a Melanospora.—A. **Piédallu**: The acclimatisation in France of a rapidly growing tannin plant, the Canaigre (*Rumex hymenosepalum*). This plant comes from Arizona and the neighbouring regions, and gives tubercles containing 28 to 30 per cent. of tannin. It has been proved to develop naturally in France, and survives the winter. It is rapid in growth, and should prove a valuable source of tanning material. Field cultivation experiments will be carried out. M. **Caullery** and F. **Mesnil**: Viviparity and parthenogenesis in the polychetal Annelids; a new viviparous Syllidian, *Ehlersia nepiotoca*.—P. **Bonnier**: Enteritis.

BOOKS RECEIVED.

Fatigue Study: The Elimination of Humanity's Greatest Unnecessary Waste. By F. B. Gilbreth and Dr. L. M. Gilbreth. Pp. 159+Figs. 33. (London: G. Routledge and Sons, Ltd.) 6s. net.

An Elementary Grammar of the Ibo Language. By Rev. J. Spencer. Third edition, revised by T. J. Dennis. Pp. x+116 (London: S.P.C.K.) 10d.

The Rain-Children: A Fairy-Tale in Physics. By T. H. Orpen. Pp. 112. (London: S.P.C.K.) 2s. 6d.

Guida Pratica del Meccanico Moderno. By A. Massenz. Pp. xxiv+351. (Milano: U. Hoepli.) 4.50 lire.

Tempera e Cementazione dell' Acciaio. By M. Levi-Malvano. Pp. xii+261. (Milano: U. Hoepli.) 4 lire.

Proceedings of the Royal Society of Edinburgh. Session 1915–16. Parts i. and ii. Vol. xxxvi. Pp. 192. (Edinburgh: R. Grant and Son.) 11s.

Bacon's Large Scale Map of the French Battle Front (Peronne to Verdun). (London: G. W. Bacon and Co., Ltd.) 1s. net.

British Birds. By A. Thorburn. Vol. iv. Pp. vii+107+plates 61–80. (London: Longmans and Co.) Four vols., 6l. 6s. net.

University of London. University College. Abridged Calendar. Session MDCCCCXVI.–MDCCCCXVII. Pp. cxviii+272. (London: Taylor and Francis.)

Cambridge Botanical Handbooks. Algæ. Vol. i. By Prof. G. S. West. Pp. x+475. (Cambridge: At the University Press.) 25s. net.

Twenty-ninth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1907–1908. Pp. 636. (Washington: Government Printing Office.)

Thirtieth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1908–1909. Pp. 453. (Washington: Government Printing Office.)

Differential and Integral Calculus. By Dr. C. E. Love. Pp. xviii+343. (London: Macmillan and Co., Ltd.) 9s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 30.

LINNEAN SOCIETY, at 5.—(1) The Floral Anatomy of some Compositæ; (2) Demonstration on the Force for Dispersal of Fruits: J. Small.—A Note on the Seed of *Iris pseudacorus*, Linn.: T. A. Dymes.

SATURDAY, DECEMBER 2.

GEOLOGISTS' ASSOCIATION, at 3.—The Palæoliths of Farnham: H. Bury.
SELBORNE SOCIETY, at 5.30.—Russian Ideals and Potentialities; Baron Alphonse Heyking.

MONDAY, DECEMBER 4.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Kansu Marches of Tibet: R. Farrer.
ARISTOTELIAN SOCIETY, at 8.—The Function of the State in Promoting the Unity of Mankind: Dr. B. Bosanquet.
ROYAL SOCIETY OF ARTS, at 5.—Coal and its Economic Utilisation: Prof. J. S. S. Brame.

TUESDAY, DECEMBER 5.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Keadby Bridge (*Discussion*): J. B. Ball.—Experiments on Earth-pressures: P. M. Crosthwaite.
RÖNTGEN SOCIETY, at 8.15.—Some Remarks upon Pastilles: Dr. Levy and Mr. Stenning.

WEDNESDAY, DECEMBER 6.

ENTOMOLOGICAL SOCIETY, at 8.—Descriptions of South American Micro-Lepidoptera: E. Meyrick.
SOCIETY OF PUBLIC ANALYSTS, at 8.—Copying-Ink Pencils and the Examination of their Pigment in Writing: C. A. Mitchell.—Brazilian Oil Seeds: E. R. Bolton and Dorothy G. Hewer.
ROYAL SOCIETY OF ARTS, at 4.30.—The Coal tar Colour Industry: C. M. Whittaker.
GEOLOGICAL SOCIETY, at 5.30.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Cytomorphosis of the Marsupial Enamel-organ and its Significance in Relation to the Structure of the Completed Enamel: J. T. Carter.—The Development of the Pancreas, the Pancreatic and Hepatic Ducts in *Trichosurus vulpecula*: Margaret Tribe.—The Fossil Human Skull found at Talgai, Queensland: S. A. Smith.—The Typical Form of the Cochlea and its Variations: H. J. Watt.—The Structure and Biology of Archotermopsis, together with Descriptions of New Species of Intestinal Protozoa, and General Observations on the Isoptera: Dr. A. D. Imms.
CHILD STUDY SOCIETY, at 6.—Psycho-analysis in Relation to Children: Dr. Constance E. Long.
CHEMICAL SOCIETY, at 8.—Spinacidene: A New Hydrocarbon from certain Fish-Liver Oils: A. Chaston Chapman.—The Nitration of 2-acetylamino-3:4-dimethoxybenzoic acid and 3-acetylamino-1:2-dimethoxybenzene: C. S. Gibson, J. L. Simonsen, and M. G. Rau.

FRIDAY, DECEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.
MALACOLOGICAL SOCIETY, at 7.—A Revision of the Species of the Family Pleurotomidæ occurring in the Persian Gulf, Gulf of Oman, and Arabian Sea: Dr. J. Cosmo Melvill.—The Occurrence in England of *Helicella neglecta*: A. S. Kennard and B. B. Woodward, with Notes on the Anatomy by Dr. A. E. Boycott, and on the Radula by the Rev. E. W. Bowell.—The Occurrence of *Eulota fruticum* in a Living State in Kent: A. S. Kennard and B. B. Woodward.

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

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THURSDAY, DECEMBER 7, 1916.

ALTERNATING ELECTRIC CURRENTS.

(1) *The Principles of Electrical Engineering and their Application.* By Prof. Gisbert Kapp. Vol. i. Pp. xii+356. (London: Edward Arnold, 1916.) Price 18*s*. net.

(2) *A Treatise on the Theory of Alternating Currents.* By Dr. Alexander Russell. Vol. ii. Second edition. Pp. xiv+566. (Cambridge: At the University Press.) Price 15*s*. net.

(3) *Alternating Currents in Theory and Practice.* By W. H. N. James. (Cambridge Technical Series.) Pp. vii+353. (Cambridge: At the University Press, 1916.) Price 10*s*. 6*d*. net.

THE progress of electrical knowledge and invention is so rapid and the ground covered so extensive that the trend of its literature is for the most part in the direction of books or monographs on special departments of it written by experts. On the other hand, as the existing complete treatises become antiquated or too bulky by additions, the necessity arises for rewriting the subject from a more modern point of view.

(1) The aim of Prof. Kapp's book, the first volume of which is before us, is to furnish the engineering student with a couple of volumes wherein the principles and modern practice of electrical engineering are treated compactly, yet completely, with reference to the needs of the engineer rather than to those of the physicist. Although, for the sake of distinction, we divide engineering into various branches, engineers of all kinds are constantly called upon to use applied electricity in various ways. Thus, a mechanical engineer may have to put up a three-phase motor to work a pump, or a civil engineer may have to lay out an electric tramway system. Hence no one practising any branch of engineering can afford to be ignorant of the principles and methods of electrical engineering. A very commendable feature of Prof. Kapp's book is that the purely mathematical aspect of the subject is kept well under restraint. Such mathematics as is used rarely goes beyond simple algebra or a simple differentiation or integration. This is a distinct advantage, as most engineering students are rather repelled by a book which bristles with mathematical symbols. Again, the verbal explanations are clear and terse, whilst the diagrams have a refreshing air of originality and have not done duty in other books.

The volume under review deals with general principles, and is divided into fifteen chapters. The first six comprise the discussion of electric conduction and resistance, its measurement, and the electrical measurement of current and voltage generally. It would have been better if the connections of the two types of plug Wheatstone's bridge, viz. the series and dial patterns, had been more fully illustrated and described. In the description on p. 20 of the "Thompson double bridge" the name should be "Thomson," as the late Lord Kelvin was, prior to his peerage, Sir William Thomson. The name is correctly spelt in a previous section on the Thomson-Varley bridge.

The chapter on potentiometric measurements contains much useful information. It seems, however, to be forgotten that the writer of this review was the first person to suggest "setting the potentiometer" by means of a standard cell of known voltage and a divided potentiometer wire, so as to make it a direct-reading instrument. Curiously enough, this method was first described by the writer in a now extinct paper called *Industries* in July and August, 1886, which at that time was edited by Prof. Kapp.

In the section on standard cells (p. 31) the name "Carhard" is a misprint for "Carhart."

Chap. v., on the distribution of continuous currents, contains some valuable information not commonly given in text-books. The analogy between an electric main tapped off at various intervals and a beam loaded at intervals with weights is very instructive, and the application of the same graphical method of solution is suggestive.

Chap. vii. introduces the reader to the principles of electrostatics, and although there is nothing of the nature of great novelty in it, the facts are well set out. Prof. Kapp defines the electrical capacity as the quotient of charge and potential difference. We think that the definition is better given in the form that the capacity is measured by the charge required to raise the conductor to unit potential when all other surrounding conductors are at zero potential.

In some of the formulæ given for capacities the student may perhaps be puzzled by the custom of writing *ln* for $\log_e$ or the natural logarithm, and *lg* for $\log_{10}$, especially when the letter l appears, as in formula 66 on p. 116, in the same expression for the length of the conductor. Also the decision to employ ϵ for the dielectric constant is not a happy one. This Greek letter has for ages past been consecrated to denote the base of the Napierian logarithms, viz. 2·71828, etc.

Chap. viii., on applied electrostatics, contains much valuable matter of a practical kind, especially on the subject of cable insulation. Chaps. ix. and x. deal with the subject of magnetism and electromagnetism in an interesting manner. There is on p. 162 another little misprint in a proper name in a reference to "Hatfield's" manganese steel. This should, of course, be "Hadfield." Chap. xi. covers elementary electrodynamics, and the information given is kept well in touch with practice, as, for instance, in the remarks on p. 223 on the method of reducing the time constant of motor field circuits. On p. 208, second line, "Lenze's law" should be "Lenz's law."

The last chapter, xv., discusses alternating currents, and gives in compact form most of the necessary information. Altogether the book is one which can be strongly recommended, and we shall look forward with interest to the second volume as likely to contain much of great value

P

drawn from Prof. Kapp's large practical experience in electrical engineering. The printing and get-up of the book are all that could be desired.

(2) Dr. Alexander Russell's book is of a more theoretical and mathematical character, and is the second edition of the second volume of a treatise on the theory of alternating currents. It appeals therefore to an advanced student or designer who is not averse to full mathematical treatment. A valuable feature of the book is the list of references to other works and papers given at the end of each chapter. The book consists of twenty chapters, covering the full theory of alternators, transformers, induction motors, commutator motors, rotary converters, and electric power transmission by alternating currents. Chap. iii. comprises a very complete discussion of Fourier's theorem and the practical methods of determining the constants in the Fourier expansion. Although chiefly of interest to the pure mathematician, the electrical engineer has frequently occasion to enter this field of analysis. Nevertheless, if much of it has to be done, as in the analysis of tidal curves, then some mechanical means, such as Lord Kelvin's harmonic analyser, would be used.

A very important application of pure mathematics is dealt with in chap. xix., viz. the discussion of the properties of hyperbolic functions and their application in the problem of the long-distance alternating-current power transmission. No electrical engineer concerned with this subject can afford to be ignorant of these modern methods.

Chap. xiv gives a good account of the general theory of induction motors, and chap. xvi of the commutator motor. In this connection we confess we should like to have seen included the theory of Goldschmidt's frequency-raising alternator, now of importance in wireless telegraphy. It has been treated by Pupin as a particular case of asymmetrical rotors in unidirectional magnetic fields. Also another subject of interest in close connection is the use of pairs of static transformers for raising frequency by means of unsymmetrical flux in the cores. The question of the efficiency of this method of frequency raising needs discussion.

It would have been an advantage to include some general description of extra high frequency alternators, such as those of Alexanderson and the method of frequency raising by alternators in cascade suggested by MM. Latour and Béthenod. Nevertheless, the book as it is is a work of the greatest value to all concerned with alternating-current working, and no advanced student should neglect it.

(3) The third book on our list is of a less ambitious type, but is intended to provide within very moderate compass for the needs of students in universities and technical colleges whose mathematical knowledge is of restricted range. To each chapter is appended a series of examination questions and numerical examples, with the answers in many cases added. The diagrams and illustrations are in most cases new and well selected.

The chapter on switchgear and protective appliances for high-tension transmission is a particularly useful one, and the diagrams are extremely instructive. The plates at the end showing the modern types of switchgear and panels for handling large currents are valuable.

The book strikes us as very well adapted for second-year students in the electrical engineering departments of our colleges, and as a text-book, from its moderate size and yet thoroughly practical character, it will be popular. It is one of the excellent books in the Cambridge Technical Series edited by Mr. P. Abbott, and the fact that it is printed at the Cambridge University Press is a sufficient assurance that its typography and illustrations are of the very best.

J. A. FLEMING.

THE INFLUENCE OF INTERNAL SECRETIONS ON SEX CHARACTERISTICS.

The Sex Complex: A Study of the Relationships of the Internal Secretions to the Female Characteristics and Functions in Health and Disease. By Dr. W. B. Bell. Pp. xvii+233. (London: Baillière, Tindall and Cox, 1916.) Price 12*s*. 6*d*. net.

DR. BLAIR BELL belongs to that limited group of medical men who resort to the experimental laboratory to extend and verify their means of diagnosis and treatment of clinical conditions. He has given us, under the title "The Sex Complex," observations made in the course of a prolonged inquiry into the nature of the secondary sexual characters of the human body—more particularly the normal and abnormal manifestations of sex in woman. His work will appeal to all who are trying to unravel the obscure and delicate manner in which the sexual system is developed and balanced. From prehistoric times mankind has been familiar with the effects of castration; the effects which followed that operation gave rise to the belief that the sexual characteristics of the male, both mental and bodily, were determined by the testes, while, conversely, feminine characters depended on the ovaries.

The chief aim which Dr. Blair Bell has in view in his present work is to prove that sexual characterisation is the manifestation of a complex glandular system of which the sex-glands form only a part—a system which includes all the glands of internal secretion—the pituitary, the pineal, the thyroid and parathyroids—the thymus, and suprarenal bodies. The normal development of male and female characters depends on the interaction and co-operation of all the members of this complex glandular system; it is in a disturbance of the balance of the various members of the glandular system that Dr. Blair Bell seeks for a rational explanation of the sexual disorders to which so many modern women are liable. Beyond doubt the method of investigation which the author has adopted is one which promises a scientific basis of treatment for disorders which are as common as they are obscure.

For a number of years we have possessed definite evidence that the pituitary gland plays a part in the maintenance of sexual life and in the production of the sexual characters of the body. Dr. Blair Bell has carried out a prolonged series of experiments on the pituitary body. His most definite results were obtained by compressing or cutting the stalk of the pituitary gland; in such cases the dogs operated on manifested all those characters which clinicians are familiar with in certain patients. Sexual appetite is lost; the genital glands atrophy; there is an abundant deposit of fat all over the body; the bones become long and slender. He also places on record the notes of a very instructive case—that of a young woman who began to develop certain male characters in face and voice. It was found that her ovaries were of a complex type; in their cortex were true ova, situated in normal follicles; in the centre of the ovaries the tissue assumed a testicular structure, although spermatozoa were not present. It is the examination of such cases which shows how complex are the factors which go to the differentiation of sex. Dr. Blair Bell emphasises the influence of the glandular products on the mental life of the individual. His final conclusion is: *Propter secretiones internas totas mulier est quod est.*

VIGNETTES OF FRIENDS.

Memories. By Edward Clodd. Pp. xi+288. (London: Chapman and Hall, Ltd., 1916.) Price 10s. 6d. net.

MR. CLODD is well known to readers of NATURE as one who has most successfully introduced the discoveries and generalisations of various departments of science to innumerable readers—old and young. In the course of a long and active life he has made friends with a remarkable number of noteworthy people, being richly endowed with the "genius for friendship." One has only to look through the table of contents of his "Memories" to see how the sympathy of the author reaches out to very diverse types, and there is scarcely a name on the list which does not stand for pre-eminence in literature, art, or science. There are constant references to the pleasant Whitsuntide gatherings under Mr. Clodd's hospitable roof at Aldeburgh, where kindred spirits, but of diverse aptitudes, exchange ideas on all imaginable subjects when eating, smoking, walking, or cruising with their skipper-host in the *Lotus.* To some extent the book is a series of reminiscences of talks on such occasions. The fragment of his own autobiography that Mr. Clodd gives as a sort of preface is interesting reading, and affords a clue to the particular direction of his intellectual activity.

Most of the "Memories" are very short—like lantern-slides thrown on a screen to be rapidly replaced by others. Little is said about Thomas Henry Huxley, but in this case the reader should refer to the author's biography of the biologist. The jottings on Herbert Spencer do not depict the philosopher in a very agreeable light. Concerning Henry Walter Bates we read: "No word of mine can convey the charm infusing the memory of so rare a soul as that which dwelt in Bates. . . . There was a wonderful freshness in all that he said, and a wonderful magnetism in the way he said it." The brief account of Joseph Thomson indicates how much was lost by the early death of a brilliant traveller. The few remarks on Paul B. du Chaillu are of interest, as his early work was erroneously discredited. Andrew Lang has been described as having a "touch of superciliousness in his manner," but Mr. Clodd says "the aloofness was only skin-deep . . . those who came to know him longest learned to appreciate him most. . . . Sometimes he gave offence by the tone of his reviews, the temptation to banter being too great to be resisted. But he bore no malice; and they who submit their wares to the critic must not be too squeamish over the verdict." Samuel Butler "was of the *genus irritabile.* . . . As Chauncey Depew said: 'When once you've stood on your head, the public won't let you stand on your feet.' The truth of this was Butler's irritating experience." The appreciations of Grant Allen, George Meredith, and George Gissing are among the best things in a book replete with shrewd, kindly criticism.

A. C. HADDON.

OUR BOOKSHELF.

Cours d'Hydraulique. By Prof. J. Grialou. Pp. vi+549. (Paris: Gauthier-Villars et Cie, 1916.) Price 20 fr.

THIS volume is designed for the use of advanced students; it embodies the third-year course of lectures delivered by Prof. Grialou at the Lyons Central School. Much of it, naturally, is ground covered by the generality of text-books on the subject, but there are also special sections on particular problems, such as the application of cylindrical co-ordinates to the motion of turbines, the loss of head due to abrupt variation of pipe section, fluid resistance, etc.

Prof. Grialou's treatment is rigorously mathematical, and he explains that he has endeavoured throughout to make constant use of general equations, whether applicable to "perfect" liquids or to liquids characterised by viscosity. He considers that the study of hydraulics has acquired too empirical a character, and that this should be rectified by adhering as closely as possible to theoretical principles.

We certainly agree with him in the desirability of directing the attention of students to the lack of scientific precision in many hydraulic formulæ, but this is in order that too great a degree of accuracy may not be assigned to the numerical results which they give. The conditions attaching to hydraulic flow in actual practice are such as to render unavoidable a dependence to a greater or less extent on data derived from observation rather than on the predictions which might be based on the behaviour of a perfect liquid.

The book deals with hydrostatics and hydrodynamics as well as with the field of phenomena more strictly known as hydraulics. Wave theory and tidal action are also touched upon. It will thus be seen that the purview of the volume is fairly extensive, with the consequence that the treatment, in parts, is unavoidably sketchy, but, as a whole, it gives a fair presentment of a subject which is beset by many complexities.

One cannot help wondering why such important scientific works in France are published in paper covers, and why it is left to the reader laboriously to cut the pages. B. C.

The Origin of Finger-Printing. By Sir William J. Herschel, Bart. Pp. 41. (London: Oxford University Press, 1916.) Price with paper covers, 1*s*. net.

WHEN Sir Francis Galton issued "Finger-Print Directories" in 1895 he inscribed the volume to Sir William J. Herschel, Bart., in the following words:—"I do myself the pleasure of dedicating this book to you, in recognition of your initiative in employing finger-prints as official signatures, nearly forty years ago, and in grateful remembrance of the invaluable help you freely gave me when I began to study them." And now, in the year 1916, fifty-eight years after he lighted "upon a discovery which promised escape from one great difficulty of administration in India," Sir William Herschel tells the story of how our modern system of identification by means of finger-prints was born in the magistrates' court at Jungipoor, on the upper reaches of the Hooghly. In his dedication to Sir Edward Henry, Commissioner of the Metropolitan Police, Sir William writes as follows:—"I am offering you this old story of the beginnings of finger-printing, by way of expressing my warm and continuous admiration of those masterly developments of its original applications, whereby, first in Bengal and the Transvaal, and then in England, you have fashioned a weapon of penetrating certainty for the sterner needs of justice."

There can be no doubt that England has given the world the most perfect system of identification—identification of an individual by means of his or her finger-prints. The method was initiated by Herschel; it was developed and created into a system by Galton; it has been perfected and applied by Henry. Nor should it be forgotten that it was on the initiative of Mr. Asquith, when Home Secretary in the Liberal Administration of 1892–95, that the method found an early recognition at Scotland Yard. All who are interested in the use and significance of finger-prints will feel grateful to Sir William Herschel for placing on record the first steps of an important development.

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.*]

Robert Recorde.

THE reference to the (probably) unique record of a great Welsh man of science in the Notes columns of NATURE (November 2) well illustrates the uncertainty of the data of (even scientific) fame, and the subtle comparison of the latter to the river which submerges merit and floats mediocrity to its destination. It may now be well affirmed that the writer of the Notes paragraph, or the correspondent of the *Western Mail*, or Mr. Arthur Mee in his luminous appreciation in the *Nationalist* of May, 1909, or even the myriad-minded Mr. Lloyd George himself, has done far less than full justice to the achievements of Robert Recorde. Nor has any of them duly underscored the fact that he was a member of our medical profession (M.D. Cantab.), in an age, too, in which the pioneers of the "advancement of science" were mostly disciples of Æsculapius. Accordingly, inquiring readers may well be reminded that Robert Recorde scored a unique series of "firsts" in the very generation in which England tore off the swaddling-clothes of "authority" and stepped boldly forward to grasp the banner of intellectual empire (1510–58), and which exactly preceded that of Francis Bacon, the so-called "Father of Modern Philosophy," of which he knew so much less than little, but regarding the probable value of which he preached with something resembling prophetic inspiration.

Let the reader who would estimate the value of popular reputation now remember that not only was, as we have just been reminded, the great Cambrian man of science the first to "use the sign = to denote equality," and the first who wrote in English on arithmetic and geometry respectively, and to treat the doctrine of "the sphere" in the same language; he was also the discoverer of the method of extracting the square root of multinomial algebraic expressions; his "Whetstone of Witte" was the first English book to use the signs + and − ; and he was "the first Briton (in all probability) who adopted the system of Copernicus"—a system which (*horribile dictu*) Francis Bacon remained, in the following generation, permanently unable to comprehend, just as he could neither understand nor accept the *circulation of the blood*, although he had been "puddering in physicke all his life," and his medical adviser was William Harvey himself! His "Urinall of Physicke" survives as one of the valuable rarities of medical literature, and contains many observations which could be utilised to save the latter-day bacteriological pathologist much trouble—and invention! And not only was he a pioneer in mathematics, physics, and medicine, he also was, as we learn from the "Dictionary of National Biography," "deeply skilled in rhetoric, philosophy, polite literature, history, cosmogony, astronomy, astrology, physic, music, mineralogy, and every branch of natural history." No wonder that he found no time to thimblerig for a knighthood (but this was long before the degrading Baboo-Yahoo and Blunderboar-Bulephant creations), or that he died in gaol—not for manslaughter, but for debt.

JOHN KNOTT.

Royal College of Surgeons, Dublin,
November 10.

Luminous Centipedes.

WITH reference to the paragraph in NATURE of November 23 (p. 233) on luminous centipedes in France, it may be of interest if I mention that these were very frequent in the neighbourhood of Albert and Fricourt in the autumn and winter months a year ago. They appeared to be *Geophilus electricus*, which I had often seen glowing, particularly on mild, damp evenings in late autumn, in Surrey lanes, and sometimes on garden paths in London suburbs.

As the troops marched across the damp grassland to and from the trenches by night, the spots of phosphorescence on the ground at their feet were taken for glowing match-ends, though one might occasionally hear a man from the country refer to them as "glow-worms." I have more than once known an officer get seriously perturbed when troops were marching across a danger zone and the glowing points on the ground seemed evidence that the men were disobeying the "no smoking" order which had been passed along the column!

Luminous centipedes were also to be found in the trenches themselves. (Sergt.) F. M. ROBERTS.

Sutherlands Auxiliary Hospital, Reading, November 27.

Searchlights.

SEARCHLIGHTS are now so common that it may be of interest to record that, as might have been expected, the beam shows the presence of polarisation, if it is viewed through a Nicol prism, the line of sight through the prism being perpendicular to the direction of the beam. On rotating the prism, the part of the beam viewed changes its intensity in such a way as to show that the light reflected from it is polarised in a plane passing through the length of the beam and the eye of the observer. The best results occur, of course, when the haze reflecting the beam is thin in character, its particles being small. In such cases the light nearly disappears for a suitable azimuth of the Nicol. C. T. WHITMELL.

Invermay, Hyde Park, Leeds, December 1.

Columnar Ice-Crystals.

AFTER the recent frost a thin layer of gravel became separated from the rest on the paths here (in the park), and on examination was found to be supported by columnar ice-crystals resembling basalt or sal-ammoniac in formation.

The columns were vertical and parallel, closely packed together, and of uniform length (about one centimetre).

I should be glad if some reader would kindly explain this (to me) remarkable uniformity.

A. E. LARKMAN.

County School, Merthyr.

AGRICULTURE AND THE WHEAT SUPPLY.

THE present high price of food has directed attention to the urgent need for increasing the production of wheat in this country so that we may be less dependent than at present on foreign supplies. Prior to the outbreak of war the official statistics showed that we were producing only about one-fifth of the wheat we consumed. As the war came in August our home-grown supply was at its maximum, and the Board of Agriculture was able to issue a reassuring report as to the quantities in hand. But the shortage of available shipping has so affected the amounts of imported wheat that the demand has exceeded the supply, and in consequence prices have risen.

The production of wheat on a large scale in this country is by no means a simple matter. There are, broadly speaking, three factors, soil and climate, economic conditions, and labour, each of which has to be considered separately.

The most fundamental way of increasing the amount of wheat is to increase the yield per acre, and this can be done by either (*a*) improving the soil conditions, or (*b*) introducing new varieties capable of better growth than those already in use.

The improvement of soil conditions is brought about by increasing the supply of plant nutrients, *i.e.* artificial fertilisers, by cultivation, and in other ways. Before the war the world's consumption of artificial fertilisers was increasing more rapidly than the supply, so that prices were going up; this was particularly true of nitrogenous fertilisers. During the war farmers have had a demonstration of the value of artificial fertilisers, which will probably lead to a larger consumption after the war. The whole trend of the activities of the educational and advisory staffs of the agricultural colleges and other institutions is in this direction. The newer agriculture in other countries also calls for more fertilisers: Japan, Australia, India, Africa, and Java are all importers of artificial fertilisers from Europe. It seems reasonable to anticipate, therefore, a considerable increase in the consumption of these fertilisers provided the supply is forthcoming, and one of the most important and most hopeful problems for the future is to ensure these supplies.

Better cultivation of the land requires better implements, but, above all, a better understanding of what cultivation does to the soil. Research in this direction is in hand at Rothamsted and elsewhere, but considerably more work is wanted on the study of implements and better opportunities for testing them.

The production of new varieties is another method by which yields may be increased. Soil and climatic conditions are capable of only a certain degree of modification, and it is clearly an advantage when the plant-breeder can meet the soil-improver half-way and produce a new plant better adapted than the old ones to the conditions actually obtaining. The work of the newer school of botanists seems full of promise in this direction; Prof. Biffen at Cambridge has already done a good deal, and the move of the Botanical Section of the British Association in appointing a special committee to consider this matter is a welcome sign of their intention to attack an important and highly interesting problem.

Another method for increasing the amount of home-grown wheat is to increase the area devoted to wheat either by taking in more land or by displacing some other crop already grown. Increasing the area of land is a favourite suggestion, but one fraught with numerous difficulties. The non-technical tourist walking over Dartmoor or

Bagshot Heath is very apt to ask why this land is not reclaimed and made to grow crops. The question is not a new one. Whenever war has come prices have gone up, and in the old days, when there was less regard than now for public rights, people did not hesitate to enclose any land they thought suitable. The result is that our present waste lands have already been picked over several times, and therefore only the least desirable are left. Some of the land reclaimed in older periods of high prices has gone out of cultivation and could be brought back, but not all of the wastes are suitable, even if the very troublesome questions of public and other rights could be solved. A survey is badly needed of the wastes of the country; there are no statistics giving the information needed, and the loose talk about millions of acres of reclaimable land does not forward matters.

A more promising direction is to displace other and less valuable crops by wheat. Of these the most suitable is grass. Mr. Middleton recently showed that the German farmer feeds 70 to 75 people per 100 acres, while the English farmer feeds 40 to 45 only. It is not that the German gets so much more per acre, but that he has two-thirds of his land in arable and only one-third in grass; while in England only one-third is arable and two-thirds is grass. Now grassland only produces about one-half as much food as arable. Many suggestions have been made for breaking up grassland. From the theoretical point of view this course is eminently sound. Unfortunately, there are grave economic objections. Grassland involves so little risk that it serves as a useful counterpoise to the larger risks of arable farming. It is of no use disguising the fact that farmers are not breaking up their grassland, and they meet every appeal with the statement that they cannot afford to do so. Various ways of meeting their difficulty have been suggested, but as they are mainly political they need not be discussed here.

This leads up to the economic factor. The farmer grows wheat for profit and not for pleasure, and when he is presented with a scheme for increasing his yield his first question is, "Will it pay?" There is a limit set by soil, climate, and the plant itself, beyond which growth will not go. Our average wheat crop is 32 bushels; a good farmer will look for 40, in specially good seasons he may get 50, but 60 bushels would represent a crop he had heard about but probably never seen. There being this limit to the amount producible, the main economic factor becomes the selling price. This is complicated by the circumstance that wheat takes many months to produce, so that a rise in price does not induce a corresponding increase in the supply unless there is good reason to suppose that the increase will recur when the new crop is ready. Thus wheat is now 78*s*. per quarter, but this circumstance is not so powerful an incentive to an increase in area as it looks, because the wheat sown now will not be ready for sale until October or November, 1917, by which time the price may be down to 30*s*., or even less. On the other hand, a run of low prices is a powerful deterrent for a long time. For years after the low prices of the early 'nineties farmers were very shy of growing wheat, and even up to the time of the war they were always afraid that low prices might come back.

Lord Milner's Committee proposed to overcome this difficulty by guaranteeing a minimum price to farmers, and thus using a supply even though in particular years the arrangement might involve a charge on the national finances. It is argued that in this case the community would be better off than it is on present lines, where prices sometimes fall very low and sometimes rise considerably higher. Of course, such a guarantee on the part of the community would involve a corresponding obligation on the part of the farmer, and the precise adjustment of these obligations affords scope for considerable political ingenuity.

The labour question is partly, but not entirely, bound up with the question of cost. The gross return per acre obviously fixes the amount of money the farmer can afford to spend on the crop, and of this only a portion can be allotted to labour. So long as the work is done, it is immaterial to the consumer whether labour's share goes to few or to many. From the labourer's point of view, however, this is very important; and as he does not like low wages, and as, further, he can often get much higher pay on the railway or other work, no small difficulty has arisen on farms where the efficiency of the labourer is low, and where, therefore, a good many labour-hours are required to produce an acre of crop.

This difficulty can be met by increasing the labourer's efficiency and so reducing the number of labour-hours. Machinery can be made to help in two ways: by doing a given piece of work with fewer men and by doing it in less time. In either case the labourer gains more money, unless the machine swallows up the whole. It is certain that considerable possibilities are opened up here. To take a single instance: On an ordinary farm the ploughing of an acre of land takes one man and two horses a whole day, or on some soils it needs a man, a boy, and three horses. In the writer's district the usual rate of pay for such work is about 3*s*. for the man, and normal prices and yields would not justify much more. But with a motor-plough one man can plough three or four acres per day. The cost of the implement is more than that of a plough and two horses, so that more has to be allowed for interest and depreciation. But there is still a sufficient balance left to justify the payment of a higher wage to the man, and therefore to induce him to remain on the land.

It is impossible to foretell the extent of the revolution caused by the internal-combustion engine. It has given us motor-cars and aeroplanes, and thus revolutionised travel by land and by air, and now it is being applied on the farm. For the moment it is being treated as if it were a strange kind of horse, and simply hitched on to the old horse implements. But it is conceivable that some new kind of implement altogether is needed in order to get the best out of this engine. Experiments are sadly needed on this problem. None of the agricultural experiment stations are taking the matter up at present because of the cost and other difficulties, but it needs to be done.

None of these difficulties are insuperable; the various research institutions which now exist in this country can attack the technical problems with considerable hope of success. The economic problems, however, require different treatment; above all they require to be approached from the point of view of the business man rather than from that of the party politician.

The first thing needed is to decide the importance of home-grown food: whether it is vitally important to the community or simply highly desirable. If it is only desirable, things can be left as they are, because agencies are already at work that will take the farmer so far as he feels disposed to go with present high costs of production and the risk of a slump in prices in 1917. If, on the other hand, a large supply of home-grown food is vitally important, then our present methods must be modified so as to aim at maximum-crop production regardless of possible low prices in 1917. At present the farmer is invited to bear the whole of this risk, and with the best will in the world many feel that he cannot do so; it is lack not of patriotism, but of capital that bars the way. The remedy might, and possibly would, involve making agriculture a controlled industry, but, at any rate, it would enable big unified schemes of crop production to be put into operation.

E. J. RUSSELL.

THE JEWELRY TRADE IN WAR-TIME.

THE jewelry trade is very largely one of luxury, and consequently serves as an extremely sensitive indicator of the kind of weather the barque of State has encountered. In the bright days of prosperity people are apt to buy jewels: in the dark days of adversity they are no less apt to sell or pawn them. It is not surprising that at the outbreak of war even the most optimistic of jewellers were filled with the gloomiest forebodings as to the fate the future held in store for their business unless hostilities were soon brought to a satisfactory close. The war has, however, lasted far longer than was anticipated at the beginning by all save a few with exceptional depth of knowledge, and it is possible now to ascertain how far those forebodings were fulfilled.

The question, "What is the state of the jewelry trade in days of war?" may, as regards the United States and, to some extent, Great Britain, be answered from the report on the "Production of Precious Stones for the year 1915," which, as in former years, has been contributed to *Mineral Industry*[1] by the well-known gem-expert, Dr. G. F. Kunz. The answer agrees with what is within common knowledge. The exceptional prosperity which the war has brought to areas engaged in the manufacture of munitions is reflected in the trade in precious stones done there. Thus, we read that in May, 1916—Dr. Kunz does not adhere rigidly to the year with which he is supposed to deal—upwards of five million dollars' worth of precious stones were imported into the United States—nearly three times the amount in the corresponding month of the previous year; in fact, all records were broken, even for the "boom" period of 1906.

[1] Vol. xxiv., pp. 591–613, 1916. (New York: McGraw-Hill Book Company, Inc.; London: Hill Publishing Co., Ltd.)

Again, as regards our own country, it is stated:—

It is worth noting as one of the curious effects of the war in London trade that the present demand for cheap diamond rings, such as are sold by East End jewellers, is phenomenally large. This is due to the exceptionally high wages earned by many British workers in the special industries, and also to their inclination toward free spending of their money. On the other hand, the demand for the larger diamonds has fallen off in England, since the wealthy classes have suffered a very considerable decline of income, due to industrial derangement and, above all, to heavy taxation. In Birmingham also the trade in low-priced diamond rings is exceedingly brisk.

Whether the picture thus outlined is strictly true for Great Britain as a whole we question. We believe that there is a great shortage of labour, not only owing to the requirements of the Army, but because so many of the skilled workers have been drafted into factories, their training having been found to fit them for many of the delicate operations in the manufacture of munitions. Nevertheless, the jewellers will perhaps go so far as to admit that things are very much better at this stage of the war than might have been anticipated beforehand.

Since diamonds are of such great importance for working the hard steels largely used in munitions, stringent precautions are taken by Great Britain to prevent stones, either cut or rough, from falling into hostile hands. Dr. Kunz prints the guarantees, to the effect that the diamonds will not be exported, directly or indirectly, to any country at war with Great Britain, which before the release of the package in question have to be signed before the British Consul-General by importers into the United States.

The report consists of two parts, each of about the same length, the first dealing with general points, and the second with particular species of precious stones. We notice in the former many interesting or curious points in addition to those already referred to. Thus, we are told that before the war much attention was being given in Paris, Vienna, and Berlin to colour-harmony in the wearing of jewels; apparently not in London—are we therefore to infer that a lower degree of taste prevails there? The lozenge-shape of cutting so popular for emeralds has been applied to diamonds with good results. The famous gem-district at Pala, San Diego County, California, has yielded magnificent crystals of rubellite weighing as much as 2 to 4 lb. each. Dr. Kunz boasts that the United States to-day possesses greater collections of precious stones than any other nation, and instances the collections in the American Museum of Natural History at New York, the Field Museum at Chicago, the National Museum at Washington, the New York State Museum at Albany, the Golden Gate Museum at San Francisco, and the Public Museum at Oakland. It is certainly an extensive list, but possibly the collections in London and Edinburgh will, for real scientific interest, bear comparison with any of them.

As an indication of trade conditions it is mentioned that the demand for diamonds has increased so much that by February of this year the Diamond Syndicate had advanced the price for rough stones about 40 per cent., and of cut stones between a carat and 5 carats in weight about 21 per cent. Small stones under a carat in size were scarcely affected, no doubt in order to meet the competition of the stones, which are nearly always small, from the fields in what was German South-West Africa. It is stated that many diamond-cutting establishments have been opened in London by Belgian refugees.

The omission of ruby from the species of precious stones considered is significant; we believe its fortunes as a gem have been severely affected by the comparative success of the synthetic stone. Sapphires, on the other hand, have prospered, and prices have risen. The trade in the Queensland stones appears to have been brought to a standstill by the war, because all the stones were cut in Germany. Hitherto comparatively little in detail has been known of the famous emerald mines in Colombia; it is interesting, therefore, to learn that a careful survey of the district has recently been published by Dr. J. E. Pogue.[2]

[2] "The Emerald Deposits of Muzo, Colombia." Bull. Amer. Inst. Min. Eng., May, 1916.

STATE AID FOR SCIENTIFIC RESEARCH.

At the Institution of Civil Engineers on Friday last, December 1, the Marquess of Crewe, Chairman of the Committee of the Privy Council for Scientific and Industrial Research, with members of the Committee and of the Advisory Council to the Committee, received a deputation from the Board of Scientific Societies. Sir J. J. Thomson, president of the Royal Society, in introducing the deputation, referred to the functions of the board, which had been formed to promote co-operation between those interested respectively in pure and applied science. The deputation wished to urge the necessity for further grants in aid of research, both in pure science and in its applications to industry. It was often difficult to foresee, at the time a research in pure science was carried on, what its ultimate applications might be. The Röntgen rays, discovered incidentally in a purely physical investigation, but now of inestimable value in connection with surgery, furnished an instance. Therefore men who devoted themselves to such researches, with little prospect of immediate personal benefit, should receive from the State sufficient assistance to enable them to do their work in comfort. The neglect of pure science might be compared with the ploughing and manuring of a piece of land, followed by an omission to sow any seed.

Sir M. FitzMaurice, president of the Institution of Civil Engineers, supported Sir J. J. Thomson, and expressed the hope that research would be conducted in a more systematic manner in the future than it had been in the past.

Prof. H. B. Baker referred to the importance of chemical research in industry. It would be found that chemical processes formed the basis of many of the most important national industries.

Lord Crewe, replying as Chairman of the Committee of the Privy Council for Scientific and Industrial Research, said that increasing attention had been lately devoted to the industrial aspects of research. It had now become evident that the work of the Advisory Council could no longer be regarded as an annexe to the Board of Education. The Government had therefore decided to form a new department, presided over by the Committee of Council. The Government also recognised the need for further financial assistance for this work, and desired to encourage the application of research to the leading industries of the country on a large scale. It was clear that wealthy industries, which might naturally expect to derive direct profit from researches in their province, should be willing to defray part of the expenditure involved, and the Council was endeavouring to bring about a scheme of co-operation with the chief industries for developing researches of this nature. What they desired to see was the formation of trade associations which would survey the conditions in their respective industries and decide upon and initiate desirable researches. Such associations should work under carefully selected committees of direction, including some leaders in the industry concerned, men of science, and also representatives of the skilled workers in the different trades.

In addition to industrial research of this kind, of direct and immediate value to industry, there would also be other broader researches of great national value, but not offering immediate prospects of profits to individuals, which would form fit subjects for Government support. In view of the varied conditions under which co-operation in these different classes of researches would be carried on, it was difficult to assess the amount of money required in any particular year, and in the circumstances it was impracticable to proceed by annual estimate. The Chancellor of the Exchequer was therefore prepared to advise the Government to devote a large sum to cover operations during the next five years, on a scale which would enable them to spend four, and perhaps five, times as much on such co-operative industrial research as had been spent for the whole purposes of research by Vote hitherto.

The Chancellor of the Exchequer had also decided that, in order to encourage firms to make generous contributions, money devoted to research, on specified terms, will be regarded as "working expenses," and will thus be free from income tax and excess profits tax. Money so allotted by traders must be devoted to a research or to an association for research under partial State control.

Speaking next on the subject of technical education, Lord Crewe said there had been conferences with local authorities with the view of bringing the conditions under which public money was granted to educational institutions more up to date. The new regulations would simplify administration and stiffen instruction. Special increases would be made in the Estimates of the Board of Education to assist local authorities, and improved arrangements would be made for the training of teachers and for scholarships for selected industrial students.

There would also be (in addition to the block sum to cover five years' expenditure mentioned above) an annual Vote in the Estimates for various purposes, and a sum would be set aside to meet cases in which assistance was required by the individual worker, or by professional societies which stood in need of funds to carry on research work.

Sir J. J. Thomson, on behalf of the deputation, thanked Lord Crewe for his address.

The following official statement has been issued as to the constitution of the new department:—

The Government have decided to establish a separate Department of Scientific and Industrial Research for Great Britain and Ireland under the Lord President of the Council, with the President of the Board of Education as vice-president. They have also decided, subject to the consent of Parliament, to place a large sum of money at the disposal of the new department to be used as a fund for the conduct of research for the benefit of the national industries on a co-operative basis.

The Board of Inland Revenue have decided, with the approval of the Chancellor of the Exchequer, that no objection shall be offered by their surveyors of taxes to the allowance, as a working expense for income-tax purposes, of contributions by traders to industrial associations which may be formed for the sole purpose of scientific research for the benefit of the various trades; and the allowance would be equally applicable as regards traders' contributions specifically earmarked to the sole purpose of the research section of an adapted existing association.

In both cases the allowance would be subject to certain conditions, *e.g.* the association or the research section to be under Government supervision and the trader's contribution to be an out-and-out payment, made from his trade profits and giving him no proprietary interest in the property of the association, etc.

In order to enable the department to hold the new fund and any other money or property for research purposes, a Royal Charter has been granted to the official members of the Committee of the Privy Council for Scientific and Industrial Research under the title of the "Imperial Trust for the Encouragement of Scientific and Industrial Research." The trust is empowered "to accept, hold, and dispose of money or other personal property in furtherance of the objects for which it has been established, including sums voted by Parliament to that end." The trust can take and hold land, and can "accept any trusts, whether subject to special conditions or not, in furtherance of the said objects."

A substantial gift has already been made to the trust by two members of the Institution of Mechanical Engineers for the conduct of a research in mechanical engineering to be approved by the department in the hope that this example will be followed by other members of the institution.

Mr. H. Frank Heath, C.B., has been appointed permanent secretary of the new department, to whom all correspondence should be addressed until December 31 next at the offices of the Board of Education, Whitehall. On and after January 1, 1917, all correspondence should be addressed to the Secretary, Department of Scientific and Industrial Research, Great George Street, Westminster, S.W.

NOTES.

PROFS. PAUL PAINLEVÉ, of Paris, and Vito Volterra, of Rome, have been elected honorary members of the Royal Institution.

THE sum of 1000*l.* has been left to the Paris Academy of Medicine by Dr. Magnan, a former president of the academy, for the foundation of a triennial prize for the best work on a subject relating to psychiatry.

A COMPETITIVE exhibition of artificial limbs is to be held in Bologna in February next, and the Rizzoli Orthopædic Institute of Bologna, under the auspices of which the exhibition is to take place, offers a prize of 200*l.* in connection with it.

A NEW medical periodical entitled *Archives médicales belges* is to be published at the beginning of next year. It will contain reports of the medical work done by exiled Belgians, and be issued by the medical department of the Belgian War Ministry.

MR. F. W. LANCHESTER, the new president of the Junior Institution of Engineers, will deliver his inaugural address to the institution on Monday, December 11, on "Industrial Engineering: Present Position and Post-War Outlook."

A COMMITTEE has been appointed to promote a memorial at the Middlesex Hospital to Mr. F. Clare Melhardo, late secretary-superintendent of the hospital. The memorial is to take the form of the raising of a fund for the permanent endowment of the Bland-Sutton Institute of Pathology.

ADMIRAL SIR HENRY JACKSON, K.C.B., F.R.S., First Sea Lord of the Admiralty, has been appointed to the vacant post of President of the Royal Naval College, Greenwich, and has been succeeded as First Sea Lord by Admiral Sir John Jellicoe, K.C.B.

WE regret to announce the death, on November 30, at a nursing home in London, of Prof. J. Wrightson, president of the College of Agriculture, Downton (1880–1906), honorary professor of agriculture at the Royal Agricultural College, Cirencester, and professor of agriculture and agricultural chemistry in the Royal College of Science, South Kensington, from 1882 to 1898.

DR. ERIC MJÖBERG, assistant in the Entomological Department of the Swedish State Museum, has received leave of absence for three years in order to prepare and conduct an expedition to the interior of New Guinea. His intention is to penetrate into the country by aeroplane, taking as his starting point one of the small islands in Geelwink Bay, at the north-west end of the country. Dr. Mjöberg recently left for America to carry out a lecture tour by which he hopes to raise large sums to cover some of the heavy expenses of his expedition.

THE annual meeting of the Hakluyt Society was held last year on November 23 at the house of the Royal Geographical Society. This year marks the tercentenary of Hakluyt's death, and the president of the society, Mr. Albert Gray, in the course of a commemorative address, remarked that investigations are being made for the purpose of discovering Hakluyt's birthplace. Nothing seems to be known of his father or mother, but there is a monument to his wife in Ludlow Church. The society hopes to find the original manuscript of a treatise by Hakluyt that was printed in America from a copy.

THE Walter and Eliza Hall Institute of Research in Pathology and Medicine has been established in Melbourne in connection with the Melbourne Hospital, through the generosity of the trustees of the Walter and Eliza Hall Fund. The institute is controlled by a board representing the trustees, the University of Melbourne, and the Melbourne Hospital. A spacious building, including a basement and three stories, has been erected at a cost of more than 10,000*l*. in immediate connection with the pathological department of the hospital. The hospital itself has recently been entirely rebuilt, and now contains 325 beds. Applications for the office of director of the institute are being invited through the Agent-General for Victoria, from whom full information may be obtained.

DR. EUGÈNE L. DOYEN, the well-known Parisian surgeon, died on November 21, aged fifty-seven. He was the author of a number of surgical treatises, the better known being "Traitement Chirurgical des Affections de l'Estomac et du Duodenum" (1895), "Technique Chirurgicale" (1897), and "Atlas de Microbiologie" (with M. G. Roussel, 1897). His best-known work, however, is "Etiologie et Traitement du Cancer" (1904). In 1901 he discovered a micro-organism in cancerous growths which he regarded as the cause of such formations, and named it *Micrococcus neoformans*. He introduced serum treatment for cancer, and claimed he had discovered both the cause and cure of this terrible disease—a claim which other medical men, with the best will in the world, have never been able to confirm. At an early date (1898) he utilised the kinematograph as a means of demonstrating his technique and his personality to medical students. He was an enthusiastic worker, but never succeeded in gaining scientific support for his many claims and theories.

CAPT. H. FAIRLEY MARRIS describes a new test for typhoid and paratyphoid fevers, based upon the effect of atropine on the rate of the heart-beat. In a well person, or in one suffering from a number of diseases other than those named, atropine causes an increase of the pulse-rate by about twenty beats or more per minute. Should the pulse-rate increase only ten beats or less, infection by one of these diseases is suggested; if the increase is more than ten and less than twenty beats per minute the interpretation is uncertain. The method of applying the test is as follows. At least one hour after a meal should elapse. The patient should be horizontal and remain perfectly quiet. The pulse-rate is then taken and recorded minute by minute for about ten minutes. Then 1/32 grain of atropine sulphate is injected hypodermically, and after an interval of twenty-five minutes the pulse-rate is again taken minute by minute until it is obvious that any rise which may have followed the injection of atropine has occurred and that the pulse-rate is falling again to the lower level—fifteen to twenty minutes may be necessary (*British Medical Journal*, November 25, p. 717).

THE ninety-first illustrated Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Prof. Arthur Keith, his title being "The Human Machine which All Must Work." The following are among the lecture arrangements before Easter:—Prof. C. S. Sherrington, six lectures on the old brain and the new brain and their meaning, and pain and its nervous basis; Prof. W. E. Dalby, two lectures on the structure of metals; Prof. J. W. Gregory, three lectures on geological war problems; Prof. F. G. Donnan, three lectures on the mechanism of chemical change; two lectures by Prof. E. S. Prior; Prof. A. Dendy, two lectures on sponges: a study in evolutionary biology; Prof. J. A. Fleming, two lectures on modern improvements in telegraphy and telephony; Mr. A. R. Hinks, two lectures on the lakes and mountains of Central Africa; Mr. Daniel Jones, two lectures on the science of speech; Dr. C. W. Saleeby, two lectures on Imperial eugenics; Mr. Stephen Graham, two lectures on Russian idealism. The Friday evening meetings will commence on January 19, when Sir James Dewar will deliver a discourse on soap-bubbles of long duration.

SIR RALPH PAYNE-GALLWEY, who died on November 24, at sixty-eight years of age, was a very famous wildfowler, and it was on his knowledge of the habits and haunts of wildfowl, gained during many winters spent in their pursuit, that his claim to the title of an ornithologist chiefly rests. In his knowledge of the habits of these birds as observed by a fowler (who has the best possible chances of observation) he was perhaps unrivalled. The various kinds of fowl have many little peculiarities, all of which have to be humoured, so to say, if the fowler is to get within striking distance of them. Hence the necessity of a knowledge of the general appearance in the distance, distinguishing calls, and different flight of fowl, and the endless other characteristics of which no one but those who in winter have hied them to the coast with its myriads of wild, wary birds can have any idea. Sir Ralph's most important book, "The Wildfowler in Ireland," is full of out-of-the-way information of the kind to delight the naturalist, and as it was begun at sea with a heavy gale blowing there is a certain freshness about it. "The Book of Duck Decoys," an exhaustive work, and the only one on the subject, also contains a good deal about the natural history of ducks and the ways of the birds. For in this kind of fowling the birds are led rather than pursued. His other best-known work is the "Letters to Young Shooters," the third series of which contains a useful description of all the wildfowl met with in the British Islands. Sir Ralph earned the gratitude of those interested in the former state of our avifauna by having the ancient sign of the "Dotterel Inn" (which stands on the Yorkshire wolds) restored, after it had been sadly ill-used by a local artist who had repaired it.

WE regret to announce the death of M. Emile F. Maupas, librarian of the National Library in Algiers, in his seventy-fourth year. M. Maupas devoted his spare time to zoological researches, the results of which appeared in eighteen papers issued between the years 1876 and 1901. His memoirs on the multiplication and conjugation of ciliate protozoa (1883, 1888, 1889) made his name well known to all students of zoology. By careful and laborious experiments he determined the rates of fission of about twenty species of ciliates under varying conditions of food and temperature. He found that in his cultures—each of which was begun with a single ciliate—there occurred, after a certain number of fissions had taken place, a gradual reduction of the ciliary apparatus and a degeneration of the nuclei, which he regarded as indications of senescence, leading to cessation of fission and death. If, however, before such degeneration took place in any given culture, individuals of the same species, but of different origin, were introduced, conjugation took place. M. Maupas traced the nuclear interchange and the complete reorganisation of the nuclear apparatus, and concluded that this syngamic process determined rejuvenescence. Largely on account of his work, conjugation has been regarded as the sole panacea for protoplasmic old age and death. M. Maupas published, in 1890–91, brief accounts of his investigations on reproduction and sex-determination in rotifers, and in 1900–01 detailed researches on the moulting, encystment, and reproduction of nematode worms, in which, in addition to the descriptive matter, there are discussions on points of great general interest, *e.g.* that the diœcious, and not the hermaphrodite, is the primitive condition, and that sex is determined in the egg very soon after fertilisation, if not earlier. For these papers on nematodes M. Maupas was awarded a prize by the Paris Academy of Sciences in 1901.

DR. E. W. SCRIPTURE recently read to the Pathological Section of the Royal Society of Medicine a communication on registration of speech sounds in the diagnosis of nervous diseases, in which he described a method of recording speech sounds in the early stages of certain diseases of the central nervous system, such as sclerosis, and he claims that the tracings so obtained are almost an infallible mode of diagnosis. The method has been carried out in various institutions in London. It is evident that very slight modifications of the articulating mechanism may thus be detected, and it is remarkable that such modifications are characteristic of different diseases; thus an additional method has been placed at the disposal of clinical physicians, and this has come from the region of experimental phonetics.

PROFS. SALA and Verga deal with the diagnosis of the peripheral nerve-lesions in 150 cases of gun-shot wounds in a paper just received ("Le lesioni dei nervi periferici per ferite d'arma da fuoco," *Memorie del R. Istituto Lombardo di Scienze e Lettere*, vol. xxi.—xii. della serie iii., fasc. x.; Milano: U. Hoepli). The authors lay stress upon the practicability of ascertaining, by study of the disturbances of skin and bone sensation, and by the electrical reactions of the muscle and nerves, the precise seat of the nerve-lesion, and to some extent whether it involves rupture of structural continuity of the nerve or strangulation of it by cicatricial fibrous tissue. The large part played in the causation of paresis, whether of motion or sensation, by cicatricial bands constricting otherwise uninjured nerve-trunks in such cases is dealt with at length and fully illustrated. The utility of testing at the time of the operation the exposed nerve-trunk with faradism applied by platinum-pointed electrodes, as in the physiological laboratory, is dwelt upon, and shown to be productive of no harm to the nerve-trunks. The operative procedures for freeing nerve-trunks from fibrous bands compressing them, and for repairing disrupted nerve-trunks, are discussed. A full report of the success of the treatment adopted is promised for a later paper.

IN the November issue of *Man* Mr. H. D. Skinner traces an interesting link of connection between the Melanesian and New Zealand cultures in a description of three characteristic Maori weapons, known as the Hani, Tewha-tewha, and the Pou-whenua—all forms of a wooden club. In one form the carving at the lower end has been boldly designed and finely executed with stone tools. The point represents a human tongue ornamented with scrolls; above it are the teeth and upper lip, above which again may be discerned a diminutive nose, eyes obliquely set and inlaid with circlets of shell, and a beetling brow with conventional forelock. With these forms the writer compares a paddle club from the Solomon Islands, from which, compared with the ordinary paddle of the same group, the difference is slight, and every intermediate gradation of shape might be figured. From these facts he arrives at the conclusion that we are justified in claiming a Melanesian ancestry for the two-edged clubs of Rarotonga and New Zealand. The question arises: Did the three Maori forms differentiate themselves in New Zealand, or must their point of origin be placed oversea? From a consideration of the facts the writer reaches the conclusion that the differentiation of the Tewha-tewha form had already begun in Melanesia.

THE activities of the United States Board of Agriculture cover a wide field, and, happily, their behests are promptly attended to. Originally the preservation of wild birds was undertaken purely from the point of view of economic zoology. During recent years, however, the Board has taken over the charge of numerous and extensive reservations for the protection of birds to save them from the ravages of the plume-hunter and the egg-collector, and they have done magnificent work in this direction. How great are the difficulties of the Board, and how wide its powers, may be gathered from the statement in the *American Museum Journal* for October to the effect that news reached the officials that a Japanese poaching vessel had been seen in the neighbourhood of the Hawaiian Islands, where a reservation has been established. At once the Revenue-cutter *Thetis* was ordered to cruise to the bird islands. In due time the vessel returned, bringing twenty-three Japanese feather-hunters, captured in their work of destruction. In the hold of the vessel were stored 259,000 pairs of wings, $2\frac{1}{2}$ tons of baled feathers, and several large cases of skins, for which the Japanese, had they escaped with their booty, would have realised more than a hundred thousand dollars. In Florida, we are glad to learn, the white egrets are slowly recovering from the ruthless slaughter to which they have been subjected, though the warden charged with their protection goes in daily peril of his life from desperate and lawless agents of the plume-trade.

THE course of lectures on "The Origin and Evolution of Life upon the Earth," delivered by Prof. H. F. Osborn before the Washington Academy of Sciences earlier in the year, is now being made available to a far wider public through the medium of the *Scientific Monthly*. The October number contains the first lecture of part iv. Herein the contrasts between plant and animal evolution and the origin of animals are discussed. The process of the differentiation of the invertebrate types of to-day, it is urged, "began in pre-Cambrian times, and among aquatic types, of which we have as yet very imperfect knowledge. The evolution of the terrestrial forms began with the Devonian, when the increasing verdure of the land invited the invasion of life from the waters, the first conquest of the terrestrial environment being attained by the scorpions, shellfish, worms, and insects. This is an instance of the constant dispersion of new animal forms into new environments for their food supply, the chief instinctive cause of all migration. This impulse is constantly acting and reacting throughout geologic time with the migration of the environment." This is an interpretation to which some at any rate will demur. Rather migration seems, in the first place, to come about as a result of over-population, when, to avoid competition, the individuals at the periphery of the range of the particular species in distress are compelled to extend farther afield. But be this as it may, these lectures provide most stimulating food for thought, and in their present form they have the further advantage of being most profusely illustrated.

THE failure of the North American wheat crop this year is causing some anxiety in the West Indies, as the islands rely entirely on this source of supply. It seems doubtful if the usual quantities of flour will be available, and the question of possible substitutes is receiving official attention. The *Agricultural News* (Barbados) of October 21 suggests that the cultivation of maize, Guinea corn, cassava, and sweet potatoes should be extended. All these foodstuffs are already grown in the islands, but, in contrast with the imported cereals, none of them will keep without special precautions; the sweet potato, the principal vegetable of the people, is particularly perishable. As regards corn, the difficulty can be overcome by drying, and the Governments of Antigua and St. Vincent have established kiln driers working on a co-operative basis. If the shortage of wheat flour should become serious, the rice crop of British Guiana will have to be drawn on to a greater extent than it is already, and the cultivation of this cereal, which is at present a large industry in Trinidad, may be further developed.

IN view of the shortage of potash by reason of the cutting off of the supply from German sources, two papers recently issued by the United States Geological Survey are now of especial interest. The first, "Evaporation of Brine from Searles Lake, California" (Professional Paper 98-A), records experiments by Mr. W. B. Hicks designed to discover an economical method of extracting the potash from the brine of Searles Lake. The latter is a bed of crystalline salts, containing in its interstices a brine which carries about 2·1 per cent. of potassium, probably in the form of chloride, sulphate, carbonate, and borate. The brine was fractionally evaporated and crystallised, the deposits formed during evaporation being kept separate from those resulting on cooling. As a result of a series of seven such evaporations and crystallisations, the author shows that only 8 per cent. of the potassium in the brine is separated, during either the evaporation or the subsequent cooling, when this is concentrated to one-half of its original volume. When the brine thus concentrated is further evaporated to about one-fifteenth of its original volume and cooled, more than 70 per cent. of the total potassium present is deposited, whilst 12–13 per cent. is left in solution. The second paper, entitled "Experiments on the Extraction of Potash from Wyomingite" (Professional Paper 98-D), is by Mr. Roger C. Wells. Wyomingite is a lava composed largely of the mineral leucite, which is a silicate of alumina and potash. The substance was subjected to levigation with water after crushing, was extracted with water in the presence of gypsum, was heated alone and with gypsum, sulphuric acid, potassium, hydrogen sulphate, alunite, calcium carbonate, calcium and magnesium chlorides, ammonium sulphate, and a bittern respectively. The results indicate that the most promising method would be to heat the wyomingite with 50 per cent. of its weight of alunite (a naturally occurring sulphate of alumina and potash found in the same neighbourhood as wyomingite), whereby 70 per cent. of the total potash (55 per cent. of that in the wyomingite) is rendered soluble.

A GENERAL survey of the coke industry of New South Wales is made by L. F. Harper and J. C. H. Minguye in Paper No. 23 of the New South Wales Department of Mines and Mineral Resources. Chemical analyses and physical properties are given for all types of coal found in New South Wales, and also unusually complete analyses of the coal ashes. Coke burning has been established in the colony for half a century, and is an important and growing industry, the production having risen from 304,800 tons in 1914 to 417,753 tons in 1915. A perusal of this report suggests, however, that the methods of the industry have not kept pace with modern coke-oven practice. Preliminary coal-washing is carried on to a very limited extent, although the ash content of the cokes is very high, and there is some laboratory evidence that washing would be serviceable. The sulphur in the coals and cokes is quite remarkably low, and might be even lower after washing. Unfortunately the survey has not included nitrogen content. The coking properties of the coals are good. A modified beehive oven is most commonly used for coking, rectangular in plan, but with arched roof. The coke is discharged by a ram and quenched outside the ovens. Heating is effected by burning part of the coke-oven gas in external flues, and in some plants the waste heat is collected for power production. The ordinary beehive oven is also in use, but only one modern by-product plant is in full operation (since 1915)—a battery of regenerative Semet-Solvay ovens at Newcastle, N.S.W., with semi-direct ammonia recovery and a benzol plant. Another battery of ovens of the Coppée type has been built in the neighbourhood, but trouble with refractory materials seems to have hindered its operation. Results obtained in the recovery ovens suggest that coking for by-products should have good prospects; the yields are stated as 30 lb. of ammonium sulphate, 3 gals. of benzol, 8 gals. of tar, 12,600 cub. ft. of gas (585 B.T.U.) per ton of coal. It is believed that these results may give a practical object-lesson on the possibilities of by-product coking in the colony, and do something to destroy the prejudices and conservatism evidenced by the general use of older, simpler, and cruder types of plant.

SCIENTIFIC PAPER No. 294, issued by the U.S. Bureau of Standards, gives an account of the accurate redetermination of the freezing point of mercury made at the bureau by Mr. R. M. Wilhelm. Temperatures were measured by means of three platinum thermometers standardised at 0° C., 100° C., and 444·6° C. About 40 c.c. of mercury were placed in a glass tube of 2 cm. inside diameter, and into it the bulb and a considerable length of the stem of the platinum thermometer were inserted. The mercury tube was surrounded by another glass tube of 3 cm. inside diameter, which was placed in a well-stirred freezing bath. In making a determination the temperature of the bath was maintained either a little above or a little below the freezing point of the mercury, and the slow change of temperature of the mercury owing to the transmission of heat across the layer of air between the two glass tubes was observed. At the melting- or freezing-point the temperature remained constant for ten to twenty minutes. Three different samples of mercury were used, and after purification gave identical results. The final result of the whole series of measurements is $-38·873°$ C.

THE Journal of the Franklin Institute for November contains an account of some interesting work on riveted joints by Mr. Cyril Batho, of the McGill University. By means of the principle of least work it is shown how a series of equations may be obtained for any riveted joint, giving the loads carried by each of the rivets in terms of a quantity K, which depends upon the manner in which work is stored in, or by the action of, the rivets. A large number of experiments have been made with the object of determining the distribution of the stresses; from the results of these the author deduces that the extensometer measurements on the outer surfaces of the cover-plates of a riveted joint are sufficient for the determination of the mean stresses in the plates, and that the partition of the load among the rivets may be determined from such measurements. All the experiments tend to show that friction does not play an important part, but further experiments are necessary on this point. Experiments on a number of specimens having a single line of rivets gave results in close agreement with the theoretical considerations. An empirical rule for the value of K is given for joints similar to the experimental specimens. We can commend a careful study of this important article to any who are interested in riveted joints.

THE *Journal of Anatomy and Physiology*, founded by the late Sir William Turner in 1866, will in future appear under the title *Journal of Anatomy*, and will be the official organ of the Anatomical Society of Great Britain and Ireland. In the preface to the first part of the fifty-first volume Prof. R. Howden, president of the society, remarks that until the year 1878 the journal was the organ of the two sciences, anatomy and physiology. In that year the *Journal of Physiology* was established, and thereafter physiological papers became few and far between in the joint journal, and finally ceased to appear. It has therefore been deemed advisable to drop the words "and Physiology" from the title. The editors of the *Journal of Anatomy* are Profs. A. Macalister, A. Thomson, A. Keith, and A. Robinson.

THE catalogue of publishers' remainders just issued by Mr. H. J. Glaisher, 55 Wigmore Street, W., is full of interest. The works offered for sale at greatly reduced prices are new unless otherwise stated, and cover a wide field. Very many of the books deal with scientific subjects. Among them we notice:—Newton's "A Dictionary of Birds"; Galton's "Memories of my Life"; Spence's "Notes of a Botanist on the Amazon and Andes"; Mill's "The Siege of the South Pole"; Clerke's "The System of the Stars" and "A Popular History of Astronomy"; Cooke's "Introduction to the Study of Fungi," "British Edible Fungi," and "Handbook to British Hepaticæ"; Smith's "The Life of Sir Joseph Banks"; Bonhote's "Birds of Britain"; Amundsen's "The North-West Passage"; "The Angler's Library," five vols.; Gadow's "Through Southern Mexico"; Scherren's "The Zoological Society of London." The catalogue should appeal to readers of NATURE in search of standard works at low prices.

ON a previous occasion the attention of readers was directed to the excellence of the pads of "Acribo" sectional paper supplied by Mr. W. H. Harling, 47 Finsbury Pavement, E.C. He is now able to provide the paper printed on linen bank in three scales, and in this strong form the popularity of such a convenient, accurate, and British-made product should be increased.

OUR ASTRONOMICAL COLUMN.

THE ZODIACAL LIGHT.—Mr. Denning writes us that displays of this light were surprisingly intense on the mornings of December 4 and 5. He has observed it on many hundreds of occasions, both at the morning and evening apparitions, but never remembers to have seen it more conspicuous. It stretched upwards from about E. by S., and its fainter limits were just traceable to the stars Regulus and γ Leonis in the Sickle of Leo. It was best seen at about 5.40 a.m., and as Regulus passed the meridian at Bristol at 5.23 and 5.19 on the mornings mentioned, the light must have extended over a considerable arc.

A NEW COMET.—A telegram from Prof. Pickering, received through the Centralstelle at Copenhagen on November 26, announces the discovery of a new comet by the Rev. Joel Metcalf on November 21. At Greenwich time 13h. 36·9m. on that day the R.A. of the comet was 3h. 38m., and the N.P.D. 71° 27′. No indication of the brightness or motion of the comet is given. The above position is located about 5° south of the Pleiades, which are now visible throughout the night.

THE SEARCH FOR A TRANSNEPTUNIAN PLANET.—Notwithstanding the failure of nearly half a century's systematic search for a planet beyond Neptune, M. A. Borelly, of the Marseilles Observatory, is still hopeful that such a planet may be discovered. The comet-seeker which he has mainly employed in his work on small planets has permitted the observation of stars down to the 12th magnitude, and M. Borelly is now inclined to think that the planet sought for must be of less brightness than this. He believes it possible, however, that the planet might be detected with the aid of the photographic chart of the heavens, which includes stars as faint as the 14th magnitude. If the period of the planet be a little more than double that of Neptune its motion would only be 1° per annum, or about 10″ per day, so that the short exposures which suffice to show the motion of planets between Mars and Jupiter would not be effective. The occurrence of what may be called Transneptunian comets, including the comets of 1532, 1661, 1862 (III.), 1843 (I.), 1880 (I.), 1882 (II.), is regarded as an argument in favour of the existence of planets outside the orbit of Neptune (*Jour. des Observateurs*, vol. i., No. 12).

SOLAR PROMINENCES IN 1916.—Admirable records of solar prominences are now being obtained under the direction of Mr. Evershed at Kodaikanal, and prompt publication of the results is a commendable feature of the work carried on. In view of the more satisfactory data relating to position angles, heights, and areas which are obtainable from the spectroheliograph photographs, the visual observations are now practically confined to displacements of the hydrogen lines and to metallic prominences. A summary of the observations for the first half of the present year is given in Kodaikanal Bulletin No. 52. Compared with the previous six months, there was a decrease of 22·6 per cent. in areas and an increase of 26·1 per cent. in the number of prominences, the average area per prominence having diminished by about one-third. The areas show a slight preponderance on the eastern, and the numbers a slight preponderance on the western, limb. Metallic prominences were observed in greater number than during the preceding half-year, and there was also a large increase in the number of displacements of the hydrogen lines observed at the limb. In observations on the disc 305 reversals of the C line, 34 darkenings of the D_3 line, and 103 displacements were recorded; there was a large preponderance of displacements towards the red. Absorption markings in H_α, attributed to prominences projected on the disc, were photographed on 147 days; the daily number was the same as for the previous period, but there was a diminution in area.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Thursday last, November 30, when the report of the council was presented, and Sir J. J. Thomson delivered his presidential address, which included the following statement of the scientific work of this year's medallists:—

Sir James Dewar, F.R.S. (Copley Medal).

The scientific work of Sir James Dewar covers a wide field. By applying his ingenuity to problems of practical and theoretical importance, he has obtained results which have contributed largely to modern progress in physics. His early work dealt with organic chemistry, the nature and properties of the picoline and quinoline bases, and he investigated the properties of Graham's hydrogenium. He made a study of the explosion of gaseous compounds, and he was associated with Sir Frederick Abel in the introduction of cordite. Experiments on electro-photometry at one time engaged his attention, and he carried through some researches on the physiological and chemical efficiency of light. In conjunction with Prof. Liveing he published many results of spectroscopic investigations, and afterwards devoted considerable time to the spectroscopic examination of the various gaseous constituents separated from the atmosphere.

Sir James Dewar's best-known recent work is connected with low temperatures and the liquefaction of gases. His introduction of the vacuum flask and his discovery of the power of gaseous absorption of charcoal at low temperatures rendered possible his investigation of the properties of many liquefied gases. He was the first to succeed in solidifying hydrogen. Helium was then the only gas which had resisted liquefaction. Sir James Dewar foretold how this refractory gas might be obtained in liquid form, and the efficacy of the method was verified by Dr. H. Kamerlingh Onnes, who, in 1908, obtained liquid helium, and reached the lowest known temperature (about 3° abs.). Sir James Dewar's experiments in calorimetry and the electrical resistance of metal at low temperatures have opened a wide field of research.

Prof. William Henry Bragg, F.R.S. (Rumford Medal).

Prof. Bragg has been continuously engaged since 1904 in researches into the nature and properties of the rays from radio-active bodies of other ionising radiations. Using new methods in the study of the ionisation of gases by α rays which greatly simplified the experimental conditions, he investigated the distribution of the ions produced along the path of an α particle through a gas. These experiments threw an entirely new light on the nature of the absorption of α rays by matter, and proved that the α rays resulting from each radio-active transformation have a definite characteristic range, depending on the initial velocity. These investigations (in which he was assisted by Kleeman) formed one of the most important advances in our knowledge of the properties of these rays since their discovery.

Prof. Bragg also made important contributions to our knowledge of the nature and properties of β rays and kathode rays, and especially of their relation to γ rays and Röntgen rays. He attacked the problem of the nature of the process of ionisation by X-rays and γ rays and put forward the view, now generally accepted, that the ionisation is entirely secondary and due to the corpuscular rays produced by the primary radiations. His Bakerian lecture (1915) contains an investigation on the reflection of X-rays from crystals, which has led to most important and novel results.

Dr. John Scott Haldane, F.R.S. (Royal Medal).

Dr. Haldane is awarded a Royal medal on account of the important contributions he has made to physiology, especially on the subject of respiration. His study of the conditions of combination of carbon monoxide with hæmoglobin have been fruitful in many directions. They led him to the investigation of gas explosions in coal mines, which has had important results in the saving of life in mines. They also led to the discovery of methods for the determination of the oxygen tension in the blood and of the total volume of the circulating blood in man, which have had wide clinical applications.

Dr. Haldane has also studied the effect of high temperatures under varying conditions of moisture on the human body, and was the first to lay down the definite conditions under which it is possible to withstand or to work in high temperatures. The greater number of his papers, and those of his pupils, refer to the conditions of activity of the respiratory centre. He was the first to demonstrate beyond dispute the all-important part played by the tension of carbonic acid in the blood in the regulation of the respiratory movements, and to elucidate the chemical self-steering mechanism by means of which the pulmonary ventilation is adjusted to the respiratory needs of the body and to the activities of the animal. The knowledge obtained in these researches has enabled him to lay down the conditions which must be observed for the preservation of life among divers, and to elucidate the phenomena of mountain sickness and of acclimatisation to high altitudes.

Prof. Hector Munro Macdonald, F.R.S. (Royal Medal).

A Royal medal is awarded to Prof. H. M. Macdonald on the ground of his contributions to mathematical physics. Prof. Macdonald has been engaged continuously in original research for the last twenty-five years, and in that time has produced many notable memoirs and one remarkable book ("Electric Waves," Cambridge, 1902). His work extends over a wide range: hydrodynamics, elasticity, electricity, and optics, and branches of pure mathematical analysis which have applications to these subjects, especially the theory of Bessel's functions. Among the papers of more distinctly physical character, perhaps the most important are the series of papers treating of the theory of diffraction, and especially the diffraction of electric waves by a large spherical obstacle, a problem which is of especial importance in connection with the theory of the transmission over the earth's surface of the waves utilised in wireless telegraphy. He was the first mathematician to attack this problem, and also the first to obtain the correct solution. The interval between the first attack and the final conclusion was about eleven years (1903–14), and the discussion which took place in the meantime attracted contributions from some of the most eminent mathematicians of the day, including such authorities as Lord Rayleigh and the late Henri Poincaré.

Henri Louis le Chatelier, For. Mem. R.S. (Davy Medal).

M. le Chatelier, successor to Moissan at the Sorbonne, is the most distinguished living French chemist. His name will always remain associated with important discoveries in several divisions of chemistry. In co-operation with M. Mallard, he was the author of an elaborate investigation on the ignition and explosion of gaseous mixtures, in which several principles of fundamental importance were established. As the result of much investigation he introduced the le Chatelier thermo-couple, and inaugurated a new period in the measurement of high temperatures. M. le Chatelier was one of the pioneers of micrometallography, and one of the first to introduce exact methods and clear ideas into the science of industrial silicates. His views on the relation of science to industry and on the teaching of chemistry, which command great attention in France, are exemplified in his highly original book "Le Carbone."

Prof. Yves Delage (Darwin Medal).

Prof. Delage is a member of the Institute, professor in the faculty ot science in the University of Paris, and director of the Zoological Station at Roscoff. He is well known for his biological and zoological writings, especially for his great work, "L'Hérédité et les Grands Problèmes de la Biologie Générale," and his important "Traité de Zoologie Concrète" (the latter published in conjunction with Prof. Hérouard).

Prof. Delage's original memoirs include a very important work on the development of sponges ("Embryogénie des Eponges; développement postlarvaire des Eponges silicieuses et fibreuses marines et d'eau douce," *Arch. Zool. Expér.* (2), x., No. 3, pp. 345–98).

M. Jean Gaston Darboux (Sylvester Medal).

Professeur de géométrie supérieure à la faculté des sciences de Paris since April, 1881. Secrétaire perpétuel de l'Académie des Sciences pour les Sciences Mathématiques since May, 1900. Author of "Leçons sur la Théorie Générale des Surfaces" (four volumes), "Leçons sur les Systèmes Orthogoneux," and of many individual papers dealing with kinematics, theory of partial differential equations, planetary theory, the principles of infinitesimal geometry, functions of a real variable, and numerous other subjects. He is one of the most distinguished of contemporary French mathematicians, and has been honoured by nearly every academy in Europe.

Prof. Elihu Thomson (Hughes Medal).

Prof. Elihu Thomson, of Lynn, Massachusetts, has long been a leading man in the technical applications of electricity in the United States. In the early 'seventies, when teaching in Philadelphia, he was one of the pioneers of electric arc lighting, and invented numerous pieces of electric apparatus. In 1887 he discovered, experimentally, the repulsion experienced by masses and sheets of conducting metal when placed in an alternating magnetic field. Following up this matter, he devised an alternating-current motor, for some years the only one of its kind. He is the inventor also of the process of electric welding which bears his name, and has made valuable investigations into the production of high-frequency discharges and oscillations.

The following are among the subjects referred to in the report of the council of the society:—

The late Lieut. H. G. J. Moseley, killed in action, bequeathed to the society the whole of his estate, to be applied to the furtherance of experimental research in pathology, physics, physiology, chemistry, or other branches of science, but not in pure mathematics, astronomy, or any branch of science which aims merely at describing, cataloguing, or systematising. The value of this bequest has not yet been fully ascertained. Under the will of the late Prof. Meldola the society will eventually receive a legacy of 500*l.*

The council has decided that in present circumstances it is not desirable that the Central Bureau should undertake any work pledging the society to publication of the International Catalogue beyond the fourteenth issue. The Committee of the Privy Council for Scientific and Industrial Research has made a grant of 4250*l.* to the catalogue on condition of an equal sum being provided from private sources for the purpose of assisting the society to keep this important scientific undertaking in being. Sir Charles Parsons guaranteed the collection of this second sum of 4250*l.*, and thus secured the contribution from the Treasury. At the request of Dr. Walcott, secretary to the Smithsonian Institution, Washington, the Carnegie Corporation of New York made a grant to the institution of 6000 dollars (1253*l.* 18*s.* 4*d.*) for the International Catalogue. Sir Charles Parsons has collected 1088*l.* in private subscriptions, and, by himself subscribing 1909*l.*, made up the sum available from all these sources to 8500*l.* 18*s.* 4*d.* It is believed that this sum will enable the catalogue to be published to the end of the fourteenth issue without the necessity of asking for further assistance.

In June last, at the request of the President of the Board of Agriculture and Fisheries, the president and council appointed a committee to consider and report upon the bionomics and economic importance of grain-infesting insects, with especial reference to imported grain, the committee consisting of the treasurer (chairman), Prof. V. H. Blackman, Prof. A. Dendy, Prof. Stanley Gardiner, Mr. W. B. Hardy, Prof. R. Newstead, with Mr. J. H. Durrant (of the British Museum), Mr. J. C. F. Fryer (representing the Board of Agriculture), and Mr. Oswald E. Robinson (president of the Incorporated National Association of British and Irish Millers). This committee has been at work for some time on the important subject referred to it, and has appointed a small sub-committee which is engaged upon the necessary investigations and has recently presented a progress report.

Under regulations for the administration of the recruiting schemes adopted by the Government last year the Board of Trade included a provision that analytical, consulting, and research chemists were not allowed to be called up for service with the colours without the consent of the Royal Society. The Military Service Act which became law last March embodied a list of certified occupations, including that of analytical, consulting, and research chemists, "if recommended for exemption by the Royal Society." These provisions have led to a large number of applications being made to the Royal Society by persons claiming to come within the category of chemists above described, and the consideration of these claims has given, and continues to give, rise to a large amount of labour and difficulty.

The Sectional War Committees mentioned in the last report of the council have continued their labours, and several of them have been actively engaged throughout the past year in consultation with the departments of Government concerned.

The classified lists for the War Register referred to in the last report of council have been completed so far as possible, printed, and placed in the hands of the naval and military authorities. In addition, a register of scientifically trained men available for work in connection with the war, covering roughly the period between the issue of Lord Derby's scheme and the passing of the first Military Service Act, has been compiled, and arranged in the form of a card index, which has been placed at the disposition of Government departments and freely consulted.

Owing to the special test work undertaken, and the large number of special investigations carried out for the Admiralty, the War Office, and the Ministry of Munitions, the work of the National Physical Laboratory has greatly increased during the past year, and it has been necessary temporarily to make considerable additions to the staff. In the last report of the council reference was made to the steps which had been taken before the war to secure more adequate support from the Government for the work of the laboratory, and while it is clear that during the war every effort must be given to war work, it is necessary that a scheme, to come into effect as conditions become normal, should be devised to enable the laboratory to take its place in the general plan of industrial research.

Several of the senior members of the staff have been seconded for service in Government departments, and their responsibilities at the laboratory have had to be assumed, to a great extent, by the younger men. Since the formation of the Ministry of Munitions the director of the laboratory has acted as adviser in physics to the Ministry. He has also acted as chairman of the Instruments Committee of the Munitions Inventions Department, and has served on a number of committees of the Ministry of Munitions, the Munitions Inventions Department, and the Board of Invention and Research.

Large additions have been made during the year to the laboratory buildings owing to the growth of the work. Early in the year an urgent request was made by the Admiralty and the War Office for an extension of the aeronautics research. This required the provision of two or three additional wind-channels, with increased accommodation for model-making and similar purposes. Authorisation to proceed was immediately given by the Treasury, and the necessary building and constructional work was undertaken by the Office of Works. The new building contains two wind-channels, a 7-ft. and a 4-ft., with patternmakers' shop, generator-room, offices, etc. An addition to the metrology building, to provide additional accommodation for the work of gauge-testing, has also recently been erected by the Office of Works, while other buildings have been provided for temporary purposes.

CHEMISTRY AT THE BRITISH ASSOCIATION.

THE work of Section B (Chemistry) at the recent meeting of the British Association at Newcastle-upon-Tyne differed somewhat from that of previous years in that it was concerned mainly with two subjects—coal and fuel economy, and the future of the British chemical industries. As the first of these important topics will be dealt with separately, the following brief account of the sectional proceedings will refer chiefly to the second of the subjects of discussion.

"The Future of the Synthetic Chemical Industry in Great Britain" was the subject of a paper by Mr. F. H. Carr, in which the question of training chemists for this branch of the industry was considered at some length. Mr. Carr does not profess to be an educationist, and that is perhaps the reason why he gave his interesting views on the education of chemists to Section B rather than adding them to the fascinations of the programme of Section L.

The essence of the educational scheme proposed by Mr. Carr is the establishment of technological colleges with a course of two years, the college itself being practically a business concern for the manufacture of fine chemicals. Students who did not qualify in successive stages would be liable to dismissal, and a daily attendance of eight hours with but short holidays would be demanded.

As the colleges would have practically the equipment of a works, the student would learn to look at chemical processes from the point of view of cost of materials, yield of finished product, and value of the time and labour, heat and power expended on any particular operation, while at the same time he would become familiar with the ordinary plant found in actual factories.

To impart this training a staff with thorough works experience would be needed, and it is unfortunately not very clear how such a staff could be got together, for such men would most likely be better off financially in works, and might perhaps have little taste for teaching. The college buildings and equipment would be provided by Government, while chemical manufacturers should supply the endowment.

This scheme might be expected to produce technically and scientifically trained men suitable as departmental managers, but the equally important trained operative must also be considered. Here Mr. Carr regrets the absence of an apprenticeship system, and feels the loss of the old mechanics' institutes. For the present, training will have to be carried out in the factory, but he suggests that there should be compulsory continuation of education until eighteen years of age, more latitude being given to schools to suit particular industries of the district, and more differentiation at the age of thirteen in the training of boys of different aptitudes and tastes.

Mr. Rintoul, in a paper on the "Preparation of Chemicals for Laboratory Use," described the work being carried on by Nobel's at Ardeer for producing pure reagents and materials hitherto chiefly obtained from Germany.

Dealing with the subject in a more general way, Mr. Rintoul was of the opinion that much of the research work for the preparation of such chemicals need not necessarily be carried out in technical laboratories, as much of it was well suited to university conditions. It would indeed afford an opportunity for bringing chemical industries and universities in contact, for instead of producing many papers of perhaps somewhat doubtful value, the university laboratories might produce authoritative statements on new or comparative methods for the preparation of compounds, information on which is at present either lacking or inaccurate. Most of the raw materials required could be obtained in the British Empire, and he deplored the fact of our dependence on Germany for supplies of pure materials the manufacture of which would be of educational value, and at the same time of importance in the industry.

A paper by Mr. C. M. Whittaker on the "British Coal-Tar Colour Industry in Peace and in War" gave a summary of the work already carried out, mainly by British Dyes, Ltd., to supply colours for all kinds of dye purposes, ranging from typewriter ribbons to khaki cloth. An immense amount of work has been done, and many colours are now made in this country in huge quantities for war purposes, and all credit is due to the firms concerned. The paper conveyed, no doubt rightly, the impression that every soldier and sailor, whether hale or wounded, was a living memorial to the industry of chemists concerned with the British coal-tar colour industry. Many people have perhaps not appreciated this aspect of the war.

Apart from the discussions on coal and fuel economy, the three papers above briefly reviewed constituted the *pièce de résistance* of the meetings of the Chemical Section, but there were also a few short papers of considerable interest which must just be mentioned.

Dr. J. E. Stead contributed three short papers on (*a*) the oxidation of nickel steel; (*b*) the reduction of solid nickel and copper oxides by solid iron; (*c*) the disruptive effect of carbon monoxide at 400° to 500° C. on wrought-iron. These papers, all of interest to metallurgists, have been the subject of a discussion at the Iron and Steel Institute.

Prof. W. M. Thornton gave an account of his stepped ignition in gases, and after reading the paper illustrated it experimentally. A short discussion on the paper showed that there was considerable divergence of opinion as to the real explanation of the phenomena observed and shown by Prof. Thornton.

Dr. J. A. Smythe contributed a note, illustrated by experiment, on a "Modified Chlorination Process." He showed how calcium chloride acted as a catalyst for the chlorination of ethylene and other hydrocarbons.

In conclusion it should be mentioned that throughout the meeting there was open an exhibition of British-made chemicals and apparatus, which showed what steps have already been made to replace goods in this line of enemy origin.

REFRACTORY MATERIALS.

A GENERAL discussion on refractory materials was held on November 8 at the Faraday Society, the chair being occupied by the president, Sir Robert Hadfield. Numerous exhibits were on view, including British, Colonial, and Indian raw materials, manufactured products, appliances, etc.

In his introductory address the president surveyed the whole range of refractory materials, and mentioned that when Belgian sand was no longer available for open-hearth furnace bottoms, those concerned were not long in discovering British sands which give practically the same results. This point was emphasised later by Mr. Cosmo Johns and Dr. Boswell.

Dr. J. W. Mellor (Stoke-on-Trent) opened the discussion with a paper on

"The Texture of Firebricks."

Dr. Mellor classed texture and refractoriness as the two most important properties of a firebrick. Numerous samples illustrating texture were exhibited, prepared by cutting across with a saw, polishing the cut face, and cementing a glass plate on with hot Canada balsam. This method of showing a brick's texture (now used, it is believed, for the first time) was suggested by Mr. Lomax.

Size of Grain.

The softening of clay material takes place gradually. From the fact that increased fineness of grain has been found to increase the contraction of fired clay bodies, presumably owing to increased surface reaction in promoting vitrification, it might be expected that pressure would also lower the softening temperature of a clay by increasing the area of contact, and this has recently been shown to be the case.[1]

This effect of fineness ot grain comes out prominently in the case of high-temperature fluxes, like mixtures of clay and fine-grained quartz, where the vitrification temperature may be brought so low as to spoil the firebrick. Conversely, the presence of coarse-grained quartz appreciably increases the refractoriness of fireclays; the quartz grains, however, should be angular, not rounded, the rounded quartz grains being only loosely held by the clay bind, besides which angular particles pack together more closely and form a more compact skeleton for the brick, as in samples exhibited.

After-Contraction and After-Expansion.

The firebrick manufacturer arrests the chemical reaction at a certain stage. When the brick in use is strongly heated, the uncompleted reaction is continued, giving rise to *after-contraction*. This after-contraction a few years ago amounted to 2 or 3 per cent., but was reduced by improved methods to 1 per cent., and then to ½ per cent. It is usually impracticable to eliminate all the after-contraction in the original burning of the firebrick. Silica firebricks show an *after-expansion*, which may reach up to 16 per cent. The quartzose silica of clays behaves similarly, unless it be dissolved by the fluxes. The fluxes in a clay also expand about 6 per cent. in firing, so that the apparent contraction of a firebrick is a joint effect. In silica bricks the resultant effect is an expansion.

Refractoriness and other Qualities.

It is clear that conditions which increase the extent of surface of the clay particles in contact or which produce closer contact make the clay soften at a lower temperature, and this indicates how to obtain maximum refractoriness for normal conditions with a given clay. The refractoriness can be further augmented by addition of some of the higher refractories, like shrunk bauxite, shrunk zirconia, or carborundum. It should, however, be borne in mind that a coarse-grained refractory material has low crushing strength and tenacity, and is also very friable and liable to disintegration by shocks or abrasion, besides being easily penetrated by flue dusts and slags. When maximum refractoriness is not really wanted, some refractoriness may be sacrificed advantageously to improve other desirable qualities.

Hand-made v. Machine-made Firebricks.

With reference to the making of firebricks by hand or by machinery, the machines often get blamed for faults which have no direct connection with the use of the machines, but arise from differences in the method of preparing the clay, which affect the uniformity in texture of the product.

Corrosion of Firebricks.

The joints between firebricks are the weakest places in a structure. Where slags are concerned the firebricks should be fine-grained, and the jointing clay should quickly vitrify without cracking and weld the bricks together when the furnace is fired for the first time. Where bricks are exposed to corrosive vapours the chemical composition is of special importance, as well as the texture of the bricks.

Prof. T. Turner (Birmingham), referring to Dr. Mellor's statement that angular particles give closer packing than round particles, contended that the closest packing of all is obtained by adjusting two sizes of round particles so that the smaller grains shall approximately fill up the interspaces between the larger grains.

Other Refractory Materials.

Dr. Hutton directed attention to the great value as refractories of completely shrunk silica, alumina, and magnesia, all of which can stand sudden heating and cooling.

Dr. W. Rosenhain stated that zirconia has a promising future as a refractory material, especially the purified substance. It withstands very high temperatures, but should be previously heated to a higher temperature than that to which it is to be exposed, in order to avoid cracking. It is also very apt to form a carbide in a reducing atmosphere, and the properties of the carbide are very different from those of the oxide.

J. A. A.

[1] J. W. Mellor and B. J. Moore, Trans. Eng. Cer. Soc., xv., 117, 1916.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LIVERPOOL.—The University has just received two valuable gifts—8000*l.* from Mr. C Sydney Jones, to endow the chair of classical archæology, hitherto maintained by temporary guarantees, and 10,000*l.* from Prof. and Mrs. Herdman, to establish a chair of geology. Both chairs are memorials: the first of a father, Mr. Charles W. Jones; the second of a son, Lieut. George A. Herdman, a young student, not merely of promise, but of distinction, who was killed in action in France a few months ago. Each satisfies a real need, for at Liverpool the course of study in Latin and in Greek recognises that without some knowledge of life and custom it is impossible to understand ancient history or to appreciate classical literature. The professor of classical archæology, therefore, takes an active part throughout the classical course, though his work is so arranged as to leave one term in the session free for research at home or abroad.

On the importance of geology it is needless here to dwell. Geology has its own place, and that a high one, among the sciences; without due provision for its study no university is complete. Geologists will be profoundly grateful, therefore, to Prof. and Mrs. Herdman for having completed the geological chairs in the English universities. Liverpool has long been such an active centre of geological work that the lack of a chair in the science at the University was a regrettable deficiency. New conditions of life have brought with them a growing demand for men whose scientific training shall include not only a knowledge of geological aspects of geography, but also of the earth's mineral resources. The war has cost science and the universities so much in life and brain, and also in wasted effort, that the example set by Prof. and Mrs. Herdman in establishing such a useful and appropriate memorial to their son will, we hope, be followed by others.

A PUBLIC lecture on "Chemistry and its Relation to National Affairs" will be delivered by Sir William A. Tilden, at Birkbeck College, Chancery Lane, on Tuesday, December 12 (Founder's Day), at 5.45 p.m. The chair will be taken by Sir Alfred Pearce Gould, Vice-Chancellor of the University of London. The lecture is open to the public without fee or ticket.

ACCORDING to the *Münchener medizinische Wochenschrift* the number of students during the summer semester of 1916 in the Austrian universities was as follows: Vienna, 3472; Prague (Czech university), 1891; Cracow, 1281; Lemberg, 1174; Graz, 647; Prague (German university), 638; Innsbruck, 584. The proportion of medical students was highest at Vienna and at Graz (both about 30 per cent. of the total). At Vienna nearly two-fifths of the medical students were women.

THE evening classes held at University of London, King's College, Strand, W.C., will be open during the session 1916–17 to members of his Majesty's Forces of all ranks wearing uniform who have at any time passed the matriculation examination of the University of London, or any examination exempting therefrom, and are desirous of spending what time is available after their military duties in furthering their education in arts or science. In view of the fact that the attendance of such students will be liable to interruption, no tuition fee will be charged during the war for any classes or course of study entered upon. Those who attend these classes may be registered as internal students of the University of London.

THE General Medical Council on December 2 adopted by a majority a proposal to make Latin optional in the medical higher preliminary examination. The Education Committee of the council, in a report, expressed the opinion that the possession by a student of a senior leaving examination certificate or its equivalent, the matriculation certificate of the universities, affords ample evidence that all the objects of the council in prescribing a preliminary examination in general knowledge are fully realised. The report recommended the council to accept such certificates without further proviso than that they should embrace at least four subjects, including English and mathematics, the two or more additional to be chosen from among the principal subjects of the school curriculum. On the following day the question of making Latin optional in the preliminary examination of candidates for admission to the medical curriculum belonging to the junior class was discussed by the council, and eventually, at the suggestion of the president, Sir Donald Macalister, the question was referred back to committee.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 23.—Sir J. J. Thomson, president, in the chair.—Sir Robert **Hadfield** and Dr. E. **Newbery**: The corrosion and electrical properties of steels. The condition that a metal shall dissolve in an acid with evolution of hydrogen is:—Single potential of metal + over-voltage < single potential of hydrogen electrode, all measurements being, of course, made in the given acid. If therefore we assume that the atmospheric corrosion of a metal is a process similar to that of dissolution in an acid, it should be possible to predict the corrosion-resisting power of a given metal by determining its single potential referred to a hydrogen electrode, together with its over-voltage in a suitable electrolyte. Experiments on a number of special steels have been carried out to test the validity of the above assumption. The over-voltage, single potential, and loss of weight in acid of each specimen were determined and compared with the atmospheric corrosion observed after exposing clean surfaces to the air for ten weeks. The results showed that the electrical method gives decidedly better estimates of the corrosion-resisting powers of steels than the acid method, and although neither method gives trustworthy estimates in all cases, yet the electrical method appears to rest upon a sound theoretical foundation, and is probably capable of further developments which may result in the formation of trustworthy corrosion data.—Dr. A. E. H. **Tutton**: Monoclinic double selenates of the nickel group. In this paper the results are given of the investigation of the double salts, potassium nickel selenate, rubidium nickel selenate, cæsium nickel selenate, and ammonium nickel selenate, each containing six molecules of water of crystallisation. The results are in line with all those already published for the complete monoclinic double sulphate series with $6H_2O$, and for the isomorphous magnesium and zinc double selenate groups. The morphological and physical properties exhibit the progression in accordance with the atomic weight of the alkali metal brought out by the previous work, and the ammonium salt is shown to belong to the isomorphous series, and to exhibit the peculiar traits described in connection with the other ammonium salts of this monoclinic series already dealt with.—Dr. A. E. H. **Tutton**: X-ray analysis and topic axes of the alkali sulphates and their bearing on the law of valency volumes. An X-ray spectrometric analysis, carried out with the author's crystals in the laboratory of Prof. W. H. Bragg by Prof. A. Ogg and Mr. F. Lloyd Hopwood, of the rhombic crystals of the alkali sulphates R_2SO_4, where R is K, Rb, Cs, and NH_4, has indicated that four molecules of R_2SO_4 are contained in the unit rectangular cell of the space-lattice, as suggested by the author in 1894. The atoms of sulphur occupy the corners of the rectangular cell and the middle point of each side. The planes of sulphur atoms parallel to the (001) face are of pseudo-hexagonal structure, the atomic centres being arranged in nearly regular hexagons, as suggested by Federov and adopted by the author. The metallic atoms are also probably arranged in nearly regular hexagons. It is fully substantiated that the constants, molecular volume, and topic axial ratios afford true indications of relative volume and dimensions of elementary space-lattice cells in the cases of crystal structures of isomorphous series.—Dr. T. J. I'a. **Bromwich**: The scattering of plane electric waves by spheres. The first section contains a very general solution of the electromagnetic equations in curvilinear co-ordinates, and it is proved that this solution contains as particular cases those previously obtained by Hertz, Fitzgerald, Rayleigh, Love, and Lamb. This general solution is then applied to the problem indicated in the title of the paper, and the results are analysed further in two particular cases, corresponding to long waves and to short waves. The formulæ deduced here for the case of short waves have been tested numerically for the values given by $\kappa a = 9$ and 10—that is, for wave-lengths one-ninth and one-tenth of the perimeter of the sphere. —J. **Proudman**, A. T. **Doodson**, and G. **Kennedy**: Numerical results of the theory of the diffraction of a plane electromagnetic wave by a perfectly conducting sphere. This paper is entirely concerned with the computation, from quoted formulæ, of the electric disturbance at a great distance from the sphere. The length of the incident wave being $2\pi/\kappa$, and the radius of the sphere being a, results are obtained for $\kappa a = 1, 2, 9, 10$. Tables and curves are given of the results and also of the principal stages of the work. The methods of carrying out the computations, the means of securing accuracy and detecting errors, and an analysis of the results are also given.

Linnean Society, November 16.—Sir David Prain, president, in the chair.—A. W. **Waters**: Some collections of the littoral marine fauna of the Cape Verde Islands made by Cyril Crossland in the summer of 1904—Bryozoa. The collection made by Mr. Cyril Crossland consists of forty-five species or varieties, of which twenty-five were already known from the Atlantic, fifteen are British, twenty-four Mediterranean, probably seventeen Australasian. Of the forms in this collection seven are considered either new species or new varieties.

Zoological Society, November 21.—Dr. S. F. Harmer, vice-president, in the chair.—Dr. B. **Petronievics** and Dr. A. Smith **Woodward**: New parts of the pectoral and pelvic arches lately discovered in the London specimen of Archæopteryx. The coracoid bone most closely resembles that of the ratite birds and the Cretaceous Hesperornis. The pubic bones are twice as long as the ischia and meet distally in an extended symphysis, gradually tapering to a point, which seems to have been tipped by a mass of imperfectly ossified cartilage. —B. F. **Cummings**: Studies on the Anoplura and Mallophaga, being a report upon a collection from the mammals and birds in the society's gardens—Part II. This paper continues the account of the Mallophaga, and contains descriptions of five new genera and two new species. Some observations are made upon the spermatophores in a genus parasitising the ibises, and emphasis is laid on the frequently remarkable differences found in the structure of the internal organs, especially those of the male reproductive system.—Lieut.-Col. J. M. **Fawcett**: A collection of Heterocera made by Mr. W. Feather in British East Africa. Of the 124 forms dealt with, forty-five are described as new, together with seven new genera.

Geological Society, November 22.—Dr. Alfred Harker, president, in the chair.—C. **Reid** and J. **Groves**: Characeæ from the Lower Headon Beds. The investigations here recorded have been made at Hordle Cliffs (Hampshire), where the strata below the superficial gravel belong entirely to the Lower Headon Beds, and consist of fresh-water and brackish-water (more or less calcareous) deposits, laid down apparently in wide shallow lakes and lagoons. Such habitats are the most favourable to the growth of Characeæ, and several of the beds have yielded numerous remains of these plants. There is a great diversity in the fruits of Chara found, representing evidently a number of species belonging to several different sections or genera. Characeæ are found in still fresh or brackish water all over the world under widely different conditions as regards heat, etc., and may therefore be expected to occur in almost all fresh-water formations. For these reasons it is suggested that the fruits of this group of plants, when more widely collected, may prove of considerable value as zonal fossils for the correlation of lacustrine deposits lying in isolated basins. Doubtless, on account of their small size, the Characeæ have in the past often been overlooked.

MANCHESTER.

Literary and Philosophical Society, November 14.—Mr. T. A. Coward (vice-president) in the chair.—Dr. J. S. **Thomson**: The Gorgonacea of the Cape of Good Hope. The paper contains descriptions of twenty-nine species of Gorgonacea, of which twelve are new. The new species are as follows:—Family Briareidæ, *Anthothela parviflora*, sp.n.; family Melitodidæ, *Melitodes jauri*, sp.n., *Melitodes grandis*, sp.n., *Mopsella singularis*, sp.n., *Wrightella trilineata*, sp.n., *Wrightella fragilis*, sp.n., *Wrightella furcata*, sp.n.; family Primnoidæ, *Stachyodes capensis*, sp.n.; family Gorgoniidæ, *Leptogorgia africana*, sp.n., *Leptogorgia aurata*, sp.n., *Eugorgia lineata*, sp.n., *Stenogorgia capensis*, sp.n.—Prof. F. E. **Weiss**: The manufacture of manure from peat. In 1815 a Scottish landowner described a method which consisted of spreading alternate layers, about 6 in. deep, of peat and fairly fresh dung, until a heap of about 4 or 5 ft. was constructed, which was then left for some months. The peat was transformed into a perfect compost as effective, weight for weight, as farmyard manure. Peat and seaweed have been similarly combined, and it was found unnecessary to add lime in the preparation of this manure, the acidity of the peat becoming neutralised by the ammonia contained in the dung, while decay-producing bacteria may percolate into the peat, in addition to those normally contained in it, but the activity of which is inhibited by the presence of humic acid. Dachowski's experiments with bog-water were dealt with. The method of preparation of "bacterised peat" (humogen) was also explained, and various experiments made to test the value of this manure were discussed.—J. **Barnes**: Sugar and starch in the banana (*Musa paradisiaca*).

NEW SOUTH WALES.

Linnean Society, September 27.—Mr. A. G. Hamilton, president, in the chair.—E. F. **Hallmann**: Revision of the genera with Microscleres included, or provisionally included, in the family Axinellidæ (Porifera); with descriptions of some Australian species. Part II.—The Australian species hitherto comprised in the genus Axinella have been re-examined, and have been found to belong to four distinct genera, Allantophora, Sigmaxinella (s.str.), and two others proposed as new. Reasons for the inclusion of the genera Tylodesma and Biemna in the family Axinellidæ are adduced.—T. **Whitelegge**: Preliminary note on the gametophyte of *Psilotum triquetrum*, Swartz. Spores were successfully grown on the rhizomes of *Davallia pyxidata*, but better results were obtained from spores germinated in the synangia.—F. H. **Taylor**: Contributions to a knowledge of Australian Culicidæ (Diptera). No. III. Five species are described as new, and notes on synonymy and additional records for known species are given.—Dr. V. F. **Brotherus**: Some new species of Australian mosses. Thirty-seven species are described as new.—T. G. **Sloane**: New species of Australian Carabidæ belonging to the tribe Scaritini (Coleoptera). Twenty-three species and one genus are proposed as new; these include some interesting forms from the Murchison district of West Australia.

CALCUTTA.

Asiatic Society of Bengal, November 1.—Sir G. **Grierson**: Ōrmuṛī or Bargistā language: an account of a little-known Iranian dialect. The Ormurs or Baraki are a tribe living in Afghanistan in the midst of Afghans, but do not speak the Paṣtu language.

Their position and their language were long a problem with ethnographists and linguists. Sir G. Grierson has in this paper satisfactorily solved the problem by a careful examination of their language, which he declares to be western Iranian. A full grammar and vocabulary of the language will appear in the appropriate volume of the Linguistic Survey.—B. A Gupta: Folklore in caste proverbs.—Sarat Chandra Mitra: Some Indian ceremonies for disease transference. In this paper the author has described and compared the different ceremonies, current in western and southern India, for conveying the disease-spirit, in a chariot, from one place to another.

BOOKS RECEIVED.

In Far North-East Siberia. By I. W. Shklovsky ("Dioneo"). Translated by L. Edwards and Z. Shklovsky. Pp. vii+264. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Geological Map of Mysore. (Bangalore: Department of Mines and Geology.)

Economic Geology. By Prof. H. Reis. Fourth edition. Pp. xviii+856+plates lxxv. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17*s*. net.

The Canning of Fruits and Vegetables. By Z. P. Zavolla. Pp. xii+214. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Stresses in Structures. By A. H. Heller. Revised by C. T. Morris. Third edition. Pp. xviii+374. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11*s*. 6*d*. net.

A Treatise on Mine-Surveying. By B. H. Brough. Fourteenth edition, revised and enlarged by H. Dean. Pp. xviii+477. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*. net.

Studies in Animal Behavior. By Prof. S. J. Holmes. Pp. 266. (Boston, Mass.: R. G. Badger.) 2.50 dollars net.

Cambridge University Calendar for the Year 1916–1917. Pp. xxvi+1077. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

The Anthocyanin Pigments of Plants. By M. Wheldale. Pp. x+318. (Cambridge: At the University Press.) 15*s*. net

At Suvla Bay. By J. Hargrave. Pp. x+182. (London: Constable and Co., Ltd.) 5*s*. net.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—The Cytomorphosis of the Marsupial Enamel-organ and its Significance in Relation to the Structure of the Completed Enamel: J. T. Carter.—The Development of the Pancreas, the Pancreatic and Hepatic Ducts in *Trichosurus vulpecula*: Margaret Tribe.—The Fossil Human Skull found at Talgai, Queensland: S. A. Smith.—The Typical Form of the Cochlea and its Variations: H. J. Watt.—The Structure and Biology of Archotermopsis, together with Descriptions of New Species of Intestinal Protozoa, and General Observations on the Isoptera: Dr. A. D. Imms.—Torsional Hysteresis of Mild Steel: J. J. Guest and F. C. Lea.

CHILD STUDY SOCIETY, at 6—Psycho-analysis in Relation to Children: Dr. Constance E. Long.

CHEMICAL SOCIETY, at 8.—Spinacidene: A New Hydrocarbon from certain Fish-Liver Oils: A. Chaston Chapman.—The Nitration of a-acetylamino-3:4-dimethoxybenzoic acid and 3-acetylamino-1:2-dimethoxybenzene: C. S. Gibson, J. L. Simonsen, and M. G. Rau.

FRIDAY, DECEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Photographic Determination of the Parallax of Three Southern Binary Systems: J. Voûte.—Errata in the Double Star Measures of the *Monthly Notices*, vols. lxvi. to lxxv.: E. Doolittle.—The Choice of an Origin for Galactic Longitudes: C. D. Perrine.—The Radiative Equilibrium of the Sun and Stars: A. S. Eddington.—An Observation by Lamont of Prof. Barnard's Proper Motion Star: A. C. D. Crommelin.

MALACOLOGICAL SOCIETY, at 7.—A Revision of the Species of the Family Pleurotomidæ occurring in the Persian Gulf, Gulf of Oman, and Arabian Sea: Dr. J. Cosmo Melvill.—The Occurrence in England of *Helicella neglecta*: A. S. Kennard and B. B. Woodward, with Notes on the Anatomy by Dr. A. E. Boycott, and on the Radula by the Rev. E. W. Bowell.—The Occurrence of *Eulota fruticum* in a Living State in Kent: A. S. Kennard and B. B. Woodward.

MONDAY, DECEMBER 11.

SOCIETY OF ENGINEERS, at 3.—The Sources of the Minerals Required by the Iron and Steel Industries of the United Kingdom: Prof. W. G. Fearnsides.—The Mineral Resources of the British Empire as regards the Production of Non-Ferrous Industrial Metals: Prof. C. G. Cullis.

ROYAL SOCIETY OF ARTS, at 5.—Coal and its Economic Utilisation: Prof. J. S. S. Brame.

VICTORIA INSTITUTE, at 4.30.—The Influence of Christianity upon other Religious Systems: Rev. W. St. Clair Tisdall.

WEDNESDAY, DECEMBER 13.

ROYAL SOCIETY OF ARTS, at 4.30.—The Development of Imperial Resources: H. W. Fox.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY, at 4.30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Colonial Telegraphs and Telephones: R. W. Weightman.

MATHEMATICAL SOCIETY at 5.30.—Orbits Asymptotic to an Isosceles Triangle Solution of the Problem of Three Bodies: Prof. D Buchanan.—Diffraction of Waves by a Wedge of any Angle: Prof. H. S. Carslaw.—(1) Proof that almost all numbers *n* are composed of about log log *n* prime factors; (2) An Asymptotic Formula for the Number of Partitions of a Number: G. H. Hardy and S. Ramanujan.—Two Theorems of Combinatory Analysis and Two Allied Identities: Prof. L. J. Rogers.—The Harmonic Functions associated with the Parabolic Cylinder (second paper): C. N. Watson.—(1) The Internal Structure of a Set of Points in Space of any Number of Dimensions; (2) The Inherently Crystalline Structure of a Function of any Number of Variables: Prof. W. H. Young and Mrs. Young.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—(*Discussion*): British and Metric Measures in Geographical Work, opened by the Secretary.

OPTICAL SOCIETY, at 8.—The Refractometry and Identification of Glass Specimens—especially Lenses: L. C. Martin.—A Workshop Method of Determining the Refractive Index of a Piece of Glass having one Flat Surface: Dr. R. S. Clay.

ROYAL SOCIETY OF ARTS, at 4.30.—The World's Cotton Supply and India's Share in it: Prof. J. A. Todd

LINNEAN SOCIETY, at 5.—Observation on the Root System of *Impatiens Roylei*, Walp.: Miss Isabel McClatchie.—The Teeth of some Palæozoic Sharks: Dr. A. Smith Woodward.—Sex Distribution in *Myrica gale*, Linn.; Miss A. J. Davey and Miss M. Gibson.

FRIDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

ILLUMINATING ENGINEERING SOCIETY, at 5.—Suggestions regarding War Economies in Lighting: L. Gaster.

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

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THURSDAY, DECEMBER 14, 1916.

AT LAST!

THE war has brought many changes of custom and condition, but none is so likely to influence national history as the method adopted in the choice of members of the new Government. For the first time the heads of departments of State have been selected because of their particular knowledge and experience, and not on account of political needs and exigencies. It has been assumed hitherto that a member of the party in power may become in turn the President of the Board of Trade, Board of Agriculture, Board of Education, and of as many other departments as political circumstances may require, without possessing any special qualifications to deal with the affairs of a single one of them. A new principle has, however, now been introduced; and the Government formed by Mr. Lloyd George consists mostly of men who know instead of men who had to be given appointments because of their political claims. The whole nation welcomes this first endeavour to reconstruct on a scientific basis its politics, its statesmanship, its commerce, its education, and its civil and industrial administration. It has been fashionable in political circles to distrust the man who has made it his business to know, and to assume that he must be kept under control by official administrators; but we hope the appointments to offices in the new Government signify that this view has now gone for ever, and has been superseded by the one in which national use is made of the most capable men.

The constitution of the Government evolved under war conditions by Mr. Lloyd George has, in Wordsworthian phrase, so far as the future of education is concerned, "brought hope with it and forward-looking thoughts," and, in any event, has set an example which it is to be hoped may be followed in later appointments. For the first time in the history of the Board of Education a man has been selected for its leader and inspirer entirely apart from political prejudices or ambitions, and without the idea that the position is to be regarded as simply a convenient resting-place for a time in view of some other political office of greater importance, if there be such. Like most of the other offices in the new Ministry, a choice has been made on purely business principles with the sole view of securing for the office the most capable administrator, who will bring not only undivided energies to its effective discharge, but formative and stimulating ideas, high intelligence, learning, and rare gifts of exposition in the written word and in speech.

The appointment of Dr. H. A. L. Fisher, Vice-Chancellor of the University of Sheffield, to the Presidency of the Board of Education will receive the heartiest welcome from friends of education of every grade. It is particularly welcome at the present crisis, when the feeling is rife in all spheres of educational thought that there is need for a complete reform in our methods of education and in the importance assigned to certain subjects. Dr. Fisher comes to the responsible post to which he is assigned from the centre of the industrial life of England, where he has been in close touch with men of affairs with whom the application of science to industrial needs is of paramount importance. He brings, too, a breadth of mind and a keen interest in all democratic movements, especially those concerned with social and economic questions. As a teacher of high repute he will not fail of sympathy with those who are charged with the due training of the youth of the nation in all branches of education. He has already been engaged in important public inquiries, for he was a member of important Commissions, as, for example, that which visited India four years ago to inquire into Indian administration and the conditions of the Public Services. Dr. Fisher has great problems to face and solve, since to be really effective he must break with old traditions which have held the nation hide-bound for many generations. There is, however, reason to believe that he appreciates fully the gravity of the task, and that he has not lightly entered upon it. He brings to its solution a free and liberal mind and an undivided and abiding interest, and it is to be hoped that all parties will unite in giving him the most loyal support.

The lessons of the war have brought home to the English people as never before the need for drastic changes in our educational policy, and we therefore look forward with a confident hope that the new appointment will be abundantly justified in its results and form a precedent for future guidance.

The new Government includes a number of other men who know the "business" with which they have been entrusted. The national needs of the moment are a complete organisation of production, a stringent regulation of, and economy in, consumption, a thorough efficiency of transport, all focussed with the fierce concentration of purpose of an entirely roused people upon one aim, the winning of the war. All these needs have led the Government of the country away from the somewhat arid academic debatableness

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of the rostrum into the arena of business life, where things are done, and done with efficiency and dispatch. Hence the nation welcomes the application of the sound principle that men with the "business sense," the intangible ability or intuition which results from a lifetime passed in a successful business environment, should control the national effort. Mr. Lloyd George, as a practical man, has disposed of the superstition that a man of first-class ability in one department of human affairs is equally capable in other realms of activity.

The appointments made to the Board of Agriculture will give the greatest satisfaction to agriculturists. Mr. R. E. Prothero, who becomes President of the Board, has a unique knowledge of his subject, both on the scientific and the practical sides. His historical studies have thrown much light on the development of the subject, and shown how the present agricultural position arose, and his experience in connection with the Bedford estates has given him admirable opportunities for learning what is possible under present conditions. Capt. Bathurst, who will probably be Parliamentary Secretary to the Board, is well known as a landowner who has made improvements on his own estate and encouraged others to do the same. He has himself worked a small holding so as to acquire that first-hand knowledge which cannot be won in any other way but by direct contact with the things themselves. If matters have not gone too far, Mr. Prothero and Capt. Bathurst ought, between them, to be able to put the food problem on a sound foundation. They start with the good wishes and the confidence of the agricultural community.

The appointment of business men like Sir Albert Stanley to the Board of Trade, and Lord Rhondda to the Local Government Board, carries on the same admirable principle of selection. The supreme example lies not only in the new offices, the Controllerships of Food and Shipping and the Ministry of Labour, but in the choice of the men to fill these posts. Lord Devonport, who becomes Food Controller, is familiar, as the chairman of the Port of London Authority, not only with the magnitude of the traffic of the greatest port in the world, but also with the intricacy of the details of the greatest food-importing agency of all time; roughly, half our total food supplies are imported, and the major portion of these imports pass through the London Docks. Sir Joseph Maclay, Shipping Controller, started business as a clerk, and is now one of the largest private shipowners in the country; he has that "sense of the sea" which is the despair of the landsmen and the most notable human result of our insular situation. Sir Alfred Mond, First Commissioner of Works, is another excellent appointment; and Dr. Addison, to whom belongs the chief credit for the successful establishment of the Ministry of Munitions, rightly carries on the work of Minister of that department. Even in the case of what have been called the "strictly political appointments," the same principle has been at work; Mr. Hodge, the Minister of Labour, and Mr. Barnes, the Pensions Minister, bring to their labours the *flair* which comes from a lifelong association with the material, *i.e.* the working-man, with which they have to deal. In such fashion the Prime Minister has chosen his colleagues, and with the small War Council and his own abundant energy he promises that relentless, thorough, and efficient concentration on the winning of the war for which we, as a people, have been pining for many months. In the long run, democratic government is by consent of the governed, and the new rulers of Britain will embark upon their mighty effort with the willing consent of the people of this country and of the Empire.

METEOROLOGY FOR GENERAL READERS.

The Weather-Map: an Introduction to Modern Meteorology. By Sir Napier Shaw. Pp. 94. (London: Meteorological Office, Exhibition Road, S.W., 1916.) Price 4*d*.

NEVER has the demand for natural knowledge of all kinds been so insistent as during the present war, and scientific information of the most various kinds has been placed at the disposal of many who have had no previous training in such subjects. They and the students of science have usually no common language, and the ideas which even the simpler technical terms connote are unfamiliar to them. In these circumstances it is no easy matter to place the resources of science effectively at the disposal of all who may wish to utilise them.

Meteorological science has contributed its share, not only in the form of weather forecasts and climatic information, but also in placing its knowledge of the upper air at the service of aviation, gunnery, etc., to aid in the solution of the new problems which are continually being formulated. Here, too, some acquaintance with the general ideas of modern meteorology is necessary if the full meaning of a forecast or the climatological description of a region is to be understood and adequately appreciated. Everyone is interested in the weather, which is indeed a consideration in nearly all human operations and affects our ordinary avocations of peace as well as the operations of war; and though in both these cases it may be necessary at times to disregard the favourable or unfavourable character of weather or climate, still a knowledge and an understanding of the principles of meteorology will make for a general increase of efficiency.

But since the general education of the majority in this country does not yet include such a knowledge of the atmosphere and of the elements of physics and dynamics as will render meteorological and climatological descriptions fully intelligible, this introduction to modern meteorology has been issued by the Meteorological Office for the benefit, in the first instance, of those who are making use of meteorology in the present war.

In calling it "The Weather-Map" Sir Napier Shaw lays stress on an essential condition of weather-forecasting which is usually overlooked by those who are not conversant with its procedure, namely, that success depends not upon the skill or the long experience of a single observer, but upon the organised collection of information from as wide a circle of observers as possible, which can then be plotted on a map of the region. Similar maps prepared at intervals of a few hours enable the trained meteorologist to see what changes are taking place, and he can then draw his conclusions as to those which will take place in the near future. When this is generally known and more widely understood, the advantage of preparing forecasts at one centre will be recognised, since it provides much fuller information, and that on a surer basis than is possible for a single observer of long local experience only. But if the local meteorologist is provided with such a weather-map, he can by his knowledge of local conditions amplify with advantage the general deductions of the central institution.

The construction of a weather-map, therefore, is here considered in detail. First, the weather at a number of stations in the British Isles and the North of France on the afternoon of a summer day last year (6 p.m., August 2, 1915) is shown cartographically, and similar maps show the distribution of the winds, the temperature, and the pressure on the same occasion. The distribution of each is explained and discussed so as to lead up to the normal weather-map, on which all these factors are represented together.

This brings us to a short reference to the sequence of weather and its classification according to a few simple types of pressure distribution, and two examples are given of the effect of notable cyclonic depressions which have passed over the British Isles. A series of five maps represents the movement of the depression of November 12–13, 1915, which gave rise to severe gales on our coasts, and four others enable the reader to follow the changes which took place in wind, weather, etc., as the deep depression of December 27–28 of the same year passed over these islands. From the careful description of a weather-map here given anyone can obtain a clear idea of the utilisation of meteorological observations for practical needs. But to ascertain the physical causes of the variations which are shown upon the map, so that we may deal with them as events following causes, is the general problem of the application of the sciences of dynamics and physics to the atmosphere—a problem of the highest interest, but of the utmost difficulty.

The upper air and the conditions prevailing there are shortly described, but the reader is warned that in order to go further he must make himself acquainted with words and ideas which may be unfamiliar to him if he is to make intelligent use of the information which modern meteorology provides. To assist him in this a glossary of brief explanations of many technical meteorological terms and short articles on kindred matters is stated to be in preparation. As a supplement are given climatic summaries for London and Paris, and for Philippopolis, Babylon, Cairo, and Dar es Salaam as representing the types of climate in various theatres of war. The form which these take is somewhat different from that which is ordinarily met with in works which treat of climate. The extreme conditions and the variation of the climatic factors are more important in military operations, etc., than the mean values with which the climatologist is usually concerned. Hence we find that the greatest and least recorded rainfall for each month are given, as well as the average number of days in each month on which rainfall was between certain fixed limits, viz. 1–5, 6–15, 16–25 mm. Similarly, besides the absolute extremes, the normal monthly extremes of temperature are given as indicating the range of temperature to be anticipated in each month; and as for rainfall, a table showing the average number of days in each month on which the maximum and minimum temperatures fall between certain limits clearly exhibits the march of temperature throughout the year and the special character of each month.

These tables, together with a series of isoplethic diagrams of the mean temperature, pressure, wind, rainfall, and humidity at the four observatories of the Meteorological Office, should appeal to everyone as giving climatological information in a form peculiarly suited to practical needs.

This elementary introduction to meteorology will appeal to a much wider circle than those whose present duties on service require the use of meteorological information, for it will be found most useful in all schools where the daily weather-maps are in use as an exposition of their construction and of their place in meteorological science.

H. G. L.

THE ROYAL SOCIETY'S CATALOGUE OF SCIENTIFIC PAPERS.

Catalogue of Scientific Papers. Fourth Series (1884–1900). Compiled by the Royal Society of London. Vol. xv., Fitting–Hyslop. Pp. vi+1012. (Cambridge: At the University Press, 1916.) Price 2*l.* 10*s.* net.

THE Royal Society is to be congratulated on the publication of the fifteenth volume of its Catalogue of Scientific Papers. The first twelve volumes of the catalogue cover the period 1800 to 1883, forming an alphabetical list of authors' names, with the titles of all the papers they published during those years. The volume now issued is one of a series which will complete the work to the end of the year 1900.

Vol. xv. contains the names of authors from "Fitting" to "Hyslop," so that three volumes are required to reach the end of letter H in the alphabet. It would appear, therefore, that eight volumes may be needed to index the literature of the seventeen years 1884–1900, whereas the papers published in the eighty-four years 1800–1883 could be indexed in twelve volumes.

The volumes for 1884–1900 so far published have been produced under the direction of Dr. Herbert McLeod, whose love of accuracy is well known. An examination of vol. xv. reveals the extreme pains that have been taken to render every detail correct. We would particularly direct attention to the care taken to avoid confusing authors of the same name. Where the director has been unable to satisfy himself as to the identity of an author whose surname alone is given in the paper, that fact is duly indicated. At the present time, when England and Russia are drawn together by common interests, we are glad to observe many entries in Russian characters, such entries having a translation for the convenience of those who are not yet able to read the language of our Ally.

We very much regret that Dr. McLeod has been obliged, through ill-health, to resign the directorship of this work. In the volumes of the catalogue published under his direction he has set a standard of accuracy which is hard for any successor to attain. We hope that Dr. McLeod has been able to leave the manuscript for the remainder of the author index for 1883–1900 so far complete that the Royal Society will have no difficulty in publishing it.

Although a work of this character should find a place upon the shelves of every scientific library, it is obvious that the expense of its production must be too great to be covered by the sales. The late Dr. Ludwig Mond and other generous friends of the undertaking provided funds to make up the deficit. The Catalogue Committee of the Royal Society found that these funds were practically exhausted by the end of 1914. This has not deterred the Society from continuing the publication of the series of volumes. In so doing it has acted in the interest of science, for a work of this kind is most valuable when the papers indexed are still of living interest.

It will be remembered that the Royal Society's Catalogue of Scientific Papers is designed to index all the scientific literature of the nineteenth century. The corresponding work for the twentieth century has been undertaken by the International Catalogue of Scientific Literature, which has already carried on the index from 1901 to 1913.

"L'HOMME MACHINE."

Man—An Adaptive Mechanism. By Prof. G. W. Crile. Pp. xvi+387. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1916.) Price 10*s.* 6*d.* net.

ACCORDING to Prof. Crile, the proper term for describing man is mechanism. "Man is essentially an energy-transforming mechanism, obeying the laws of physics, as do other mechanisms." This obedience to the laws of physics is generally admitted by biologists; the question is whether the mechanistic (or chemico-physical) description, which is true so far as it can go, is exhaustive and adequate. Prof. Crile insists that it is, but when we find him including in his conception of mechanism "the fabrication of thought" (by which the mechanical formulæ were themselves fabricated), we wonder if he has sufficiently considered his position. He seems to us to have passed insidiously from a scientific materialism which is admittedly a progressive working hypothesis in physiological research to a philosophical materialism which holds that a true and full description of the world can be given in terms of matter and motion.

When we lay down the mechanically heavy but psychically lightsome volume, and ask ourselves what its chief contributions are, we may select the following. (1) The author gives many forcible illustrations of the unity of the organism. In the web of behaviour what we call mental and what we call bodily are inextricably interwoven. More than that, the whole bodily life is correlated with a subtlety which can scarcely be exaggerated, verifying St. Paul's remark that the various members of the body work as if they had "a common concern for one another." The author gives a very vivid account of the physiological linkage concerned with the transformation of potential into kinetic energy. In this "kinetic system" "the brain is the initiator of response, being activated by the environment within or without the body; acting like a storage battery, it contributes the initial spark and impulse which drives the mechanism. The adrenals act as oxidisers, making possible the transformation of energy and the neutralisation of the resulting acid products. The liver is the chief fabricator and storehouse of the carbohydrate fuel by which muscular action and heat are produced. The liver also plays a large *rôle* in the neutralisation of the acid products of the transformation of energy. The muscles are the engine or motor in which is consummated the final step in the transformation of energy into heat or motion. The thyroid, by supplying a secretion which facilitates the passage of ions, would seem to be the organ of speed control, governing the rate at which the transformation of energy is effected."

(2) Distinctive of the book is the emphasis laid on acidosis, or increased concentration of H-ions in the blood. This may be induced, as is shown in well-illustrated detail, by excessive muscular activity, excessive emotional activation, surgical

shock, asphyxia, strychnine convulsions, inhalation anæsthetics, and so forth. The acidosis throws increased work upon the organs by which the neutralisation of acid is accomplished, and diseases ensue. Prof. Crile's practical point is in general terms an application of the principle of the conservation of energy to the organism, especially through the exclusion of harmful stimuli. Along this path he was able as a surgeon to "perfect the shockless operation," and he is enthusiastic as to similar therapeutic methods of dealing with the manifold "conditions resulting from the over-excitation of the 'Kinetic System,' whether by psychic, traumatic, infection, foreign protein, or drug stimulation."

(3) Throughout the book we feel the influence of the significant idea that health and disease alike must be studied in their evolutionary setting, for the intricate system of adaptive arrangements and responses has been wrought out in the course of an age-long "drama of adaptation." "In the distribution of contact ceptors, of chemical ceptors, of the mechanisms for overcoming pyogenic infections and for blood-clotting; in the distribution of pain areas and of special reflexes we have—a phylogenetic summary of the evolution of man." That all this attainment and registration of adaptations has been effected by a succession of mechanisms, *i.e.* systems adequately described by mechanical formulæ, we are unable to believe, and we have found nothing in this vigorous volume to incline us to transfer the author or ourselves from the category of organism to any other.

OUR BOOKSHELF.

Raymond: or Life and Death. With Examples of the Evidence for Survival of Memory and Affection after Death. By Sir Oliver J. Lodge. Pp. xi+403. (London: Methuen and Co., Ltd.) Price 10*s*. 6*d*. net.

Lieut. Raymond Lodge was killed by shrapnel, near Ypres, in September, 1915. In this volume, which is at once scientifically important and humanly touching, we are given in part i. a selection of letters which show Raymond's fine and attractive personality; in part ii. some of the evidence which indicates his continued existence and occasional communication; and in part iii. Sir Oliver Lodge discusses the philosophy of the subject, with large tolerance but full conviction. Survival is reasonable enough. Life is not a form of energy. It guides or directs energy, but there is no sound reason to believe that it goes out of existence when it ceases to manifest through a particular body.

Of part ii., which more specially concerns a scientific journal, the most striking incident is the one referring to a photograph which was said—through two sensitives—to have been taken, though the family knew nothing about it, and learnt nothing for some months. This photograph was described very minutely. It was said to consist of a group of soldiers, numbering a dozen or more men, some standing and some sitting; Raymond would be found at the front, sitting down, with a stick, and a man was said to be leaning on him or trying to lean on him; vertical lines would be prominent at the back, and of the figures the most prominent would be that of a man whose name began with B. Ultimately the photograph (taken in Flanders) came to light, and all the details corresponded with the description received. As given in full in the book, this incident is very impressive, and it is supported by many others of varying degrees of evidential weight.

The volume is inevitably of an intimately personal nature, but a restrained and scientific temper is maintained throughout, and contentions are supported by facts. It will probably be considered the most important psychical book since Myers's great work on Human Personality; and it is unique in the sense that it is the first large book of its kind to be published by a man of science of the first rank. J. A. H.

Elements of Military Education. By W. A. Brockington. Pp. xvi+363. (London: Longmans, Green and Co., 1916.) Price 4*s*. 6*d*. net.

In his prefatory note the author says: "This book is intended primarily for use in public and other secondary schools which have O.T.C. and cadet contingents; . . . hence the attempt to show the relation of some parts of military education to the ordinary school curriculum." In this attempt he has been remarkably successful, and he will have earned the thanks of those who are trying to adapt school education to present circumstances. The book is, therefore, to be recommended to headmasters and others as well as to the officers of cadet contingents.

The author has taken from the official manuals (either by quotation or reference) just those parts which are suitable for elementary military training, and has omitted the less essential details. But he has done more than this, for he has added much sound advice both to officers and cadets. Thus at the end of a chapter on minor tactics he has given ten pages of memoranda of common errors remarked by examiners for Certificates A and B of the O.T.C.

The book shows a certain lack of balance, some portions of the work being treated in full detail, while others are inadequately dealt with. Thus one page on the chemistry of cordite, three pages on the elementary mechanics of projectiles, and seven lines on the purification of water by chemical means are either too many or too few. Also, the chapter on map-reading is too condensed to be read without reference to other books—in which case much of the detail is unnecessary.

No account is given of the applications of electricity in the field, a subject which is being taught in many schools; and space might have been given to the physiology of respiration and the effects of poisonous gases of different types. The excellent "Handbook of Artillery Instruments" might have found a place in the list of military books. C. L. Bryant.

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.*]

Extrusion of Columnar Ice-Crystals from Moist Earth.

THE phenomenon described by Mr. Larkman (NATURE, December 7, p. 269) was noted and studied by Prof. James Thomson in 1864 and later: see notes collected in his "Papers on Physics and Engineering," 1912, pp. 269–71. Rather than freeze on the moist earth below, the water prefers to push up the load above it so as to be free to form a homogeneous mass of ice outside, columns of ice being thus gradually extruded. Prof. Thomson regarded the phenomenon as an illustration of his principle of thermodynamical interaction between congelation and stress or other physical circumstances of the medium, which later became widely extended and defined in Willard Gibbs's classical work. See also G. F. Becker and A. L. Day "On the Linear Force of Growing Crystals," *Journal of Geology*, May, 1916. J. L.

Cambridge, December 8.

The Name "Linethwaite."

IN the review of "Cleator and Cleator Moor" in NATURE of November 16 the interpretation of *Linethwaite* as *flax-field* (Lin + thveit) is taken as inevitable because of the contiguity of a flax-mill. But history, which cannot be ignored in explaining place-names, does not agree with this solution of the word. The flax-mill has been on this site only about a century. On the exact site of the flax-mill a hundred years ago there stood six conical iron-smelting furnaces. But the field name *Linethwaite* has been here for hundreds of years. Something, therefore, may be said for Lin = Linde, or lime-tree; thwaite = a clearing: the clearing in the lime-trees. The whole district was once forest, and, from time to time, it has been denuded of its timber. The process is going on at the present time. CÆSAR CAINE.

The Vicarage, Cleator.

IT is unsafe to dogmatise about place-names, and, if I have appeared to do so in the instance of Linethwaite, I must plead in mitigation that the suggestion in Mr. Caine's statement that here is "the oldest flax-spinning mill in the country, perhaps in the world," was irresistible, especially as the whole of the district in question was long in Scandinavian occupation. On the other hand, it is extremely improbable that the lime- or linden-tree ever grew in the forests of northern England. Botanists are not unanimous as to whether any species of lime is a true native of the United Kingdom. Even those who admit the small-leaved lime (*Tilia cordata*) to the British list recognise it as indigenous only in the southern and west midland English counties. Mr. Clement Reid seems to have been unable to identify fossil remains of this tree, and Mr. H. J. Elwes observes that "it seems hardly possible that a native tree should have lost its power of reproduction by seed in a climate where it succeeds so well even as far north as Ross-shire. In the north of France self-sown seedling limes are not uncommon" ("Trees of Great Britain and Ireland," vii., 1659).

YOUR REVIEWER.

FOOD AND WORK.

MUCH of what we know about our food has been derived from empiric experience handed down to us for ages. With the knowledge so acquired the human race, under normal conditions, got along comparatively well. In consequence, little attention was given to the scientific investigation of food problems until within the last half-century. Even now the lack of knowledge amongst well-educated people of the composition of foods and their relative nutritive values may not inaptly be compared with that which prevailed in respect to fresh air and ventilation before the discovery of oxygen and its use in breathing. It is not the purpose of this article to trace the various steps by which the gaps in our knowledge of food requirements have been filled. But one important discovery of no distant date deserves mention, namely, that each of our foods has its own particular value in respect to the production or output of work by the human body. A consideration of this aspect of food problems is nowadays of vital consequence to a people, which for the most part is at work to maintain its national existence.

But before referring to the energy-value of foods it should be remembered that the human body, in common with that of every living being, suffers continuous loss every day, due partly to wear-and-tear of its structure, partly to the performance of work, and partly to the production of heat for maintaining body warmth. This loss is made good by food, which therefore has several functions to fulfil, namely, to supply material for structural repair and in early life for growth, to provide energy for the performance of work, and, lastly, to furnish fuel for the maintenance of heat.

Foodstuffs.

If an ordinary suitable diet be examined it will be found to contain certain classes of substances known as "foodstuffs," which have been proved to be necessary for nutrition. The first of these is exemplified by the lean of meat, the white of egg, the casein of milk, the gluten of flour. These are the proteins or albuminous foodstuffs, and it is only from one or other of these that nitrogen can be obtained to nourish the animal body. A certain amount of this class of food is therefore indispensable, and cannot be replaced by any other. But proteins are not all equally valuable. Some, such as gelatin, can supplement other proteins in supplying nitrogen, but by themselves are unable to sustain life; they are "inadequate" proteins. Others, such as the gliadin of wheat and the legumin of peas, are "adequate" to provide for maintenance, for energy, and for heat formation, but not for growth. Still others, such as the casein of milk and the glutenin of flour, are adequate for all these purposes, and for growth as well. Inadequate proteins lack one or more ingredients indispensable for nutrition. It is desirable, therefore, to vary the diet in order to secure a sufficient amount of adequate proteins.

The second class of nutrient substances comprises the fats and oils. These serve to supply energy which may be transformed into either work or heat, or partly into one and partly into the other. A certain amount of fat is necessary for health, but it is, to a large extent, replaceable by foods of the following class, namely, starches and sugars. Fats, like proteins, are derived from both animal and vegetable sources. Most foods contain fat in a form not visible to the naked eye.

The third class of substances in our diet, necessary for healthy nutrition, includes starch and sugar. These are known as carbohydrate foodstuffs. They are used solely for the performance of work and the production of heat, and are not stored as such to any extent in the human body. But if taken too abundantly or by those who lead sedentary lives they may be converted into fat, and are then stored up in this form.

A suitable diet must also supply a certain amount of mineral salts, such as phosphate of lime, and many others which enter into the composition of flesh and other body-tissues. These are contained in most articles of diet in sufficient quantities, and hence (with one exception, namely, common salt) are not specially added to the food.

Lastly, it has been found by recent investigations that to maintain health our food must contain certain accessory substances, the nature of which is not fully known, but the lack of which brings about diseases, such as polyneuritis or beri-beri, scurvy, and possibly rickets. These substances, known as "vitamines," are present in minute but sufficient quantities in most natural foods. They are, however, liable to be removed in the process of manufacture or destroyed in the preparation of foods. Hence it is desirable that the daily diet should include some raw food, such as salads or fruit. All vitamines are not killed by the cooking of food; some are undoubtedly thermostable.

An adequate diet must not merely include the foregoing classes of foodstuffs, mineral salts, and vitamines, but must supply them in certain proportions and in sufficient quantities to cover the daily expenditure of material and energy which the body sustains.

Availability of Foods.

Before inquiring how these proportions and quantities have been ascertained, it should be remembered that all the food taken into the body is not utilised. The greater part is absorbed and used up or oxidised in the body-tissues, but part is rejected as waste. The proportion of the former or available fraction is higher in the case of animal than in that of vegetable foods. Thus, for example, of meat protein 97 per cent. is absorbed, of cereal protein 85 per cent., and of leguminous protein 82·5 per cent.

The average absorption of nutritive substances from different classes of foods is as follows:—

	Protein per cent.	Fat per cent.	Carbohydrates per cent.
Animal foods (meat, eggs, milk)	97	95	98
Vegetable foods...	85	90	97
Ordinary mixed diet	92	95	97

The Daily Expenditure of Energy.

The quantities of different foodstuffs necessary for a day's ration have been determined in various ways, such as by ascertaining the average consumption per head of different classes of the community, or of the inmates of large public institutions, or, lastly, of the population of whole towns or countries. This has been supplemented and confirmed by "balance" experiments, in which the amount of food required to keep the body in equilibrium under different conditions without gain or loss of weight has been determined. But the most fruitful of all our information has come from a comparison of the energy expended in different ways by the human body, with the food requirements necessary to meet it. In this matter we have only to deal with three forms of energy:—(1) Latent or chemical energy contained and supplied in our foods; (2) mechanical energy available for the performance of useful work; (3) heat energy furnished by the burning or oxidising of food within the body and used to maintain its normal temperature. The first-named represents the income side of the energy balance-sheet, the last two the expenditure side.

Each foodstuff has its own energy-value. This has been ascertained by burning a known weight of the dried material in a suitable calorimeter, and finding out how much heat is thereby generated. The unit of energy employed in these measurements is the quantity of heat required to raise the temperature of 1 kilogram of water from 15° to 16° C. It is known as the Calorie (written with capital C), or large calorie, to distinguish it from the small or micro-calorie used in physical measurements.

Food, when oxidised or burnt in the human body, generates the same amount of heat as when burnt to the same degree or state in the calorimeter. This has been abundantly proved by experiment and with surprisingly accurate results. Thus 10 grams of sugar yield 41 Calories of heat when burnt in the calorimeter. If added to the diet of a resting man, the additional heat generated by his body is exactly the same, the difference not exceeding one-tenth of 1 per cent. The energy-value to the human body of 1 gram of protein foodstuff has been found to be 4·1 Calories, of 1 gram of fat 9·3 Calories, and of 1 gram of starch or sugar 4·1 Calories.

The daily expenditure of energy by an average man, living at ease, is as follows in a temperate climate:—

	Calories
Radiation of heat from the body as ordinarily clothed (64 Calories per hour)	1536
Evaporation of water at skin and lungs... ...	611
Heating of respired air	80
Heating of food and drink to body temperature	53
Work of the heart and muscles of respiration, etc.	150
Total	2430

Less than the above—namely, about 2000 Calories—is expended by a man at absolute rest, such as when lying in bed; considerably more when work is performed. The addition for hard but not excessive work amounts to 1400 Calories. Consequently, to meet this expenditure, a working-man must be provided with more food to keep up the income side of his energy balance-sheet, the additional amount required being determined by the severity of the work and the conditions under which it is performed.

The Daily Food Ration.

For an ordinary day's work of eight hours in this climate, it is reckoned that a man of average weight should receive, in his daily food, from 3200 to 3300 Calories of *available* energy. A woman requires somewhat less, namely, 0·8 of a man's ration, or 2560 to 2640 Calories.

The former is provided by a ration which supplies the following:—

	As eaten, grams	As digested, grams	Net Calories
Protein	100 ...	92 ...	377
Fat	100 ...	95 ...	883
Carbohydrate	500 ...	485 ...	1988
	Total	... ...	3248

It need scarcely be said that to make out a ration of this kind a table of food- and energy-values such as is exemplified in the following short list is needed:—

Composition and Energy-value of Some Common Foods.

	Per cent. Protein	Per cent. Fat	Per cent. Carbohydrates	Per pound weight Protein, grams	Per pound weight Fat, grams	Per pound weight Carbohydrate, grams	Energy value, Calories
Beef (medium fat)	15·0	18·0	—	68·0	81·6	—	1039
Mutton	13·5	25·0	—	61·2	110·9	—	1282
Bacon (average)	9·5	59·4	—	43·0	270·0	—	2687
Herring (edible portion) ...	19·5	7·1	—	88·4	32·2	—	652
Bread	8·0	1·2	52·5	36·3	5·4	238	1175
Milk	3·4	4·0	5·0	15·4	18·1	22·7	325
Eggs	12·0	9·5	—	54·4	43·1	—	624
Cheese (full cream) ...	25·9	33·7	2·4	117·5	152·8	10·9	1950
Oatmeal ...	16·1	7·2	67·5	73·0	32·6	306·2	1860
Potatoes ...	1·75	0·1	21·0	7·94	0·46	95·3	427
Peas (green) ...	7·0	0·5	16·9	31·75	22·70	96·6	465
Peas (dried) ..	24·0	1·5	60·0	108 8	6·8	272·2	1626
Butter	1·0	85·0	—	4·5	384·5	—	3600
Margarine ...	1·2	84·0	—	5·4	381·1	—	3566
Dripping ...	0·25	96·45	—	1·1	437·5	—	4068

Allowance has also to be made for waste in food purchased, such as bone, gristle, surplus fat, etc., of meat; skin, rind, core, etc., of vegetables. Langworthy calculates that a ration of 3200 Calories *utilised* corresponds to one of 3500 Calories as *eaten*, and of 3800 Calories as *purchased*.

The Foodstuffs and Energy-value of Three Ordinary Meals.

The following gives an illustration of how the foodstuffs and food energy necessary for an average day's work are distributed over three simple meals. But it is not to be understood that this is in any sense an ideal set of meals.

Food	Protein, grams	Fat, grams	Carbohydrate, grams	Energy value, Calories
BREAKFAST.				
Bacon, 2 oz. ...	5·37	33·75	—	336
1 egg	6·55	5·40	—	78
Bread, $\frac{1}{2}$ lb. ...	18·15	2·70	119·0	588
Butter, $\frac{1}{2}$ oz. ...	0·14	12·00	—	112
Tea, sugar 1 oz., milk $\frac{1}{8}$ pint ...	2·40	2·80	32·0	167
Total ...	32·61	56·65	151·0	1281
DINNER.				
Beef, $\frac{1}{2}$ lb. ...	34·00	40·80	—	519
Potatoes, 1 lb. ...	7·90	0·46	95·26	427
Vegetables, 2 oz....	0·43	0·08	2·26	12
Bread, 2 oz. ...	4·53	0·65	30·00	147
Cheese, 1 oz. ...	7·10	8·50	0·70	111
Tapioca pudding, $3\frac{1}{3}$ oz.	3·30	3·20	28·20	159
Total ...	57·26	53·69	156·42	1375
SUPPER.				
Porridge (oatmeal, 2 oz.)	9·10	4·07	38·30	232
Bread, $\frac{1}{4}$ lb. ...	9·07	1·35	59·50	294
Butter, $\frac{1}{2}$ oz. ...	0·14	12·00	—	112
Milk, $\frac{1}{2}$ pint ...	9·60	11·30	14·20	203
Jam, 1 oz. ...	0·20	0·03	14·10	59
Total ...	28·11	28·75	126·10	900
Total for 3 meals...	117·98	139·09	433·52	3556

To be relished, foods must be appetising and well cooked, and if good digestion is to be secured and retained, the meals must not be hurried over. It is of the greatest importance, therefore, that attention be paid to the cooking and serving of meals, and that time be taken for their enjoyment.

Human Efficiency.

If the table of expenditure of energy by the human body be referred to, it will be seen that more is lost in the form of heat than in any other way. In fact, the proportion of the whole food energy which usually reappears as useful work is only from 10 to 15 per cent. of the intake. This, it may be recalled, is the case also in the ordinary locomotive or other form of heat engine. The matter may, however, be looked at in another way. For mere maintenance at complete rest the human body requires an intake of 2000 Calories, for maintenance at ease 2400 Calories, and for hard work an extra intake is needed of 1400 Calories. Of this extra intake of energy—the price paid for work—400 Calories (28·5 per cent.) ordinarily reappears as useful mechanical work, and would correspond to 170,000 kilogram-metres or 1,220,000 foot-pounds for a day's work of eight hours, to a condition of moderate fatigue. The human body has the power, however, of working more economically when severe and prolonged strain is required. Under such conditions it has been ascertained that one-half or even more of the chemical energy of the additional food taken may reappear in the form of useful external work. The human machine, all things considered, is therefore a very "efficient" one when at work, though an expensive one to maintain in idleness. W. H. T.

MEDICAL TREATMENT FOR DISABLED SOLDIERS.

OUR medical service is faced with a task which will try its skill and endurance to the utmost. "There are already," says a writer in the *Lancet* (November 8, p. 867), "at the lowest estimate 50,000 disabled soldiers discharged from the military hospitals as unfitted for further service." Every week will add to the number. It is true that these discharged men have been cured of their immediate wounds, but we must also realise that they are still convalescent. A large proportion stand in urgent need of a continued medical supervision. There are those whose lungs have been permanently damaged by poisonous gases or by the adhesions which follow healed wounds of the chest. In others the heart is injured and needs careful treatment; more frequently still, the nervous system has been thrown into a state of disorder which only nursing and skill will restore. There are thousands with damaged joints and muscles who can yet be brought back to take a full part in civil life if they receive the requisite attention.

No one will question that it is the nation's duty to attend to the immediate plight of these men. We have two national organisations which could take the problem in hand: the Army Medical Service and the National Health Insurance Commission. The Army has already enrolled most of the medical men who are specially qualified to deal with such cases; medical practitioners working under the National Health Insurance Commission are already overtaxed.

The Government of France, we learn from the *Times* (November 14), has had to face this problem —a much greater one than falls to us. The disabled French soldier, when he is discharged from a hospital in Paris, still remains a soldier, a soldier still under discipline, and passes at once under the care of an organisation housed in the Grand Palais des Beaux Arts, splendidly situated, as every visitor to Paris knows, on the north bank of the Seine. Paintings and statuary have made room for all the modern appliances needed to restore stiffened joints and wasted muscles. The Grand Palais has become a portal through which disabled soldiers emerge as men again fit to take up a useful place in civil life. If necessary, they are trained for a trade or office, such as their physical limitations will allow them to undertake. The treatment has often to be prolonged, and discipline secures a continuity of application and a completion of cure. So well has this system worked in Paris that steps are being taken to have similar organisations set up in provincial military centres of France.

The French are solving a difficult problem, and leading in a way we shall do well to follow. In this country we have established at Roehampton and at Erskine the means by which officers and men are fitted with artificial limbs. There can be no question that these two institutions are fulfilling a national service, but the limbless form only a portion of our disabled men. Massage, electrical treatment, graduated exercises under skilled men and women are the chief means of treatment we can place at their service. We have, too, says the writer in the *Lancet*, "in Sir Alfred Keogh an extraordinarily sympathetic as well as able Director of the Army Medical Service, so that we can feel assured that the cause of the disabled soldier will be treated as a matter of the gravest national importance."

PROF. A. M. WORTHINGTON, C.B., F.R.S.

THE death of Prof. A. M. Worthington at Oxford on December 5, after a short illness, will be deplored by many men of science and a large circle of students who came under his educational influence. Born in Manchester in 1852, Prof. Worthington was educated at Rugby and at Trinity College, Oxford, afterwards working at Owens College, Manchester, and at Berlin, in the laboratory of Prof. Helmholtz. From 1877 to 1879 he was headmaster of the Salt Schools, Shipley, and from 1880 to 1885 he was an assistant-master at Clifton. In 1887 he was appointed headmaster of H.M. Dockyard School at Portsmouth, where he first took a hand in the training of the students of naval engineering, then quartered on H.M.S. *Marlborough*. In 1887 he was transferred to Keyham, Devonport, as headmaster and professor of physics at the new Naval Engineering College, and in that post he remained for the next twenty years. In 1909, owing to the reduction in staff that became necessary at Keyham, which was then being gradually closed down under the new scheme of naval education, Worthington was transferred to the Royal Naval College, Greenwich, as professor of physics, but owing to ill-health he retired in 1911. The main part of Worthington's life was thus spent at Keyham, where he made a great success of the educational side, of which he had charge.

As a lecturer, Worthington was very fine. His favourite subjects were dynamics, hydraulics, optics, and statical electricity. These he presented to his students logically and clearly, illustrating them by many well-thought-out experiments performed with the simplest possible apparatus. He always laid out his lecture table with great care, so that each experiment could be seen by all. In the laboratory he was equally good, and was a most painstaking and energetic instructor, always endeavouring to make the student think for himself. He was a pioneer in the introduction of practical physics into schools, and his work in this direction, carried on at Clifton College, is embodied in his excellent little text-book, "Physical Laboratory Practice."

In his dealings with the naval officer in charge of the college at Keyham, Worthington always strove to maintain the dignity of his position and that of his civilian staff, whom he backed loyally in all matters of discipline. Here his ability to write a good letter stood him in good stead and won many a battle with a new commander who failed to gauge his strength.

As a popular lecturer on scientific subjects, Worthington was particularly good. His delightful voice and masterly style invariably held his audience up to the last moment. Occasionally he lectured to the convicts at Princetown, and twice the present writer helped him with experiments and lantern slides, the first lecture being on astronomy and the second on the dynamics of rotation. On the first occasion it did not seem possible that an audience of 1000 convicts would be entertained with such a subject as astronomy. But Worthington was in his best form, and held their attention from first to last. The second lecture was even more successful than the first, owing to the experiments.

Worthington's original work in physics is well known. He published papers on surface-tension, the stretching of liquids, the splash of a drop, and other subjects. All his work was marked by great experimental skill, especially that on the stretching of liquids and on splashes. He devoted a large amount of time to the latter subject. The apparatus used was simple, but in his skilful hands the results obtained were accurate and beautiful. Of the many hundreds of experiments made, he only published those that brought out points in a connected chain of phenomena.

He published several scientific works, the chief of which was on the "Dynamics of Rotation." Marked by great lucidity of style, this book ably filled a place in the library of physics. He also wrote and had printed a number of pamphlets on wave motion, hydraulics, statical and current electricity, and optics, for private circulation among his students. These were all most carefully prepared after much discussion with his assistants.

Worthington was a man of strong and decided character; having marked out a line of action, he stuck to it, and fought for it with all his might. In fact, he rather loved a fight, being a Lancashire man. His considered judgments were always sound, but he was impulsive at times. He ruled his department at Keyham on the principle that a headmaster should make his presence felt, and in that he succeeded; on the whole, he ruled with much wisdom, and undoubtedly the many officers who passed through his hands will recall his influence on them as entirely for their good.

To his friends and those who understood him, Prof. Worthington's death is a great loss.

PROF. JOHN WRIGHTSON.

THE death of Prof. John Wrightson, on November 30, at seventy-six years of age, removes a well-known authority and writer from the agricultural world. As professor of agriculture (1864-79) at the Royal Agricultural College, Cirencester, he formed one of a small but eminent group of teachers, including Church and Fream, who have left a lasting mark on their subject. After his departure from Cirencester he founded Downton College, of which he was president until it closed in 1906 from inability to compete with State-aided institutions. Many of his former pupils, both at Cirencester and Downton, have done much to promote the improvement of agriculture. For some years Wrightson was professor of agriculture and agricultural chemistry at the Royal College of Science, and chief examiner to the Science and Art Department in the "Principles of Agriculture."

As a writer Wrightson was distinguished by his careful selection of matter and by lucidity of style. He and Principal Newsham recently compiled a "Text-book of Agriculture" which is extremely practical in nature and has been much appreciated by many educational institutions. For many years Prof. Wrightson was agricultural editor to the *Times*, and wrote the periodical reports on crops up to the time of his death. His intimate friends, and they are many, will feel the loss of his genial personality and old-fashioned courtesy. His intellectual powers remained unimpaired by age, and his unobtrusive generosity will be remembered with gratitude by many. His name will always occupy an honoured place in the history of British agriculture, especially as regards the educational developments of which the Royal Agricultural College, the Royal Agricultural Society of England, and the Board of Agriculture (when Sir Thomas Elliott was Secretary) have been pioneers.

J. R. A.-D.

NOTES.

THE question of national laboratories of scientific research has been brought forward recently in France. In the *Comptes rendus* of the Academy of Sciences for November 13 is a preliminary report by a committee composed of MM. Jordan, Lippmann, Emile Picard, d'Arsonval, Haller, A. Lacroix, Tisserand, and Le Chatelier on this question. It is pointed out that all the great industrial nations possess national laboratories of scientific research, systematically directed towards the study of technical problems. The National Physical Laboratory in England, the Bureau of Standards and the Carnegie Institution in the United States, the Physikälische Reichsanstalt and the institutes founded by the Wilhelm Gesellschaft in Germany are given as examples. France has no corresponding institution, and after a full discussion of the questions of control, staff, and work to be done, the following resolution was unanimously carried:—"The Academy of Sciences, convinced of the necessity of organising in France, in a systematic manner, certain scientific researches, expresses its wish that a National Physical Laboratory should be started, for the prosecution of scientific researches useful to the progress of industry. As in other countries, this laboratory would be placed under the control and direction of the Academy of Sciences." On November 27 this question was further considered by the academy, and it was suggested that the general direction of the laboratory should be entrusted to a council, one-half of the members to be nominated by the academy, one-quarter representatives of the State departments, and the remaining quarter delegated by the principal industrial interests. Certain existing State laboratories might be affiliated to the National Laboratory. A considerable grant for establishment and maintenance will be necessary.

A PROLONGED trial, which has lasted 145 days, the longest British trial with the exception of the Tichborne case, and concluded with the longest speech on record in the British Bar, illustrates the inconvenience of the adoption by Rhodesia, under the influence of Mr. Hayes Hammond. of the American mining law. According to that system, instead of each mining company holding all the minerals vertically below its surface, it has the right to work under its neighbours' lands any reef that it can follow from the surface. In this case the Globe and Phœnix Gold Mining Co. was extracting very rich ore from beneath the surface held by the Amalgamated Properties of Rhodesia. The question at issue was whether this ore was part of the Phœnix reef, in which case it belonged to the Globe and Phœnix Co. by virtue of its extralateral rights, or whether it came from an independent reef. The Phœnix mine at the surface worked two parallel reefs, which came together underground, and at greater depths bifurcated several times. The Globe and Phœnix Co. claimed these bifurcations as branches of one reef. According to the plaintiff company there are no branching reefs, and the alleged Phœnix reef consists of at least five independent reefs which had been brought into practical continuity by a complex series of faults. It was claimed that the so-called coalescences and bifurcations were junctions due to faults, and that the great variations in the ore indicated that different parts of the reef had been formed at different times and by different processes, and were therefore distinct reefs. The geological evidence was subject to the drawbacks that the reef had been long ago removed at the critical junctions, and that the evidence collected by the survey of the fifteen miles of underground workings was in places inadequate, as it was not always realised what would be the essential points. The Globe and Phœnix Co. admitted that the reef was not formed in a short time and all parts of it simultaneously, as it probably grew by the slow extension of a branching system of cracks. Mr. Justice Eve's decision in favour of the Globe and Phœnix Co. therefore decides that such a slowly formed branched sheet of ore, in spite of considerable variations in its contents and some breaks in its continuity, is one reef.

We much regret to announce the death, on December 10, of Mr. Clement Reid, F.R.S., late of H.M. Geological Survey, at sixty-three years of age.

We regret to record the death on December 11, in his eighty-ninth year, of Mr. W. Ellis, F.R.S., formerly superintendent of the magnetical and meteorological department, Royal Observatory, Greenwich.

Mr. Ransom, of Hitchin, has placed with the Pharmaceutical Society funds to endow a research fellowship to bear his name. The sum to be invested for the purpose will yield about 100*l*. yearly in perpetuity.

The Primate of Ireland (Dr. Crozier), in whom the appointment is vested, subject to the approval of Oxford University, has appointed Mr. J. A. Hardcastle, a grandson of Sir John Herschel, to be astronomer to the Armagh Observatory in succession to Dr. J. E. L. Dreyer, who recently resigned to take up work at Oxford.

The "Cecil" medal and prize of 10*l*. is offered by the Dorset Field Club for award in May next, for the best paper on "The more recent applications of electricity in the present war, especially in the treatment of wounds and diseases arising therefrom." The competition is open to persons of from seventeen to thirty-five years of age, born in Dorset, or resident in the county for a year between May 1, 1915, and May 1, 1917. Competing essays should be sent to Mr. H. Pouncy, the *Chronicle* Office, Dorchester.

The death is announced, in his ninetieth year, of the Rev. W. D. Macray, librarian, historian, and archæologist, whose life was spent in the service of the Bodleian Library. His first work was a manual of British historians down to A.D. 1600, but the main study of his life was bibliography, as shown by the catalogue of the Bodleian Library, and "The Annals of the Bodleian," published in 1868. He also edited works for the Rolls Series, and prepared a calendar of the muniments of Magdalen College. He was in charge of Ducklington parish for more than forty years.

Prof. A. S. Underwood, who died on December 2, occupied the chair of dental anatomy and physiology at King's College Hospital for twenty-two years, and became inspector of dental examinations on behalf of the General Medical Council. He had also been president of the Odontological Society, and held several other offices in connection with dental science. He was born in London on January 10, 1854, and throughout his professional career did much to encourage research among those who were engaged in practice. He himself was successively interested in the production of dental caries by the action of micro-organisms, the detection of organic matter in human enamel, and the anatomy of the maxillary sinus. In 1912 he took part in the restoration of the lower jaw of Piltdown man, and in 1913 he published an X-ray photograph of this fossil, which was discussed at the time in Nature.

The death is announced of Dr. José Echegaray, member of the Spanish Academy, and president of the Spanish Academy of Sciences. Born at Madrid on April 19, 1832, he began early to incline to mathematical studies, and in 1854 he was appointed professor in the School of Bridges and Roads. From that time onwards his activities widened, and he gradually became one of the prime movers in the modern revival of science and other intellectual studies in Spain. His numerous popular articles on scientific subjects in the magazines and reviews were especially attractive, and aroused great interest. He was also a poet and author of plays, and in 1904 he shared with Mistral the Nobel prize for poetry. In 1905, when already seventy-three years old, Dr. Echegaray was called to the professorship of physics in the University of Madrid; he then began with renewed energy to promote the study of mathematics, and was occupied with the proof sheets of his last work, in several volumes, at the time of his death on September 14, 1916. Between 1868 and 1874 Dr. Echegaray took a prominent part in political life, and while Minister of Public Works, Instruction, and Agriculture founded the Spanish Geographical and Statistical Institute.

The August issue of "Records of the Geological Survey of India," which reached us a few days ago, includes the following note by the director of the survey, Dr. H. H. Hayden, upon Mr. R. C. Burton, who died of wounds on April 9, at twenty-six years of age:—"I greatly regret to have to record the death of Mr. R. C. Burton, assistant superintendent, Geological Survey of India. Mr. Burton joined the department in January, 1912, and was posted to the Central Provinces, where, during his short period of service, he did admirable work in helping to solve the question of the origin of the calcareous gneisses which constitute such an important element of the Archæan group of that area. His investigations into the origin of the bauxite of Seoni and adjoining districts also gave evidence of marked ability, and by his death the Geological Survey has lost one of the most promising, as well as one of the most popular, of its younger members. Mr. Burton joined the Indian Army Reserve of Officers early in April, 1915, and, after a short training in India, was attached to the 104th Rifles in Mesopotamia, where he died on April 9 from wounds received in action on the previous day. His loss is keenly felt by all his colleagues."

We regret to announce the death of Sir James B. Lyall, K.C.S.I., G.C.I.E., an ex-Lieutenant Governor of the Punjab, and younger brother of the late Sir Alfred Lyall. Both brothers were educated at Eton and Haileybury College, and through the influence of an uncle, a director of the East India Company, obtained appointments in the Indian Civil Service. The career of Sir James Lyall was spent in the Punjab, where he held in succession the posts of Settlement Officer of Kangra and Financial Commissioner, succeeding Sir Charles Aitcheson in 1887 as Lieutenant-Governor of the province. He did not possess the learning and literary skill of his brother, Sir Alfred Lyall; but his Settlement report of Kangra threw much light on the customs and sociology of the Hindus occupying the hill districts. His most important work of administration was the scheme for the Chenab Canal irrigation project, which brought a large area of waste land under the plough, and gave welcome relief to the more congested districts. After his retirement from the Service he was a member of the Opium and the Famine Commissions. Few men who have risen to the highest posts have been more universally esteemed by Indians and by their own countrymen, and few have displayed more constant kindliness and courtesy, combined with frankness and strength of character.

The death is announced, in his eighty-sixth year, of Dr. Richard Norris, formerly professor of physiology in Queen's College, Birmingham. From an obituary notice in the *British Medical Journal* we gather the following particulars of his career. During the 'fifties of last century Norris made his first important discovery—the photographic dry plate. In 1862 he made his first contribution to the Royal Society, "Phenomena of Attraction and Adhesion in Solid Bodies, Films, Vesicles, Liquids, Globules, and Blood Corpuscles." In the same year he was appointed professor of physiology in his old medical school, a position he continued to hold until the absorption of Queen's College by the Mason College, now the medical faculty of the University of Birmingham. During the next few years he contributed papers to the Royal Society, chiefly on physiological subjects, with, however, one on "Certain Molecular Changes in Iron and Steel during Separate Acts of Heating and Cooling." At the meeting of the British Association in 1865 he read a paper demonstrating that the opinion then held that muscular contraction caused rigor mortis was fallacious. But what he regarded as his chief work was the discovery in 1877 of large numbers of "invisible corpuscles" in the blood. In 1882 Prof. Bizzozero, of Turin, claimed to have seen similar corpuscles, but Dr. Norris easily established priority. He maintained that these corpuscles were invisible in that they possessed the same refractive index as the liquor sanguinis. Later his contentions were challenged, but he maintained his own views.

Dr. Peter Quin Keegan, who died on August 10 at Patterdale, in Westmorland, where he had lived for many years, was keenly interested in the colouring matters in leaves and flowers, and published notes on the subject in various journals. In Nature (vol. lxi., 1899) he described the results of some "Experiments on Floral Colours," indicating the effect of acids, alkalis, and salts on the anthocyanins of various flowers, and later, in Nature (vol. lxix., 1903), discussed the relation between leaf decay, or loss of vitality in the leaf, and the appearance of autumn tints. He explained the greater brilliance of the American autumn tints as compared with those in England by the greater vitality of the leaf induced by the favourable conditions of the Indian summer, which favoured "the normal process of deassimilation (the development of coloured pigment from tannic chromogen)." He contributed notes on the same subject to the *Naturalist*, and also notes on the chemical analyses of some common plants. He approached the subject from a chemist's point of view, and does not seem to have been fully cognisant of the results of other workers nor to have appreciated the diversity of factors involved from the physiological point of view. In the *Naturalist* (1910, p. 226; see also *Knowledge*, 1911, p. 15) he summarised the results of his investigations on the colour of flowers thus: the production of pigment in the petal is a purely local action due to a process of deassimilation set up to supply the insistent demand for proteid for the development of pistil and ovules, whence he argued that, other conditions being equal, "those floral organs which habitually produce most ovules ought to exhibit the most vividly tinctured corollas."

Dr. Rowland Norris has compared two methods for the preparation of anti-anthrax and other serums. In one the blood from the immunised animal is defibrinated by shaking with a coil of wire and then centrifuged; in the other the blood is mixed with potassium oxalate solution, which prevents coagulation, sedimented, and centrifuged; the plasma is then clotted by the addition of calcium chloride solution, and the serum separated. It is found that the oxalate method gives a much greater yield of serum, which is also clearer and of a better colour (Bull. 60, Agricultural Research Institute, Pusa).

The meningococcus, the micro-organism of cerebrospinal fever, frequently persists in the throat of "carriers" for long periods. Lieut.-Col. Gordon and Capt. Flack have tested the effect of sprays containing chloroamine T and zinc sulphate for freeing carriers from the meningococcus. When the infection is scanty both agents are generally quickly effectual, but when the infection is abundant the condition is far more difficult to "cure" and chloroamine only is of use (*British Medical Journal*, 1916, November 18, p. 673).

Miss L. H. Hine, in a paper on "The Bionomics of the Tiger-Beetle" (Proc. R. Phys. Soc. Edin., xx., part 1), describes for the first time the egg-laying habits of *Cicindela campestris*. The female insect bores into the soil with her ovipositor to a depth of 4 or 5 mm. "As the hole deepened, the beetle raised herself on her front legs till her body assumed an almost perpendicular attitude." The hole is afterwards filled up and the surface carefully raked over.

An interesting divergence from the normal feeding habit of its family—the Cecidomyidæ, or gall-midges—is shown by the larva of an American fly, *Aphidoletes meridionalis*; instead of eating and deforming plant-tissues it attacks and devours aphids or "greenfly" on such diverse plants as garden pea, oats, and fruit-trees. A fresh account of the life-history and habits, with figures of the various stages, has lately been published by J. J. Davis (*Journ. Agric. Research*, vi., No. 23).

Drs. Raymond Pearl and M. R. Curtis continue their "Studies on the Physiology of Reproduction in the Domestic Fowl" with a memoir on "Dwarf Eggs" (*Journ. Agric. Research*, vol. vi., No. 25). In a period of eight years nearly 300 dwarf eggs were examined at the Maine Station—one "dwarf" to 1158 normal eggs. At least 65 per cent. of those studied "were initiated by an abnormal small yolk or by a part of a normal yolk." About a third of the shells proved yolkless; such "eggs" may be formed through "the stimulation of an active duct by some particle which is not yolk."

THE *American Museums Journal* for October contains an exceedingly interesting article on the common mussel (*Mytilus edulis*), primarily intended to awaken the American public to the fact that in this mollusc they have a source of most nutritious food, which has the further advantage of being practically inexhaustible, vast beds extending along much of the Atlantic seaboard. In his general survey of the life-history of this mollusc, the author, Mr. Irving Field, points out that the ill-effects of overcrowding are at least mitigated by the power of migration which, to a limited extent, even the adults possess in the sucker-like action of the foot. This activity is much more marked in young specimens, which, timed over a measured course, have attained a speed of one inch per minute. At this stage they can creep with ease up the vertical faces of piles and rocks. Further, they have been observed, like pond-snails, to creep along under the surface-film of still water. The almost incredible fecundity of this mollusc, and the number of its enemies, which is surprising, are also fully enlarged upon.

THE forty-ninth annual report of the Fisheries Branch of the Canadian Naval Service, published this year, deals mostly with statistics of the fishery industries of the Dominion and with reports of surveys and inspections. One appendix gives an account of the rather extensive operations of the fish hatcheries in relation to the fresh-water fishes of the great lakes and rivers. Other appendices deal very briefly with the work of the biological stations at St. Andrews, in New Brunswick, and at Departure Bay, in British Columbia. Preliminary notices are made of some highly interesting investigations on the processes involved in the operations of fish-curing, and on the biochemistry of the extractives of cured fish and the organic fluids of various fresh fishes and other marine animals. Other fishery investigations are in progress, and their publication will be a matter of much interest.

THE observations on the sound of gun-firing in the south-eastern counties of England are collected and analysed in an interesting paper by Messrs. M. Christy and W. Marriott (Quart. Journ. Roy. Meteor. Soc., vol xlii., October, 1916, pp. 267–88). Mr. Christy's observations were made at Chignal St. James, near Chelmsford, which is about 125 miles from Ypres and 155 miles from Albert. The sounds which are attributed to firing in the neighbourhood of Ypres consisted of a rapid succession of dull thuds, almost more felt than heard. Those heard on June 24 last and afterwards, from the valley of the Somme, were more intense and so rapid that they formed a fluttering rumble. The sounds have been recorded from nearly the whole of Essex, Kent, Surrey, and Sussex, and from parts of the adjoining counties. The firing near Ypres was heard at Elmdon, in north-west Essex (about 151 miles), and that in the Somme Valley near Winchester and Ringwood, in Hampshire (about 200 miles), and at Wendling, in Norfolk (about 220 miles). Mr. Christy's observations show that the sounds were heard more readily the greater the elevation; in valleys they were seldom noticed. Their audibility also varies with the season. In the spring and summer they were heard nearly every day, in the early autumn very rarely, and never in the winter months. The meteorological conditions that favour the transmission of the sound are discussed by Mr. Marriott. He finds that the sounds were heard most frequently on days when there was a light or moderate breeze from between north and east, and when the sky was cloudy or overcast.

THE climate of Hongkong has recently been discussed by Mr. T. F. Claxton, director of the Royal Observatory, Hongkong. The observatory is not on the island, but is situated near the centre of Kowloon, a small peninsula in South China, separated from Hongkong by a harbour from one to three miles wide. Mean monthly diurnal inequalities are given of the principal meteorological elements, and the times of day at which different temperatures and wind velocities will occur on the average throughout the year. Numerous plates are given showing diurnal ranges of barometer, temperature, rain, cloud, and sunshine, and vector diagrams of wind are also given. At the commencement of the discussion five-day means are given of the principal meteorological elements throughout the year for the period of thirty years, 1884–1913; these values are also given graphically. The four seasons of the year are shown to be well marked in Hongkong. A comparatively cold, dry winter lasts from the beginning of December to the middle of March, followed by a damp, misty spring until May, and a hot summer from June to September, with occasional heavy rain from typhoons which pass mostly to the north and north-west of the observatory. The autumn is usually dry and pleasant. The typhoons are discussed, and especially their influence on the weather at Hongkong and on the basing of weather forecasts from their bearing and distance. Special attention is also given to the effect of variations in the solar activity on the meteorological elements. Greater details would be welcomed on some points; for instance, it is scarcely possible to obtain the recognised reduced barometer readings. The building of the observatory is said to be 103 ft. above sea-level, but the height of the barometer is not given, and clearly most of the readings are uncorrected for height. No mention is made of the correction for gravity.

THE Canadian Arctic Expedition under Mr. V. Stefansson is still at work, and only brief accounts of its progress have so far appeared in the Press. Some further details of the work of the expedition up to the autumn of 1915 now appear in the report of the Department of the Naval Service of Canada for the year ending March 31, 1916. Last year's issue of this publication contained the story of the drift and loss of the *Karluk* and the subsequent rescue of the greater part of her crew. The present volume has better news. In the summer of 1915 Mr. Stefansson, with three companions, explored and charted the west coast of Prince Patrick Island. At Cape McClintock they found one of McClintock's records from 1853. In 78° N. lat. 117° W. long. new land was sighted to the north. They reached this land and explored some miles of its coast-line, but the weather was unfavourable. However, there can be no doubt that this new island in Gustav Adolf Sea is one of considerable size. It seems to be connected with Prince Patrick Island by a chain of small islands or reefs. A further result of the expedition's work is the certainty of the absence of land in the Beaufort Sea, north of the Mackenzie River and west of Banks Land. The continental shelf extends fifty miles beyond Alaska and Banks Land, where the water rapidly deepens to more than 1300 fathoms.

VERY little attention seems to have been paid to the question of the mobility of iron in plants, probably because this element has ordinarily been considered of minor interest in plant nutrition. Pfeffer states that iron, like potassium and phosphorus, may be removed from the older dying organs and transferred to new growth. This view is challenged by Messrs. P. L. Gile and J. O. Carrero, of the Porto Rico Experiment Station, in the *Journal of Agricultural Research*, vol. vii., No. 2. Working with rice plants grown normally in water culture and then transferred to iron-free culture solutions, these experimenters find that chlorosis is invariably noticed first in the new leaves, while the old leaves remain green, the plants dying from the top downwards. If iron were mobile in the plants after reaching the leaves, the phenomena should be different; iron should be transferred from the old to the new leaves, where growth is most active, and the old leaves become chlorotic first. Analyses of the ash from old and new leaves of young rough-lemon trees (*Citrus limonum*), grown in four different soils, show that the percentage of iron in the old is almost twice that in the young leaves. The authors carefully avoid any claim that the non-translocation of iron is a general rule for all plants, since their experiments were chiefly made with rice and pineapples. They suggest, however, that in respect to mobility in the plant iron should be grouped with silicon and calcium, and not with nitrogen, phosphorus, potassium, and magnesium, which are generally considered mobile.

THE current number (December, 1916) of the *School World* contains an interesting account by Canon J. M. Wilson of a thirteenth-century MS. in the Worcester Cathedral Library. Written in Latin, it is the translation of an Arabic text containing the definitions, postulates, and axioms of Euclid's "Elements," Book I., together with a rhetorical abstract of props. 1–20. There are no figures, and, what is still more remarkable, there are no symbols for points. Thus, in English, the summary of prop. 1 is:—"To describe an equilateral triangle on a given straight line. From the two extremities of the given line, setting off its length with the compass, describe two intersecting circles. Then from the common point of the circles draw straight lines to the extremities of the given line. Then deduce the proof from the definition of a circle." One of the greatest of modern works on pure geometry is v. Staudt's "Geometrie der Lage"; here there are no figures, but the author uses symbols for points, planes, and lines. In its absence of symbols for elements, as well as its omission of figures, this geometrical fragment is very peculiar, and possibly unique. Canon Wilson says that there is room for figures on the margin, but he does not say whether any special spaces are reserved for them. Judging from the facsimile (p. 448), we should say that there were not. It may be added that the assumption used in the theory of parallels appears as a postulate and not as an axiom.

IN his repetition of Fizeau's experiment on the drag exercised by moving matter on the ether, Prof. Zeeman used water flowing with a mean speed of about 500 centimetres a second through two parallel tubes 300 centimetres in length and 2 centimetres in diameter. As the two beams of light traversing the tubes pass along their axes it is necessary to know the speed of the water along the axes. In the first instance Prof. Zeeman calculated this speed from the mean speed as given by a water meter, but more recently, according to two communications made to the Academy of Sciences of Amsterdam, which appear in vols. xviii. and xix. of their Proceedings, he has measured the axial speed directly. His method depends on the observation of small air-bubbles introduced into the stream and illuminated by a narrow beam of light sent along the axis of the tube. These bubbles are viewed through windows in the side of the tube by reflection in a mirror rotating rapidly about an axis parallel to the tube. The slope of the line of bubbles as seen in the mirror gives their speed if the angular speed of the mirror is known. He finds that the mean speed in his short pipes is 0·844 of the speed at the axis, while, according to the measurements of Stanton and Pannell at the National Physical Laboratory, the mean is 0·82 of the axial speed for water moving at the same speed in long pipes of this diameter.

MESSRS. CONSTABLE AND CO., LTD., announce the early publication of a translation, by J. H. Johnson, of Jean Rey's "The Range of Electric Searchlight Projectors." The work will embody the investigations and tests carried out by the author in various parts of the world under actual working conditions. It will contain a number of diagrammatic illustrations.

To those who are interested in Russia, Catalogue No. 370, just issued by Mr. F. Edwards, 83 High Street, Marylebone, should appeal, for it is largely composed of particulars of works relating to the Russian Empire. Another section deals with books concerning the United States, Canada, the West Indies, Central and South America, and a third with those on the western counties of England.

OUR ASTRONOMICAL COLUMN.

THE LONGITUDE OF WASHINGTON.—The first direct determination of the longitude of Washington, referred to Paris, has lately been made by American and French astronomers with the aid of wireless signals between the Eiffel Tower and the naval station at Radio, Va. Full details of the extensive observations are given in Appendix to Publications of the U.S. Naval Observatory, second series, vol. ix. The antennæ at the two stations were adapted for the use of practically the same fundamental wave-length, namely, 2150 metres. Notwithstanding the great distance of 3840 miles between the two stations, the signals received at Paris are stated to have been very clear, though those received at Radio were rather feeble. The final result Washington–Paris is given as 5h. 17m. 36·653s. ±0·0031s.; and for Washington–Greenwich as 5h. 8m. 15·721s. ±0·014s. The value of the latter previously derived by the U.S. Coast and Geodetic Survey, and quoted in the Nautical Almanac, was 5h. 8m. 15·78s. It is interesting to observe that the mean double-transmission time was 0·0429s. ±0·0029s., corresponding to a velocity of transmission of 179,000±12,000 miles per second.

A number of American observatories also made arrangements to receive the time signals from Radio and to utilise them for determinations of their longitudes from Washington.

THE VARIABLE NEBULA N.G.C. 2261.—Another case of a nebula of variable form has been found by E. P. Hubble in N.G.C. 2261 (*Astrophysical Journal*, vol. xliv., p. 190). The nebula in question is the finest known example of the rare "cometic" type, and is situated in R.A. 6h. 32m., declination +8° 51′. Its form is nearly that of an equilateral triangle with a sharp stellar nucleus at the extreme southern point, this nucleus forming the irregular variable star R Monocerotis. A photograph taken during last winter by Mr. Hubble with the 24-in. reflector of the Yerkes Observatory showed decided changes in the nebula when compared with a plate taken eight years earlier by F. C. Jordan with the same instrument. Confirmation of the variability was found in a photograph taken by Isaac Roberts in 1900, and in another taken at the Lick Observatory in 1913; also in a photograph taken at Allegheny at Mr. Hubble's request. The most striking change was what at first appeared to be a transverse shift of a bright patch just north of the nucleus, but further examination suggested that this was more probably due to the sudden appearance of a mass of bright nebulosity. There are several other differences between the photographs which appear to be due to real changes in the nebula. In particular, a small mass a little south-east of the nucleus exhibits a decided irregular movement, having moved in towards the nucleus when the above-mentioned new mass appeared. This small mass moved not less than 0·5″ per year between 1908 and 1913, and it seems likely to have a measurable parallax.

Rotation of the entire nebula would not account for the variations observed, but some of the changes may be explained by local brightening and fading of stationary matter. Actual motion of portions of nebulosity relative to the nebula as a whole, however, is regarded by Mr. Hubble as the probable explanation of most of the changes observed. The spectrum of the nebula has been found to be continuous.

THE STRUCTURE OF THE RED LITHIUM LINE.—The complex structure of the red line of lithium, λ 6708, has been further investigated by Dr. A. S. King at the Passadena Laboratory (*Astrophysical Journal*, vol. xliv., p. 172). It is shown that the line may appear with two distinct sets of components, either as an unsymmetrical doublet, or as a triplet of variable separation. In a third stage the side components of the triplet change into an ordinary reversal within which the central component can still be seen. All three conditions of the line may be produced either in the arc or electric furnace, and the controlling agency appears to be the amount of vapour in the source. The variable interval of the components suggests an electrical resolution, which would most likely be due to the action of interatomic fields. The observations have proved that the line at 6708 which commonly appears in calcium spectra is due to lithium impurity. Also, it may now be considered certain that the strong line appearing at this position in the spectra of sun-spots should be attributed to lithium. It is remarkable that this should be the only direct proof of the presence of lithium in the sun, there being no representatives of this element in the Fraunhofer spectrum.

PLANTATION RUBBER.

THE *Trade Supplement* of the *Times* for December is devoted almost entirely to plantation rubber. The editor has drawn upon some of the best authorities in the plantation world for his contributions, and without exaggeration has achieved a pronounced success. The articles deal with the development of the plantation rubber industry throughout the Middle East, the physical, biological, and chemical problems involved in the preparation of the raw material, and the importance of the supplies to the manufacturing industry in this and every other country.

The large number of contributors has resulted in repetition of the same facts, but this was scarcely avoidable in such an issue. Much of the information has already been disseminated in text-books and technical journals, but the matter has been rendered in this supplement in a form which will appeal to all interested in the industry either financially or technically.

In one of the most important articles Prof. J. Bretland Farmer outlines the risks of tropical agriculture, the efforts which have been made by Government and private individuals, and the need for still greater precaution and the placing of the industry on a better scientific foundation. It is already known that the Imperial College of Science has sent a number of scientific officers to the Middle East, and we know from personal contact with them that they have felt the necessity of periodically spending a part of their time in first-rate laboratories in Europe or America. It is impossible for the scientific officers in charge of plantations in the Middle East to be conversant with all the advances made in plant sanitation, biological problems, and testing apparatus of value to the plantation industry

A brief survey of the article on "Pests and Diseases," by Mr. J. Mitchell, satisfies one that there is every reason why the many diseases affecting the roots, bark, stems, and fruits of *Hevea brasiliensis* should be carefully watched. The necessity for independent scientific officers to be put in charge of such work is quite apparent even to the ordinary investor, who has but little knowledge of mycological and entomological problems

With regard to the physical and chemical researches in the laboratories of the manufacturers, some very useful information is contributed by Mr. W. A. Williams, Dr. Joseph Torrey, and Dr. Philip Schidrowitz. There is a great lack of uniformity in cultivated rubber, which materially affects processes of manufacture and the finished article. It is suggested that the difficulties consequent on variation of plantation rubber can be reduced by standardisation of methods of preparation on the estate and by closer co-operation with manufacturers in this country. The lack of co-operation between plantation growers and manufacturers is emphasised by Mr. Alexander Johnston.

A review of this supplement cannot be completed without reference to the very strong article by Mr. E. Stevenson, chairman of the Rubber Trade Association of London. Mr. Stevenson points out the absolute need of organisation, and shows that the growers themselves are very largely responsible for the competitive system which they have set up. Organisation is apparently as necessary among producers, manufacturers, and dealers in raw rubber as it is on the plantations, and the supplement before us will serve a good purpose if it results in any definite advances being made in this direction. H. W.

MARINE ISOPODA FROM THE NORTH ATLANTIC.[1]

THE papers before us form two of the valuable series of reports now being issued by the Danish Government, through the Zoological Museum at Copenhagen, on the results of the exploration of the deep sea in the neighbourhood of Greenland, Iceland and the Faröes. They constitute a monograph of the Isopoda and Tanaidacea of that region, and their importance may be judged from the fact that, whereas previously only fifty-three species of Isopoda were known from the area surveyed, Dr. Hansen records 242 species, of which 125 are described for the first time, and establishes eighteen new genera. This satisfactory result is due to the methods of collecting introduced by the author during the expedition. The mud brought up in the trawl and dredge was carefully sifted through fine bolting silk, and the results of the sifting preserved for future examination. In this way hundreds of small animals, which could not have been collected by any other means, were discovered. This method may be recommended to naturalists in charge of future expeditions for the ex-

[1] "The Danish *Ingolf*-Expedition." Vol. iii., No. 3, "Crustacea Malacostraca," II. By H. J. Hansen. Pp. 145+12 plates. (1913.)
"The Danish *Ingolf*-Expedition." Vol. iii., No. 5, "Crustacea Malacostraca," III. Pp. 262+16 plates (Copenhagen: Printed by Bianco Luno, 1919.)

ploration of the deep-sea fauna. We can speak from personal experience of the efficacy of a modification of Dr. Hansen's methods which has been used with great success in the exploration of the deep water to the west of Ireland, where the use of fine silk townets attached to the dredge and trawl has revealed a wealth of species undreamt of by earlier British marine biologists.

Dr. Hansen prefaces his reports by a critical account of the literature relative to the area surveyed by the *Ingolf*, and a valuable summary of the geographical and bathymetric distribution of the species in the collection.

Of special interest is his conclusion that the Wyville-Thomson ridge does not form an absolute line of separation between the deep-sea fauna of the cold and warm areas. Evidence is submitted of several species which have been found in both areas, and the author rejects the hitherto accepted explanation of this distribution, that these species were taken pelagically and not actually on the bottom.

Dr. Hansen has a valuable chapter on sexual differences among Tanaidæ, in which he comments on the rarity of adult males, and makes the interesting suggestion that the development of the marsupium and eggs in the female is accompanied by a reduction in size. His remarks on the nomenclature of segments and joints and on generic and specific characters in Tanaids will prove of the utmost service to students of this difficult order of Crustacea, which is marked by great uniformity of external form and the absence of tangible characters upon which species and genera may be distinguished.

The most important morphological feature brought forward in these reports is the evidence in favour of the author's theory, advanced some twenty-three years ago, that the sympod of all biramous appendages in Crustacea was primarily three-jointed. Hitherto no evidence in support of his case could be brought forward as regards the thoracic limbs of the Malacostraca (with the exception of Nebalia), but Dr. Hansen has now produced evidence of the existence of a præcoxal joint in the maxillipeds of two species of Isopoda.

The new species and genera are clearly described and illustrated by a series of beautifully drawn figures. The wealth of material at the disposal of the writer and his clear and critical insight into the true value of characters for systematic purposes have led him to suggest several modifications in the minor classification of the families and genera of Isopoda, which tend to a better understanding of the group and to a restoration of order out of the chaos into which it was rapidly falling.

Students of Arthropoda have been indebted to Dr. Hansen in the past for a series of illuminating papers elucidating the structure and classification of many obscure and difficult groups. Their obligations are considerably increased by the publication of these valuable papers, which workers on Isopoda will find indispensable to the successful prosecution of their studies.

W. M. T.

GROWTH FACTORS OF FOODS.

THE *Biochemical Journal* more than maintains its increasing and well-deserved reputation in the current number (vol. x., No. 3). The articles of most general interest are two on feeding experiments, which were carried out at the Cambridge Biochemical Laboratory under Prof. F. G. Hopkins's direction. These experiments are a continuation of the very careful and elaborate series which Prof. Hopkins has been making for several years past upon the growth factors of foods. In all of them young albino rats of uniform origin, sex, and weight are employed. They are fed and treated in an exactly similar manner, except with regard to the essential factor with which the investigation is concerned. The food consists of starch, cane-sugar, fat, suitable salts, and various protein products, together with the alcoholic extract of 1·5 c.c. of milk per diem, as this extract contains an unknown "vitamine," which is absolutely essential for the normal growth of the rats. In the first series of experiments, carried out by G. Totani, it was found that rats fed on the hydrolysed products of caseinogen from which all but 0·2 per cent. of the tyrosine had been removed, and to which a small quantity of tryptophane had been added, grew just as rapidly as on a similar diet to which tyrosine was added in addition. Other experiments made with a diet of hydrolysed gelatin—which contains no tyrosine or tryptophane—showed that whilst the rats lost 18 per cent. in weight in a month, they lost little, if any, weight if tryptophane were added. The addition of tyrosine as well was without influence, and so it seems highly probable that the tissues of the mammal have the power of synthesising tyrosine. They form it from phenylalanine, but the small amount of this substance present in gelatin suggests the possibility that they can synthesise the benzene ring from non-aromatic substances.

The second series of experiments relates to the synthesis of tryptophane in the body. It is known that some of the tryptophane of the food is excreted in the urine in the form of a quinoline derivative, kynurenic acid, and C. Asayama investigated the capacity of the tissues to carry out the reverse change. He found that rats fed on the amino-acids formed by the prolonged acid hydrolysis of caseinogen—a treatment which destroys all the tryptophane originally present—rapidly lost weight and died in eight weeks, though they grew moderately if tryptophane were added. If kynurenic acid were substituted for the tryptophane they lost weight and died at almost exactly the same rate as when no kynurenic acid was added at all, so we must conclude that whatever the synthetic powers of the tissues for tryptophane may be, they do not extend to this substance.

EDUCATIONAL REFORM.

THE Education Reform Council, which was founded last April at a conference called by the Teachers' Guild, has issued a programme of education reform. The work of the council is as yet incomplete, and it is hoped to publish the full report early next year. Among other important recommendations enumerated in the programme the following deserve special mention. The Ministry of Education should hold a higher place in the hierarchy of the offices of the State, and the salary of the Minister should be equivalent to that of other principal Secretaries of State. Progressive organisation is hindered by certain statutory distinctions between higher and elementary education. Local authorities for higher education should be obliged to supply or aid the supply of higher education, and the limit of 2*d*. to the higher education rate in the county areas should be removed. For the purpose of co-ordinating the activities of local education authorities with those of the universities and institutions for higher education, the country should be divided into educational provinces, the areas of which should be larger than those of the existing local authorities.

The number of efficient secondary schools of varying types should be increased. The Consultative Committee has advised the strengthening of the higher work of secondary schools, and the Reform Council considers that schools taking the lower grant should receive grants for this purpose. Pupils at any school recognised as efficient by the Board of Education should be eligible for State scholarships for prolonging secondary education, or tenable at the universities. Many capable students will continue to be debarred from the universities, with consequent loss of national efficiency, if these scholarships are limited to "aided" schools. In secondary schools pupils should remain as a rule until the end of the term in which the seventeenth birthday occurs. Financial provision should be made to enable suitable pupils to continue at school until they enter the university. The Reform Council expresses complete agreement with the view advanced by the Consultative Committee that large additional funds should be provided by the State for scholarships for higher education. The amount suggested—329,500*l.* per annum—is not too large. The selection of students for scholarships to the universities and institutions for higher education should be based upon an expert review of the relevant qualifications rather than upon a central competitive examination. Such relevant qualifications are the school record, examination record, probable career, and general personal fitness. The amount of assistance given should be such as to enable the scholar to live in a manner befitting a university student during the normal course required for graduation, and for the necessary post-graduate preparation for professional practice.

The opinion is expressed that for most professions, and for research in pure science, at least one year of post-graduate preparation is necessary. In determining the number and incidence of the awards, the main consideration should be the national need to strengthen the learned professions (including teaching), and to further industry, commerce, and agriculture. The Board of Education should allocate grants for higher scholarship purposes to the provincial boards; the provincial boards should make the awards, their action being co-ordinated by the Board of Education or by a special national board.

THE WORLD'S SUPPLY OF PHOSPHATES.

PROF. J. W. GREGORY, in his presidential address to the Geological Society of Glasgow, gave an account of the chief sources of the world's supply of phosphates, in the course of which he pointed out that an instructive lesson in the conservation of mineral resources was to be learnt from this subject. He showed that Britain has but limited supplies of natural phosphates, and these were being left unworked owing to the introduction of cheaper and richer products from foreign deposits. Prof. Gregory dealt only with the natural phosphates, but he could well have strengthened his argument by reference to the artificial phosphates; that is to say, to basic slag, which has been such a very important source of phosphorus supply to the agriculturist during recent years.

The world's production of natural phosphates in 1913 was approximately six million tons (of which the United States produced one-half), whilst that of basic slag was approximately three million tons. Great Britain is now producing considerable quantities of low-grade basic slag, a by-product from the basic open-hearth steel process, and is likely to produce much more in the near future, but much of this valuable material is being wasted to-day owing to the insistence of the authorities upon the citric acid solubility test, a test devised in Germany, and adopted without proper investigation in this country; its real object was, of course, to favour the slag produced by the Basic Bessemer, or Gilchrist-Thomas, process, a process to which German iron ores are well adapted, to the prejudice of slag produced in the basic open-hearth process, which latter suits British iron ores better. Many of our best agricultural authorities hold that, in spite of the above empirical test, our slags are quite as efficient as manurial agents as are the Basic Bessemer slags, and if we had in this country a department charged with the care of the proper utilisation of our own mineral resources, this subject would no doubt have received the attention that its importance merits.

Prof. Gregory has done valuable service in again directing attention to our supply of phosphates, and it is clear that, from the point of view both of the natural and of the artificial phosphate supply, the question is one of vital importance to our great agricultural interests.

AGRICULTURE AT THE BRITISH ASSOCIATION.

WITH the continuance of the state of war it is inevitable that where agriculturists forgather for discussion the central theme should be the problem of the more efficient utilisation of British soil. The task of British agriculture is the dual one of securing on one hand a more efficient, and on the other a more economical, utilisation of our resources in land and labour. The prolongation of the war renders more and more difficult the task of extending cultivation, and it becomes all the more necessary to devote attention to the consideration of economy.

It was thus timely and desirable that such considerations should bulk largely in the proceedings of Section M at the recent meetings. The topics discussed may be roughly grouped under the three heads of "Economy in Crop Production," "Economy in Meat Production," and "Economy and Reform in Timber Production."

The first group of problems received a fitting introduction in the presidential address, in which the possibilities of securing increased output of crops and the directions in which economies can be effected in existing practice were aptly summarised. In subsequent discussions more detailed consideration was given to the possibilities of motor cultivation and of the practice of ensilage.

Mr. C. B. Fisher introduced the former subject with a critical consideration of the possibilities of the extended application of steam and other mechanical tractors in the cultivation of the soil. His own experience led him to advocate warmly the extended use of motor tractors, although conscious that existing models left much room for improvement, and that more extensive and precise tests under experimental conditions are urgently needed. The general trend of the discussion substantially confirmed these views, although a disappointing experience in Scotland related by Mr. Alex. McCallum served to emphasise the need for caution under existing conditions.

In introducing the subject of ensilage for discussion, Mr. A. Amos gave the results of experience on Norfolk farms with this method of preserving green crops, which led him to advocate warmly its merits, not the least of which was the possibility of reducing or eliminating the costly root crop. Further testimony to the valuable results obtained in East Anglia was given by Messrs. Oldershaw and Wilson.

The importance of climate as a limiting factor in crop production was discussed by Mr. T. Wibberley, who once more urged the advantages of a rational system of continuous cropping as a means of securing increased output and greater economy.

A further contribution to the subject of economy in crop production was made by Mr. E. H. Richards in his summary of studies made at Rothamsted of the economy of the manure-heap, which demonstrate clearly how the lamentable waste of nitrogen involved in present practice may be most effectively reduced. Passing reference may also be made to his further discovery that under certain conditions an actual gain of nitrogen may be secured. The communication by Dr. T. Goodey of an experimental verification of the view advanced by Messrs. Russell and Hutchinson as to the *rôle* of protozoa in controlling the activities of soil bacteria is also worthy of note, and must have given special satisfaction to the president.

The subject of "Economy in Meat Production" was introduced by Messrs. T. B. Wood and K. J. J. Mackenzie by the contribution of interesting and valuable data as to the food requirements of animals under various conditions of feeding. The differences in the economy of utilisation of fodder for the supply of the different forms of animal produce used for human consumption prove to be most striking. Whereas the good milch cow will yield, in the form of milk, energy equivalent to one calorie for every $5\frac{1}{2}$ calories consumed in the form of fodder, the production of mutton requires practically double, and the production of steer beef nearly three and a half times, the expenditure of energy.

The subject was further discussed from quite different aspects by Prof. D. A. Gilchrist. Experience in the familiar experiments at Cockle Park led him to urge the possibility of securing considerable economies in meat production by reforms in manuring and cropping. On many farms the cost of production of meat and milk could be sensibly lowered by an increased use of basic slag or other phosphates and a reduced expenditure on oil-cakes.

Brief reference only can be made to the further interesting contribution by Mr. Mackenzie on "The Inheritance of Mutton Points," in which a summary of interesting investigations at Cambridge was given.

Much of the land of Great Britain is naturally incapable of yielding high returns to agriculture, and for such the respective claims of agriculture and sylviculture must be duly weighed. In an interesting survey of the past and future of British forestry Prof. Somerville directed attention to the fact that nearly twenty million acres of land in the United Kingdom are used as rough mountain grazing or as deer forests, some $15\frac{1}{2}$ millions being less than 1500 ft. above sea-level. This land, which produces no more than $15\frac{1}{2}$ lb. of meat (chiefly mutton) per acre per annum, would, if rationally afforested, produce a crop of one ton of timber, besides providing employment for ten times the population occupied with pastoral farming. Our forest practice in the past has been seriously defective in many respects. Our woods have been much understocked; there has been little appreciation of specific individual requirements in respect of crowding, and ground game has taken a heavy toll of young trees, or has in other ways been a serious charge on profits. Government action in the past has led to some improvement in education, management, statistics, etc., but has not prevented a marked shrinkage in our wooded area. If a large extension is to be secured, State action will be necessary, and, in the opinion of those who have given most thought to the subject, such extension on a scale commensurate with the nation's requirements can only be attained by purchase.

A further feature of interest in forest economy was dealt with by Mr. S. H. Collins. For some time Mr. Collins, in association with Mr. J. F. Annand, has been examining the possibility of economic utilisation of branch wood and other forest waste by distillation in a portable plant, whereby charcoal, tar, and acetate of lime are obtained as saleable products. Under their guidance members of the Association had an opportunity of seeing the experimental plant in operation in the Crown Woods of Chopwell. Shortage of labour has hampered the experiment in its preliminary stages, but the results so far obtained promise well for future success. The inspection of the woods under the guidance of Mr. Annand added further to the interest of the excursion.

It is gratifying to note that despite the exceptional difficulties of the times an excellent attendance was obtained throughout the sectional meetings, and adequate discussion thereby secured.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WITH the desire to encourage the study of Russian, in view of the commercial intercourse between Russia and Hull, Capt. H. Samman has expressed to the Hull Chamber of Commerce his willingness to start an endowment fund for the purpose with a sum of 10,000*l*.

THE annual meeting of the Mathematical Association will be held on Friday, January 5, 1917, at the London Day Training College, Southampton Row, London, W.C., under the presidency of Prof. A. N. Whitehead. The subjects of papers are:—The school syllabus in geometry, T. P. Nunn; Some of the work of the Teaching Committee, Mr. A. W. Siddons; Technical education and its relation to literature and science, Prof. A. N. Whitehead; An accuracy test set in some public schools, Mr. A. W. Siddons; The place of mathematics in educational reconstruction, Mr. P. Abbott. A joint meeting of the Mathematical and the Geographical Associations will be held on Saturday, January 6, at 10.30 a.m., when Prof. T. P. Nunn will read a paper on "Map Projections." Mr. H. J. Mackinder, M.P., will take the chair.

IN October last an invitation was extended by the Universities of Leeds and Sheffield to the Circle of Scientific, Technical, and Trade Journalists to form a party of journalists to visit these two cities. A similar visit to the Universities of Liverpool and Manchester took place on December 10–13. In the absence, through indisposition, of the Vice-Chancellor of Liverpool University, the party was received by Prof. Gonner, the deputy-chairman of Senate, and Mr. Carey, the registrar. Prof. Herdman gave an address, in which he referred specially to the departments of modern languages and geography, the School of Tropical Medicine, and the researches being undertaken in connection with sea-fishery. These departments, together with those devoted to chemistry, engineering, etc., were visited by the party in the course of the day. The University of Manchester and the Manchester Municipal School of Technology were visited on Tuesday. Sir Henry Miers, Vice-Chancellor of the University, addressed the party, and in the course of the inspection of the laboratories short lectures were delivered by Prof. Harold Dixon on "Explosives" and Sir Ernest Rutherford on "Radium Emanations." At the Municipal School of Technology the work was of a very varied and comprehensive character, including special departments for cotton spinning, printing and paper manufacture, organic chemistry and dyeing, engineering and electrometallurgy. The visitors were entertained by the Lord Mayor of Manchester to luncheon, when an address on the work of the Municipal School of Technology was delivered by Principal Garnett. At a dinner and reception in the evening speeches were made by Sir Henry Miers, several of the professors, and some of the visitors, the hope being expressed that such visits would lead to closer relations between the scientific and technical Press and the universities, and to a more general appreciation among manufacturers of the benefits of scientific research. The proceedings were concluded by a visit to the works of the British Westinghouse Electric and Manufacturing Co., Ltd.

SOCIETIES AND ACADEMIES.

LONDON.

Linnean Society, November 30.—Sir David Prain, president, in the chair.—J. **Small**: The floral anatomy of some Compositæ. The vascular supply of various bilabiate or ray-florets was discussed, and it was shown that in these the vascular supply varies more or less with the size of the anterior lip of the corolla. The floral anatomy of *Senecio vulgaris* was described in detail. The corolla in the Cichorieæ has a very constant type of vascular supply, similar to Senecio, but with the posterior upper peripheral bundle dividing into three to supply the edges of the ligule and the posterior stamen. *Taraxacum officinale* is described in detail. The ray-florets of *Calendula officinalis* and *Tussilago Farfara* show a very simple type of anatomy. The peculiar homogeneousness within itself of the Cichorieæ and its isolation from the rest of the Compositæ are extended to the floral anatomy.—J. **Small**: Wind dispersal apparatus. The purpose of the apparatus is to determine the exact velocity of the wind required to blow the fruits of the Compositæ a sufficient distance to secure proper dispersal. It has been found that the following minimum winds are necessary for the dispersal of the fruits of the species named below:—*Senecio vulgaris*—1·6 m.p.h. = a light air; *Senecio vulgaris*, var. *radiatus erectus*—1·89 m.p.h. = a light breeze; *Ursinia speciosa*—2·6 to 2·94 m.p.h. = a light to gentle breeze; *Taraxacum officinale*—1·5 m.p.h. = a light air; *Tussilago Farfara*—0·62 to 0·65 m.p.h = less than a light air; *Centaurea imperialis*—7·7 m.p.h. = a moderate breeze; *Leontopodium alpinum*—4·78 m.p.h. = a gentle breeze.—T. A. **Dymes**: A note on the seed of *Iris Pseudacorus*, Linn. There are two forms of seed in each capsule:—(1) Flat seeds in the straight portion; (2) more or less rounded seeds at the curved top and bottom of the capsule. The seeds drop or are blown from the placenta after the capsule dehisces. They lie over until the late spring. Those that fall on to the mud and remain there appear to perish from decay. The loose, light testa enables the seeds to float for a period of at least four months. Seeds that have not sunk germinate on or near the surface of the water in the latter half of May. The flat seeds germinate before the rounded. The cotyledon remains within the endosperm. The radicle elongates and branches freely; it does not curve downwards, but grows along the surface of the water. Adventitious roots are formed close up against the seed, and they also branch freely. The unbranched upper portion of the radicle secretes chlorophyll. The plumule grows slowly; it, too, lies along the surface of the water. When the root system is well developed the leaves begin to curve upwards and the seedling gradually assumes a vertical position, after which the leaves grow much more rapidly. The fate of those seeds, if any, that sink before germination has not yet been determined. The dispersal agents are, in the first instance, the wind, and afterwards water. Even on a slow stream the seeds may drift many miles during the four months of the floating period.

Aristotelian Society, December 4.—Dr. H. Wildon Carr, president, in the chair.—Dr. B. **Bosanquet**: The function of the State in promoting the unity of mankind. The essence of the Greek and German theory of the State has been mistaken by recent critics, although it has been rightly explained by English thinkers. The so-called absolutism of the State is merely a caricature of the unique relation between a man and the community with which his will is united, especially in so far as it provides an adjustment of all practical relations. Essentially, according to the theory, as having the same task in different territories, States are co-operative. Their function is the organisation of rights. The State, then, is a moral being with a conscience, and when its conscience is perverted it will fight for the wrong as its right. It is true that the moral position of the State is not comparable to that of a private individual, and this view is described as absolutism from unintelligence of what constitutes a moral situation and duty. As to wider loyalties and units than that of the nation-State, there *is* no being like the "humanity" of the Comtists, and humanity as a quality belongs chiefly to exceptional communities. Wider communities than the nation-State may be possible, but only if they fulfil the same condition of unity—namely, a general will. Without this, all leagues, federations, etc., are mere force and dangerous, and with it, scarcely necessary. The true outlook for peace is to the removal of causes of discontent by organisation at home, especially by freedom of human intercourse and absence of privilege. World-wide human relations are no reason for world-wide political units. A system of States, each well organised at home, might be just as peaceful as, and much more valuable than, a world-State.

PARIS.

Academy of Sciences, November 20.—M. Camille Jordan in the chair.—C. **Richet**: The alternating use of antiseptics. It has been shown by the author in earlier communications that micro-organisms can acquire immunity towards certain antiseptics, and this immunity can be transmitted. In the treatment of wounds by antiseptics this fact should be taken into account, and the conclusion is drawn that in the treatment of a wound the same antiseptic should never be used on two consecutive days.—P. **Vuillemin**: The supposed heterotaxy of nasturtium flowers.—E. **Borel**: The approximation of incommensurable numbers by rational numbers.—G. **Julia**: Some properties of the Fuchsian group formed from modular substitutions which do not change an indefinite Hermite form.—E. **Kogbetliantz**: Series of ultra-spherical functions.—G. **Koenigs**: Properties of the second order of plane movements with two parameters.—H. **Vergne**: A method of calculating perturbations of a known movement.—L. **Roy**: The problem of the wall in electrodynamics.—M. **Russo**: Geological notes on the region of Bou Laouane (western Morocco).—C. **Galaine** and C. **Houlbert**: The Hermelles reefs and the drying up of the bay of Mont Saint-Michel.—G. **Lardennois** and J. **Baumel**: Gangrenous infection of wounds by anaerobic germs.—H. **Bierry**: The detection of tubercle bacilli in expectorations and various animal fluids. Isolation and detection of elastic fibres. The technique for sputa consists in the addition of very dilute alkali and sodium hypochlorite at 35°–40° C. The liquid is just rendered acid with acetic acid, and the resulting precipitate, which contains the tubercle bacilli and elastic fibres, separated by the centrifuge. Details are given of the modifications suitable for the examination of blood, pleural secretions, and cephalo-rachidian fluid.

BOOKS RECEIVED.

Opere Matematiche. By L. Cremona. Tomo iii. Pp. xxii+520. (Milano: U. Hoepli.) 30 lire.

A Bibliography of British Ornithology. By W. H. Mullens and H. Kirke Swann. Part iv. (London: Macmillan and Co., Ltd.) 6s. net.

The Earliest Voyages Round the World, 1519–1617. Edited by P. F. Alexander. Pp. xxiii+216. (Cambridge: At the University Press.) 3s. net.

The Scientist's Reference Book and Diary, 1917. Pp. 134+Memoranda. (Manchester: J. Woolley, Sons, and Co., Ltd.) 2s. 6d.

The Standard Cyclopedia of Horticulture. By L. H. Bailey. Vol. v. Pp. 2423–3041. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 25s. net.

Mechanisms of Character Formation. By Dr. W. A. White. Pp. 342. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 7s. 6d. net.

Morphology of Invertebrate Types. By Dr. A. Petrunkevitch. Pp. xiii+263. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 6s. net.

A Text-Book of Botany for Colleges. By Dr. W. F. Ganong. Pp. xi+401. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 8s. 6d. net.

The Supervision of Arithmetic. By W. A. Jessup and L. D. Coffman. Pp. vii+219. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5s. net.

The Fundamentals of Psychology. By Prof. W. B. Pillsbury. Pp. ix+562. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 8s. 6d. net.

Elementary Qualitative Analysis. By Dr. B. Dales and Dr. O. L. Barneley. Pp. vii+205. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5s. 6d. net.

A Handbook for Cane-Sugar Manufacturers and their Chemists. By Dr. G. L. Spencer. Fifth edition. Pp. xv+529. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 15s. net.

A Manual of Fire Prevention and Fire Protection for Hospitals. By Dr. O. R. Eichel. Pp. v+69. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4s. 6d. net.

David Gill, Man and Astronomer. Memories of Sir David Gill, K.C.B. Collected and arranged by G. Forbes. Pp. xi+418. (London: J. Murray.) 12s. net.

Aérodonétique. By F. W. Lanchester. Translated by Commandant C. Benoit. Pp. xvii+478. (Paris: Gauthier-Villars et Cie.) 14 francs.

Intégrales de Lebesgue, Fonctions d'Ensemble, Classes de Baire. By Prof. V. Poussin. Pp. viii+154. (Paris: Gauthier-Villars et Cie.) 7 francs.

Poverty and its Vicious Circles. By Dr. J. B. Hurry. Pp. xiv+180. (London: J. and A. Churchill.) 5s. net.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 14.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Colonial Telegraphs and Telephones: R. W. Weightman.

MATHEMATICAL SOCIETY at 5.30.—Orbits Asymptotic to an Isosceles Triangle Solution of the Problem of Three Bodies: Prof. D. Buchanan.—Diffraction of Waves by a Wedge of any Angle: Prof. H. S. Carslaw.—(1) Proof that almost all numbers n are composed of about $\log \log n$ prime factors; (2) An Asymptotic Formula for the Number of Partitions of a Number: G. H. Hardy and S. Ramanujan.—Two Theorems of Combinatory Analysis and Two Allied Identities: Prof. L. J. Rogers.—The Harmonic Functions associated with the Parabolic Cylinder (second paper): G. N. Watson.—(1) The Internal Structure of a Set of Points in Space of any Number of Dimensions; (2) The Inherently Crystalline Structure of a Function of any Number of Variables: Prof. W. H. Young and Mrs. Young.—The Efficiency of a Surface of Pressure Discontinuity regarded as a Propeller: Prof. W. Burnside.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—(*Discussion*): British and Metric Measures in Geographical Work: opened by the Secretary.

OPTICAL SOCIETY, at 8.—The Refractometry and Identification of Glass Specimens—especially Lenses: L. C. Martin.—A Workshop Method of Determining the Refractive Index of a Piece of Glass having one Flat Surface: Dr. R. S. Clay.

ROYAL SOCIETY OF ARTS, at 4.30.—The World's Cotton Supply and India's Share in it: Prof. J. A. Todd.

LINNEAN SOCIETY, at 5.—Observation on the Root System of *Impatiens Roylei*, Walp.: Miss Isabel McClatchie.—The Teeth of some Palæozoic Sharks: Dr. A. Smith Woodward.—Sex Distribution in *Myrica gale*, Linn.: Miss A. J. Davey and Miss M. Gibson.

FRIDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Variable-speed Gears for Motor Road-vehicles: R. E. Phillips.

ILLUMINATING ENGINEERING SOCIETY, at 5.—Suggestions regarding War Economies in Lighting: L. Gaster.

MONDAY, DECEMBER 18.

ARISTOTELIAN SOCIETY, at 8.—The Organisation of Thought: Prof. A. N. Whitehead.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—New Caledonia and the Isle of Pines: R. H. Compton.

FARADAY SOCIETY, at 8.—A Precision Method of Uniting Optical Glass—the Union of Glass in Optical Contact by Heat Treatment: R. G. Parker and A. J. Dalladay.—The Effect of Pressure on the Equilibrium Constant of a Reaction in a Dilute Solution. A Simple Proof of the Expression: Dr. W. C. McC. Lewis.—Do Equiatomic Solutions in Iron possess Equal Resistances? E. D. Campbell.—Grain Growth in Deformed and Annealed Low Carbon Steel: R. H. Sherry.

TUESDAY, DECEMBER 19.

ROYAL STATISTICAL SOCIETY, at 5.15.—The Reorganisation of Official Statistics and a Central Statistical Office: G. Drage.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Further discussion:—Experiments on Earth-pressures: P. M. Crosthwaite.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—Notes on the Subject of Geological Mapping: S. Lister James.

WEDNESDAY, DECEMBER 20.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Measurement of Rainfall Duration: C. Salter.—Discontinuities in Meteorological Phenomena. III.: Prof. H. H. Turner.

ROYAL MICROSCOPICAL SOCIETY, at 7.—Certain Sessile Forms of Foraminifera: Prof. S. J. Hickson.—Note on the Relation between the Hatching and Development of the Larvæ of the Yellow Fever Mosquito, *Stegomyia fasciata*, and the Presence of Bacteria and Yeasts: A. Bacot.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL SOCIETY OF ARTS, at 4.—Classical and Scientific Education: A. C. Benson.

THURSDAY, DECEMBER 21.

CHEMICAL SOCIETY, at 8.—Studies on the Walden Inversion. V. The Kinetics and Dissociation Constant of α-Bromo-β-phenylpropionic Acid: G. Senter and G. H. Martin.—The Alcohols of the Hydroaromatic and Terpene Series. III. The Isopulegols corresponding with *l*-Menthol and *d*-Neomenthol: R. H. Pickard, W. Lewcock, and H. de Pennington.—Lead Sub-iodide with Details of the Preparation of Lead Suboxide: H. G. Denham.—Note on the Solubility of Lead Iodide: H. G. Denham.—Chromium Phosphate: A. F. Joseph and W. N. Rae.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—The Economic Geology of the Insizwa Range: W. N. Goodchild.

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

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THURSDAY, DECEMBER 21, 1916.

A TEXT-BOOK OF HUMAN PARASITOLOGY.

The Animal Parasites of Man. By Dr. H. B. Fantham, Prof. J. W. W. Stephens, and Prof. F. V. Theobald. Pp. xxxii+900. (London: John Bale, Sons and Danielsson, Ltd., 1916.) Price 45*s*. net.

THIS volume is, according to the title-page, partly adapted from the fourth edition (1908) of Braun's "Die Tierischen Parasiten des Menschen," but the section on the Protozoa has been almost entirely rewritten in order to bring it up to date, and the section on the worms has received so many additions to its text and figures, and has consequently been remodelled to such an extent, that it also may be regarded as in large degree new.

An introductory chapter deals in an interesting manner with the general characters of parasites and the influence of parasites on their hosts.

The section on Protozoa (186 pages, by Dr. Fantham) contains a systematic account of the Protozoa known to occur in man, and also of the more important forms, especially the trypanosomes, which have been found in animals—laboratory, domestic, and draught—likely to come under the notice of medical officers. In addition to the undoubted Protozoa, the Spirochætes and the Chlamydozoa receive adequate treatment. The morphology and life-history (so far as this is ascertained) of the various organisms are stated in clear and concise terms, and the results of recent work—up to about July, 1915—are incorporated, the later papers being noticed in an appendix, which also contains directions for preparing culture media and some helpful notes on general protozoological technique.

There does not appear to be any mention of Amœbæ of the *limax* type, found from time to time in the large intestine of man; a statement of the characters of this type of Amœba would have been helpful.

The whole account is well done, but the part dealing with the flagellates may be especially commended.

The section on the flat and round worms (271 pages, by Prof. Stephens) is an excellent piece of work, in which the numerous recent researches on these groups have received full attention. By the insertion, in the section on Schistosoma (Bilharzia), of a slip giving the characters of the two species, *S. haematobium* and *S. mansoni*, based on the observations of the War Office Bilharzia Mission in Egypt, the literature on these parasites is brought down to March, 1916. The anatomy of the adult, the characters of the egg and the known larval stages, the accompanying symptoms, and the pathological effects of the various parasitic worms recorded from man are clearly set forth. Special praise is due to the author for the excellence of the illustrations, many of which are either new or reproduced from recent memoirs.

The section on the Arthropoda (133 pages, by Prof. Theobald) gives a systematic account of the mites, ticks, and insects which have been recorded as attacking man. Much unaltered text from the previous edition has been retained, and with this numerous paragraphs dealing with new matter have been incorporated. This has no doubt been the cause of the use in places of obsolete nomenclature, *e.g.* the dog flea is named *Pulex serraticeps* on p. 546; its correct modern name is given on the next page, but without any suggestion that the two names are in any way synonymous.

The first part of this section deals with the Arachnida—mites, ticks, etc. Much work has been done on ticks since the last edition was issued, and many excellent figures have been published, but the present account is illustrated only with the four figures from the edition of 1906. The legend of one of these (Fig. 359B) is incorrect, the structure shown being the terminal part of the chelicera and not "the terminal joint of the maxillary palpi." The statement of the characters of some of the species of ticks is entirely inadequate, *e.g. Amblyomma cajennense* is "characterised by the possession of eyes," and no other characters are given except the measurements of the adult male and female.

The short account of the lice is reprinted with the old figures from the edition of 1906, and there is no reference to the body-louse as carrier of relapsing fever and typhus. The five figures of fleas in the former edition are reprinted; new figures should have been added to enable the reader to follow the essential differences between the principal genera described. The characters of the plague-flea are insufficiently set forth, and in the short paragraph on the relation of this flea to plague is the statement: "How the flea infects man does not apparently seem to have been proved, as it does not do so through its bite." The work of Bacot and Martin on the part played by fleas in which the proventriculus is blocked by a culture of plague bacilli has evidently been overlooked.

In the account of the structure of a mosquito two defects may be noted: on pp. 548 (last line) to 550 the terms labium and labrum are transposed (as in the last edition); and the mosquito's œsophagus bears one large ventral diverticulum in addition to the two small lateral (really dorsolateral) ones mentioned on p. 550. The account of Phlebotomus is wanting in several respects, *e.g.* the statement of the characters of the larva is so defective as to be valueless.

The difficulties to be overcome in preparing an adequate account of insects in relation to man are undoubtedly great, but the present account does not attain the same high standard of accuracy and completeness as the first two sections of the volume.

A supplement (115 pages) contains a translation of Dr. Seifert's appendix to the last German edition giving clinical and therapeutical notes. The first part of this, on the Protozoa, has been largely rewritten, but the parts on parasitic worms and arthropods are little changed.

R

ACOUSTICS AND BEYOND.

Hyperacoustics. By J. L. Dunk. Division i., *Simultaneous Tonality.* Pp. vi+311. (London: J. M. Dent and Sons, Ltd., 1916.) Price 7s. 6d. net.

THE title of the work of which the present volume is but the first division is thus dealt with in the preface: "Between the region of phenomena [undefined] comprised in the science of acoustics, and the experiences of music considered as phenomena, there appears a great gulf, which invites attempts to bridge." "The 'gulf' has two sides, and can be approached either by working forward from the material aspect of acoustics, or backward from the experiential aspects of music. However, in the present investigation it is the purely scientific side that is emphatically insisted upon. Hence the name 'Hyperacoustics' may be proposed, as indicative not only of something beyond, but also of a presumption requiring justification as to the existence and rationality of something beyond the known facts of acoustics."

It is held that the subject may be considered under the divisions Tonality, Rhythm, Organisation, and Significance. The present volume is restricted to the aspect of "Tonality," the science of musical sound in pitch and quality.

As to the treatment of the subject, whenever incidental references are made to the various intervals, whether in the just or equally tempered intonations, the author shows an accurate knowledge of the facts. But, immediately he steps beyond the facts themselves to any discussion of them, all seems on a different plane—a plane of pure fancy, or "hyperscience."

This treatment might conceivably exercise some fascination over certain minds inclined to the occult and esoteric; and in such matters the mere man of science is not competent to judge. It may be that a feeling of shrinking on the part of the ordinary reader is inevitable towards a work designed to bridge in this wise the gulf between physics and music. But, without doubt, the work is quite lacking in all appeal to either the physicist or the musician. Indeed, the scientific reader cannot help wondering whither it all tends or what it is supposed to establish. Every few pages sees the introduction of one or more terms of a strange character and vague import. These are then woven into the discussion, which again continues without any apparent advance.

One of the simplest and least fanciful parts of the work is that in which the intervals are likened to colours. Thus the perfect fourth is regarded as red, the major third as green, and the minor third as violet. Then, by composition, are obtained the following. The perfect fifth is green plus violet equals blue, the minor sixth is red plus violet equals mauve, the major sixth is red plus green equals yellow. Again, the octave is red plus green plus violet equals white, and the unison is zero equals black.

An illustration of the more general style of the work is afforded by the following quotation (p. 221):—

"The fact that, acoustically, the Seriopolar aspect of the Matrix is only effective in the Fundamental Species, and that the approximation of the Tensor Heptad to the Hemicyclic type is nearer than the Laxator Heptad, is evidently responsible for the recognition of a distinct chiral bias in progression denoted at an early date by the word 'Authentic.'"

MORPHOLOGY: OLD AND NEW.

Form and Function: a Contribution to the History of Animal Morphology. By E. S. Russell. Pp. ix+383. (London: John Murray, 1916.) Price 10s. 6d. net.

A SCHOLARLY and thoughtful book like this makes one feel how much is lost to students of biology by lack of attention to the historical development of the science. Not only is the human interest missed, but also the educativeness of tracing the history of fundamental ideas. Moreover, for lack of historical discipline, the same mistakes are made over and over again, and sound generalisations which have ceased to be prominent are unconsciously restated as new, it may be in a form far inferior to that given them by Cuvier, E. Geoffroy Saint-Hilaire, von Baer, or some other outstanding thinker of older days. We welcome, therefore, Mr. Russell's contribution to the history of morphology, for it is based on many years of first-hand study of the documents and is illumined by insight. It is true history, not chronicle; it displays the continuous endeavour from Aristotle until to-day to understand the forms of animals, both in their original establishment and in their individual reproduction in every life-cycle.

The author distinguishes three main currents of morphological thought. The first he calls "functional or synthetic," which interprets form as the manifestation of function or activity. It is "associated with the great names of Aristotle, Cuvier, and von Baer, and leads easily to the more open vitalism of Lamarck and Samuel Butler." The second he calls "formal or transcendental," which regards function as the result of form—the outcome of organisation. "The typical representative of the second attitude is E. Geoffroy Saint-Hilaire, and this habit of thought has greatly influenced the development of evolutionary morphology." The third he calls "materialistic or disintegrative," which was greatly influenced by the cell-theory.

The author's general position is with the morphologists of the first school; he believes that attention should be concentrated "on the active response of the animal, as manifested both in behaviour and in morphogenesis, particularly in the post-embryonic stages." He frankly adopts "the simple everyday conception of living things—which many of us have had drilled out of us—that they are active, purposeful agents, not mere complicated aggregations of protein and other substances."

Mr. Russell displays a fine sense of the historian's function in the way in which he has thought himself into the position of the various morphologists whose ideas he expounds. He shows a remarkably sympathetic imagination, and we suspect that he has understood some of the old masters—Lamarck, for instance—better than they understood themselves. We think his estimate of Haeckel is too severe, but his fair-mindedness is so conspicuous that we suspect our partiality may be at fault. The whole book shows fine workmanship, but we may perhaps refer to the outstanding excellence of the discussion of the controversy between Cuvier and Etienne Geoffroy Saint-Hilaire, of the Meckel-Serres law and its successor the recapitulation doctrine, of the work of von Baer, of the cell-theory, and of the import of the young subscience of experimental embryology which Roux founded. No previous English discussions of these subjects show in such high degree the qualities of scholarship, clearness, and grasp of essentials.

This masterly book suggests many reflections, and we would try to state two of these. (*a*) Mr. Russell bids us choose between the position held by Cuvier, which insists on the priority of function to structure, and the position of Geoffroy, which maintains the priority of structure to function. But may we not recognise a partial truth in both positions? The organism is indeed a particular kind of activity, a unified reaction system, but it cannot get on without organisation, any more than a stream without a bed. It conditions its organisation as the stream makes its bed, but the organisation soon begins to condition it, as the bed the stream. We do not feel compelled to admit the rigid antithesis which Mr. Russell would force on us. (*b*) In his account of the embryological work of Roux the author says that "the introduction of a functional moment into the concept of heredity was a methodological advance of the first importance, for it linked up in an understandable way the problems of embryology, and indirectly of all morphology, with the problem of hereditary transmission, and gave form and substance to the conception of the organism as a historical being." What Mr. Russell has said in this book and elsewhere concerning the conception of the organism as a historical being is very important, but what we are not sure about is that Roux's "linking-up" was "understandable." As regards linking-up, did Roux do more than suggest the hypothesis that specific chemical substances produced in connection with functionally acquired form-changes might soak through from body to germ-cells and induce in them a predisposition to similar form-changes in the offspring? The hypothesis surely takes a good deal of understanding, and, speaking for ourselves, we are not enamoured with the prospect of interpreting the form of animals in terms of their activity if it cannot be attained without a belief in the transmission of functional modifications more firmly based in fact than that of Lamarck, Samuel Butler, or Semon. Is there not some other way in which an organism may be a historical being?

EXPERIMENTAL INVESTIGATIONS INTO THE DEVELOPMENT OF VERTEBRATA.

Growth in Length: Embryological Essays. By Richard Assheton. Pp. xi+104. (Cambridge: At the University Press, 1916.) Price 2*s.* 6*d.* net.

ALL zoologists will be grateful to Mrs. Assheton for the publication of these embryological essays found amongst the papers of her late husband. Whilst nominally dealing, as the title indicates, with "growth in length," they are really a beautiful and clearly expressed summary of the early stages in development of the Vertebrate embryo, ranging through the whole series from the Elasmobranch to the Mammal. The facts are, of course, interpreted according to the late Dr. Assheton's views, with most of which we should be inclined to agree. The only point of criticism that seems to us worth raising is whether Dr. Assheton was justified in accepting on the evidence the statement that the "segmentation cavity" in the segmenting eggs of Amphibia becomes incorporated in the gut. Brachet's work (which Dr. Assheton quoted) does not warrant such a conclusion; he found, indeed, that the wall dividing the gut from the segmentation cavity was often torn during growth, but that the rent healed up again. This temporary communication between the two cavities is therefore only one of the dislocations produced by unequal growth, and has no further significance.

Dr. Assheton arrived at the conclusion that the blastopore in all Vertebrata (including Balanoglossus) becomes the anus, and that the mouth is an entirely new formation—as appears to be the case also in Echinodermata. This is a view for which there is strong evidence. The only consideration which makes us hesitate in accepting the ontogenetic processes in these two groups as a full record of their evolutionary history is that the formation of a new mouth seems to us to involve a breach of functional continuity which we find it difficult to picture to ourselves as actually occurring in the history of the race.

To the essays on "Growth in Length" is appended a reprint of Dr. Assheton's paper on "The Geometrical Relation of the Nuclei in an Invaginating Gastrula (Amphioxus)," which was an endeavour to substitute for Driesch's vague conception of the "entelechy" a force alternately monopolar and bipolar, radiating from the nuclei of the blastomeres as the efficient agent in bringing about invagination. This explanation of vital phenomena, like so many others, can be made to fit this particular case; but our doubts as to its validity are raised by its inability to fit other similar cases. How can the position of the nuclei in the cells explain the invagination in the gastrula of Echinus, when this invagination can be changed into an evagination by allowing the egg to develop in warmer water? Still, it is only by propounding and testing theories of this kind that progress can be made, and Dr. Assheton's clear exposition of the problem and his gallant attempt to solve it will, we hope, stimulate other biologists to follow in his footsteps and carry on the work to which his life was devoted, *i.e.* experimental embryology. E. W. M.

OUR BOOKSHELF.

The Heat Treatment of Tool Steel. By H. Brearley. Second edition. Pp. xv+223. (London: Longmans, Green and Co., 1916.) Price 10*s.* 6*d.* net.

THE fact that a demand has arisen for a second edition of this book within four years from its first appearance is the strongest evidence of its practical value. The author states in the preface that he is now less restrained than formerly, and is free to describe in greater detail the different methods of treating steel, and this has enabled him to deal with the subject much more completely than in the first edition.

For some time past, and especially during the stress of the last two years, it has been more fully realised than ever that the life of a tool will depend as much on the manner in which it is worked into the finished shape and on the heat treatment it receives as on the material from which it is made, and a record of the practical experience of the author will be of great value to all directly interested in procuring the best working results from the various steels used in the manufacture of tools.

For efficient handling, the subject demands an adequate knowledge of the science bearing on it, and familiarity with the results of recent research, together with a wide experience in workshop practice. The author possesses these qualifications to a high degree, and although the book deals more particularly with the practical than with the scientific aspect, it can be strongly recommended to all interested in this important subject either from the practical or from the more purely scientific point of view.

Alloy steels, and high-speed steels in particular, are more fully dealt with than was the case in the first edition, and the chapter on case-hardening has been omitted, as it has been made the subject of a separate volume.

The whole subject is well handled, and the book can be strongly recommended as a clear and comprehensive treatise on this important branch of technology. F. W. HARBORD.

Laboratory Manual in General Microbiology. Pp. xvi+418. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 10*s.* 6*d.* net.

THIS book is planned to serve as a manual of instruction in practical microbiology. To a large extent it represents the course given in this subject at the Michigan Agricultural College, and it therefore deals mostly with agricultural microbiology, and the disease-producing organisms, with two or three exceptions, are omitted.

The course is divided into 126 lessons or exercises, of which 53 are devoted to general laboratory methods and to the general morphology of micro-organisms, 33 to the physiology of micro-organisms, 15 to air, water, sewage, and soil, 11 to dairy and plant microbiology, and 14 to animal diseases and immunity.

Each lesson is detailed under a definite plan—the apparatus required, the cultures necessary, and the method of carrying out the exercise. At the end of each lesson questions are asked regarding the particular results that may be obtained and their significance.

The details given for each lesson are sufficiently full to enable the student to work independently of a teacher, and anyone who were to follow them out would possess a good practical knowledge of the subjects dealt with.

Formulæ for stains and special culture media, tables of the coliform organisms, metric and other tables, and a list of works of reference are given in an appendix, and the text is illustrated with a number of plates and figures.

The work should be of considerable value as a laboratory handbook to both teacher and student, and we can cordially recommend it for this purpose. R. T. HEWLETT.

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.]*

Pre-Columbian Use of the Money-Cowrie in America.

THE letter entitled "Pre-Columbian Use of the Money-Cowrie in America," by Mr. J. Wilfrid Jackson (NATURE, September 21, p. 48), offers a discouraging instance of superficial reading of carefully observed and recorded data.

In 1915 Mr. Clarence B. Moore unearthed, in the Roden Mound in northern Alabama, five cowries (*Cypraea moneta*). These shells, which came from a burial in the body of the mound, had been pierced for stringing, and showed evidence of considerable age. They were the only evidence found at this site of contact with the Old World (C. B. Moore, "Aboriginal Sites on Tennessee River," in Journ. Acad. Nat. Sci., Philadelphia, second series, xvi., p. 293). In all Mr. Moore's more than twenty years of most careful and painstaking exploration of mounds, cemeteries, and dwelling sites of the southern United States, from the Atlantic coast to Texas, and from the Ohio River to the Gulf of Mexico, no previous instance of the finding of *C. moneta* had been noted by him, nor has it ever been recorded as occurring with American pre-Columbian remains. The logical conclusion from the mass of this negative evidence is that the Roden Mounds were, in part, early post-Columbian, and that any other evidence of contact they may have contained was of a perishable nature. To assume, on the basis of this string of shells, the pre-Columbian use of the cowrie in America is no more justified than to claim for iron working a pre-Columbian age in the western hemisphere on the evidence of the iron celts found by the same Tennessee River expedition in Citico Mound, where absolutely nothing else save four glass beads from a superficial burial suggested the white trader and his wares. In each instance the presence of these Old World materials dates the grave as later than 1492.

In the fifteenth and early sixteenth centuries the "porcelain shell," or cowrie, was the trade medium for both the Orient and Africa, for which purpose it was strung.

In a recent statement to the present writer, Dr. William H. Dall, the foremost of ethno-conchologists, so expressed himself:—"I think the presence of *C. moneta* in a mound is evidence that the deposit is post-Columbian. Columbus believed that he was on a voyage to the (East) Indies, and no voyager of his day would have fitted out a ship for that goal without including the money-cowrie in his trade goods. That the records make no mention of them is probably due to their being considered too much a matter of course."

Moreover, strings of cowries were a part of the trappings of a gentleman's mount, and, in this capacity, some are likely to have reached the southern United States in the days of its earliest exploration.

The *C. moneta* which Mr. Wilfrid Jackson erroneously states was found *in* the Serpent Mound, Ontario, is recorded by Mr. Montgomery as among the objects "which were found in the same locality, some of them last year, and others previous to that time. Some of these were discovered upon the mounds or near them; others were either found upon the surface of the ground or ploughed up in the neighbouring fields. A few were obtained about four miles distant from the mounds" (Trans. Canadian Institute, ix., 1910, p. 6). Mr. Montgomery himself says of the artifacts in this enumeration:—"Nothing can be positively stated as to who their manufacturer was." The shell was unpierced, and there is nothing in the record, so far as published, to prove that it was ever in the possession of an aboriginal American.

As for the Cree dress, decorated with cowries, collected by the Lewis and Clark expedition, and described by Mr. Willoughby (*American Anthropologist*, 1905, p. 640), does Mr. Wilfrid Jackson maintain that the blue glass beads and brass buttons which adorned the opposite side of this shirt are also of pre-Columbian date? In sooth, it proves nothing. In 1804–5 the Cree were in close trade relations with the Hudson Bay Company, and had been in touch with the white man for more than a century and a quarter.

The modern use of the cowrie in the ancient ceremonies of the Ojibwa and Menomini tribes, cited by Mr. Jackson, is likewise wholly inconclusive of the antiquity of *C. moneta* as a culture object. Hoffman, describing "The Midéwiwin, or 'Grand Medicine Society' of the Ojibwa" (Bureau of American Ethnology, vii., Ann. Rept., 1885–6), states:—"The mígis is considered the sacred symbol of the Midéwigan, and may consist of any small white shell, though the one believed to be similar to the one mentioned in the above tradition resembles the cowrie. . . . It is admitted by all the Midé priests whom I have consulted that much of the information has been lost through the death of their aged predecessors" (p. 167). On p. 191 Hoffman again refers to "the mígis, a small white shell (*C. moneta*, L.)," and on p. 220 he further states:—"The mígis referred to in this description of the initiation consists of a small white shell, of almost any species, but the one believed to resemble the form of the mythical mígis is similar to the cowrie, *C. moneta*, L. . . . Nearly all of the shells employed for this purpose are foreign species, and have no doubt been obtained from the traders. The shells found in the country of the Ojibwa are of rather delicate structure, and it is probable that the salt-water shells are employed as a substitute, chiefly because of their less frangible character."

The related Menomini, in their corresponding ceremony, were undoubtedly using the money-cowrie as a culture object in 1890 (Hoffman, "The Menomini Indians"; Bureau of American Ethnology, xiv., Ann. Rept., p. 101), but the earliest records of the doings of this medicine society are not so convincing of the identity of the shell employed (*e.g.* Schoolcraft, "Indian Tribes," iii., p. 287). Dr. Dall has kindly permitted me to quote his private communication as follows:—"I believe the cowrie to be a comparatively late substitution, in the ceremonies of the Ojibwa and associated tribes, for some native American shell formerly used by them, just as, after the coming of the traders, the exotic *Dentalium tarentinum* rapidly replaced the smaller and more fragile *D. indianorum*, which was so highly esteemed by the West Coast tribes. The marine shell, *Marginella apicina*, which was traded up from the Gulf Coast in large quantities, in pre-Columbian and early post-Columbian times, is likely to have been the object, 'in shape and colour like a small bean,' which was thrown at the novice in the Black Dance ceremony of the Dakota, according to the earlier narrative used by Jonathan Carver in 1778 (Bureau Amer. Ethnol., Ann. Rept., xiv., p. 112). Fletcher's report of the corresponding ceremony of the Winnebago, where they used 'a small white seashell about the size of a bean' (*ibid.*, p. 110), exactly fits the Marginella."

The case thus rests entirely on Mr. Moore's find, and in the face of perhaps a hundred thousand aboriginal graves innocent of cowries, to construe the single instance of Roden Mounds as evidence of prehistoric acculturation is to sire the concept by a wish.

H. NEWELL WARDLE.

The Academy of Natural Sciences of Philadelphia.

THE question of the pre-Columbian use of the money-cowrie in America is fully discussed by me in an exhaustive memoir, dealing with the use of cowries as cult objects in the Old and New Worlds, which is on the eve of publication by the Manchester Literary and Philosophical Society. (It will probably be published by the time this letter appears in print.) The whole subject is too vast to be discussed in a short letter, but the following remarks may be offered on the criticism levelled by Mr. H. Newell Wardle at my letter in NATURE of September 21.

The evidence provided by the remarkable discovery by Mr. C. B. Moore of shells of the money-cowrie, *C. moneta*, in the Roden Mound, where they were associated with a human skull, forms merely one link in the remarkably complete chain of cultural connection between the Old World and the New in pre-Columbian times. There are other equally suggestive facts, which point conclusively in the same direction, including the significant use of large stone cists for burial purposes in the immediate neighbourhood of the place where the cowries were found, as well as elsewhere in America.

The custom of placing money-cowries in graves with the dead is a widespread Old World practice, which has a definite and wholly arbitrary significance; and it ranges in time from pre-dynastic Egypt to the present day.

As for the Cree dress decorated with cowries, I do not pretend to claim that the actual dress, with its blue glass beads and brass buttons, is of pre-Columbian date; but the idea of using cowries to decorate such a dress, which again has a very precise meaning in Africa and southern and eastern Asia, was certainly not so recent as the brass buttons suggest. To imagine that the Hudson Bay Company introduced such Oriental customs, or even knew of their existence, is surely crediting these traders with an extent of ethnological knowledge and enthusiasm for disseminating exotic beliefs, with a strong Indonesian colour, which I am not sufficiently imaginative to admit.

If it be admitted that the Hudson Bay Company traded cowries, it must have been due to having seen such already in use by the Indians, for without this appreciation of the special mystical value of the cowrie there would have been no demand for them. On the west coast of Africa the cult of the cowrie was certainly not first introduced there by the white traders of the fifteenth century; they found the blacks already in possession of these white shells, the custom of using them and the superstitious reverence attached to such shells having filtered through Central Africa ages prior to the advent of the whites. It is only natural that full advantage should have been taken by traders, and thus an enormous trade in these shells sprang up. So far as I am aware there is no evidence that the Hudson Bay Company traded in the money-cowrie.

Mr. Wardle's arguments do not explain the remarkable identity in the association of the money-cowrie with medicine ceremonies in places so far apart as Africa and America. In both these continents the cowrie is regarded as the "symbol of life"—a distinction which no other shell enjoys.

In a magazine article he has previously expounded the procedure of Columbus in introducing the cowrie, *C. moneta*, into the New World. But in his account, the gist of which appears in his foregoing letter, he omits the most wonderful episode of his "wonder-tale," as he himself calls it—I refer to the fact that after all the imaginary wanderings and episodes on sea and land, the cowries should eventually have come to rest in the heart of the American continent, and, "of course purely by accident," have become linked up with the identical beliefs and fantastic practices with which they are associated in Africa, India, and eastern Asia.

To such lengths does the American ethnologist go rather than admit the patent fact that these shells, along with the associated beliefs and practices, were taken from eastern Asia to America long before the time of Columbus. J. WILFRID JACKSON.

Manchester Museum.

Field Glasses for Army Use.

SOON after the outbreak of the war, my father, Lord Roberts, asked the public to lend their glasses for the use of the Army. After two years I think your readers may be glad to have some particulars of the result of his request.

Upwards of 26,000 glasses have been received, without reckoning those which, in pursuance of my father's suggestion, have been collected in Australia, the Malay States, and elsewhere, and issued forthwith to the local forces on their way to the seat of war. The instruments sent comprise every type, and have been classified and issued according to the needs of different units. Particularly useful have been the fine prismatic glasses sent, which have been allocated to artillery and machine-gun units, according to their power; large mounted telescopes for batteries, deer-stalking telescopes for gunners and snipers, and good old-fashioned non-prismatic racing glasses for detection of the nationality of aircraft, locating snipers, signalling by disc, collecting wounded, and musketry instruction.

I am indeed grateful for the way in which my father's appeal has been met. British people all over the world have given their best, recognising that, in spite of the fact that their glasses are on loan and that the organisation for their return has been arranged, the chances of loss are many, and that they may never get them back.

When I think of the enormous numbers of good glasses sent, it may seem ungracious to ask for more, but the demand is still great. I am told that at watering-places and on racecourses and elsewhere large numbers of glasses are still to be seen in private hands, and to the owners of these I would once more appeal. I should add that we have been entrusted by the Ministry of Munitions with the purchase of individual glasses from those who cannot afford to lend them, and that the address for sending glasses for either purpose is the same. Every good glass (except opera-glasses) and every telescope (except toys) is wanted for the service of the country.

December 18. ROBERTS.

Address for sending:—The Manager of Lady Roberts's Field Glass Fund, National Service League, 72 Victoria Street, S.W.

SCIENCE AND INDUSTRY IN AUSTRALIA.

THE second report of the Executive Committee of the Advisory Council of Science and Industry for the Commonwealth of Australia shows that energetic steps are being taken to provide and set in motion the necessary machinery for the promotion of industrial research in the Commonwealth. Strong committees have been formed in all the States with the exception of Tasmania, and it is hoped that this State will soon take action and complete the scheme recommended by the Advisory Council.

The Executive Committee has commenced its work in a methodical manner by making inquiries with the view of compiling information regarding Australian industries, problems arising in connection with them, the laboratories and *personnel* now available for research, and the facilities for the education of future investigators.

We look forward with considerable interest to further reports to learn what conclusions are arrived at as to the education of the research workers of the future. The leaders in this research movement in Australia are, of course, familiar with all our educational systems in the Old Country, and, indeed, many of them are graduates of British universities. With the special problem before them of training research workers, it will be interesting to see to what extent they will go along the old lines, or whether they will recommend new methods, having fewer Education Acts and educational interests to take into account.

The Executive Committee, since its first report a few weeks previously, has been able not only to complete the machinery of the scheme, but also to consider many suggested researches. The broad character of these shows that the committee intends that its functions should include all types of industries that can be benefited by research. Problems relating to engineering, chemistry, gold-mining, diseases of cattle, agriculture, bread-making, and other matters appear in the list.

We notice that a special committee has been appointed to deal with the standardisation of physical apparatus for the teaching of science in the technical and other schools and colleges of Australia. The object is to enable the apparatus to be made in Australia, as it is inconvenient to depend on supplies imported from a great distance.

We sometimes wonder whether there is not too much standardisation in apparatus for elementary teaching. Instrument-makers are, of course, a necessity for specialised and accurate instruments, but it might be better if schools and colleges depended more on their own workshops.

The work already accomplished in Australia, and indeed also in Canada, shows that the movement towards research methods in industry is going on all over the Empire, and it is encouraging to know that the necessary co-operation, without too much centralisation, is being arranged between the councils operating abroad and the Advisory Council at work in London. Sufficient organising machinery would seem to have been provided both at home and in Australia and Canada. The supply of trained workers is the important matter, and that brings us back to our educational systems. Will the universities be able to give the necessary care to research to enable them to meet the demand for trained investigators that we hope to see in the near future? If they are to do so larger staffs will be necessary, and there must be less school-work in the universities. There are few university professors who do not spend a large portion of their time teaching school-work. Higher entrance examinations would remedy this evil, but the university is not always so rich that it can ignore the question of students' fees.

In connection with the establishment of this Federal research scheme in Australia, it is interesting to turn to the report of the British Science Guild adopted at the annual meeting on July 1, 1915, and to find that so early as January, 1914, the South Australian branch of the Guild had drawn up plans for a Federal Institute for Original Research which were to be brought before a conference of the Australian Premiers. The institute proposed by the Guild was designed to give special attention to agriculture, and to undertake "research work beyond experimental farming." The Guild realised the importance of studying from a research point of view everything underlying the successful use of the land, including the well-being in every respect of the people engaged in farming operations. The list of subjects mentioned above, which the executive committee deals with in its report, shows that agriculture in all its bearings is receiving attention, and in this respect the idea of the South Australian branch of the British Science Guild has certainly borne fruit.

It would be well for us to consider in this country whether our agricultural research deals sufficiently with matters "beyond experimental farming." Experimental farming in its narrower sense can only lead to improvements in detail. Research work of a more fundamental character is required in agriculture as in other industries. The schemes adopted since the beginning of the war provide for such research work in connection with our manufactures, but it is not sufficiently clear that we intend to give the necessary attention to fundamental research bearing on agricultural pursuits.

THE ERADICATION OF SLEEPING SICKNESS FROM PRINCIPE.[1]

PRINCIPE is one of a group of four islands in the Gulf of Guinea. It is 17 kilometres long and 10 kilometres wide, and is 200 kilometres distant from the mainland. The main export of the island is cacao; sugar-cane, coffee, and palm kernel being practically negligible. For the cultivation of the cacao crop labour has been imported in the past from the African mainland. In all probability among these labourers there would be cases of sleeping sickness. These in themselves would constitute no danger to the island population or to their uninfected fellow-labourers, but in Principe unfortunately the carrier tsetse-fly, *Glossina palpalis*, also existed, and sleeping sickness mortality became so great that the economic life of the island was gravely menaced. The annual mortality was about 200 in a population of 3800 (average), so that in twenty years the mortality would be in excess of the total population.

How and where the fly was first imported (if it were so) is a matter of conjecture, but it is thought that this occurred in 1825 with the importation of cattle and slaves, and though so far as we are aware there are no other records of the fly putting to sea, Fernando Po, 40 kilometres from the coast, is also fly-infested, whereas San Thomé, 130 kilometres south-west of Principe, is free from fly and likewise from sleeping sickness. As regards the distribution of the fly in the island, it is practically identical with that of the wild pigs. Neither is found higher than 250 metres above sea-level. In the case of the pig this distribution is determined by that of the oil-palm, on the fruit of which the pigs feed; but how far it is a case of the fly following the pig, or the latter finding security in the haunts of the fly, is a matter of some doubt.

The section of the work dealing with the trypanosomes of various animals, pig, ox, mule, dog, is unfortunately incomplete. A dimorphic trypanosome—that is, one showing flagellar and aflagellar forms—was found in the ox, dog, and mule, but its identity is not established. It may be the dimorphic trypanosome common in cattle in Africa, *T. ugandae* (dimorphic form of *T. brucei*), or it may be *T. gambiense*, though cattle are not definitely established as hosts of this trypanosome of man. Whether, too, the human trypanosome of Principe is a special variety of *T. gambiense* must remain doubtful, as the fallacies of the biometric method of distinguishing trypanosomes introduced by Bruce and here adopted are so many that its usefulness is problematical. This book gives an account of the results obtained by the third mission dispatched to study sleeping sickness by the Portuguese Government, the first having set to work in 1871. Knowledge of the subject has increased greatly since that time, when indeed the cause of the disease was unknown, but the last mission was so successful in the practical application of this knowledge that the disease,

[1] "Sleeping Sickness. A Record of Four Years' War against It in the Island of Principe." By B. F. Bruto da Costa, J. F. Sant' Anna, A. C. dos Santos, and M. G. de Araujo Alvares. Translated by Lieut.-Col. J. A Wyllie. Pp. xii+260. (Published for the Centro Colonial, Lisbon b Baillière; Tindall and Cox London. 1916. Price 7s. 6d. net.

or, to be strictly accurate, the carrier of the disease, has been stamped out in the island.

The methods used for getting rid of the fly comprised:—(1) Clearing of vegetation, felling of forest, clearing of woodlands and secondary jungle growth, so as to admit light and air into the haunts of the shade-loving tsetse. (2) Drainage of swamps and clearing of the banks of streams. (3) Extermination of pigs, dogs, and cattle.

For the protection of those at work in the fly areas the Maldonado method of trapping the fly was adopted. The members of the fly brigade wore canvas, back and front, covered with a viscid preparation made in Reading. (It would appear to be composed, like fly-papers, largely of boiled linseed oil.) By this means at the beginning of the campaign as many as 500 flies could occasionally be caught by a single man in a day, and the average caught by the gang was about 17,000 a month in 1911, less than 6000 a month in 1912, while in the first three months of 1914 only 14 flies were caught by 297 men, and in the last nine months of the year none.

The mission is to be congratulated on the success of its efforts. J. W. W. S.

CLEMENT REID, F.R.S.

THE death of Mr. Clement Reid on December 10 is a severe loss alike to geological and to botanical science. Born on January 6, 1853, Reid joined the Geological Survey in 1874, and began field-work in the south-west of England, but was soon transferred to the eastern counties. Here, in mapping the Cromer Forest Bed and other plant-bearing formations exposed on the coast, he entered upon the investigation of our Pliocene and Pleistocene flora, which thereafter he pursued with characteristic enthusiasm and ability throughout his life. Devising ingenious methods for separating out the seeds of plants from any material in which they lay hidden, he showed the significance of these inconspicuous fossils as indicators of past climate; and he soon became recognised as our leading authority on this subject. In the "Cromer" memoir of the Geological Survey (1882) he firmly established his capability both as an investigator and as an expositor. His next field-work was in Yorkshire, first on the north-eastern moorlands and then in the Holderness country, after which it was carried southward into Lincolnshire, the results being published in the "Holderness" memoir (1885). This done, he was sent to map the South Downs and the coastal tract of Sussex; and he worked westward thence through Hampshire and part of the Isle of Wight into Dorset and Wiltshire, describing this country in several more memoirs, published between 1898 and 1903. Meanwhile, he had also produced a collective "General" memoir on the Pliocene deposits of Britain (1890), during the preparation of which he visited Belgium and North Italy for the study of the equivalent deposits there.

Besides his official work, Reid had by this time contributed many notable and widely discussed papers to scientific societies and periodicals, dealing mainly with the palæobotany of the later geological periods; with the climatal conditions indicated by geological formations; and with subjects in the debatable territory where geology and archæology meet. In 1899 he summed up his knowledge of past botanical conditions in a book full of acute observation and suggestion, entitled "The Origin of the British Flora"; and, in 1913, he dealt similarly, in a small book, with our "Submerged Forests." His critical study of the fossil Characeæ, in collaboration with Mr. J. Groves, of which the first-fruits are in course of publication, has now been lamentably arrested.

In his later researches Reid was ably assisted by his wife (previously Miss E. M. Wynne Edwards), joint-author with him in his description of the interesting Pliocene flora of Tegelen, Holland, and in several other botanical and geological papers.

On his advancement to the post of district geologist in 1901, Reid was placed in charge of the Geological Survey work in Cornwall and Devon, and afterwards in the south-eastern district around London. On retiring from official duty early in 1913, he went to live at a chosen spot at Milford-on-Sea, overlooking the Solent, and died there, after a short illness.

In recognition of his work, Reid was awarded by the Geological Society the Murchison Fund in 1886, and the Bigsby Medal in 1897; and by the Royal Geological Society of Cornwall, the Bolitho Medal in 1911. He was elected a fellow of the Royal Society in 1899. He served terms of office on the council of the Linnean Society and of the Geological Society, being vice-president of the latter from 1913 to 1916. He leaves a widow, but no children.

WILLIAM ELLIS, F.R.S.

FOR the third time in about six months the Royal Meteorological Society has to mourn the loss of a past president. Mr. William Ellis was born at Greenwich on February 20, 1828, and succumbed to heart failure on December 11 at Blackheath, having spent nearly the whole of his long life in the immediate neighbourhood of the Royal Observatory. His father, Henry Ellis, was an assistant there, and he himself began work there as a boy computer in 1841. After several years' experience as an astronomical observer, he left in 1852 to take charge of Durham Observatory, returning in 1853 when a vacancy occurred on the staff at Greenwich. He was attached to the Time Department, and soon afterwards had charge of it, including the galvanic batteries and circuits, but after eighteen years' superintendence of that work, and more than twenty years as a regular astronomical observer on the staff, he was transferred, on Glaisher's retirement, to the Magnetical and Meteorological Department, of which he was superintendent for nineteen years, until his retirement at the end of 1893, in which year he was elected F.R.S. During his short stay at Durham he communicated results of his observations of minor planets to the Royal Astronomical Society, following them up with further contributions, and was elected a fellow of the society in 1864. Soon after succeeding Glaisher in 1875, he became a fellow of the Royal Meteorological Society, and was president in 1886 and 1887, also serving as official referee for papers for nearly thirty years.

The most important Greenwich publication associated with Ellis's name is that which deals exhaustively with air temperature for fifty years, 1841–90, in the production of which he did a very great amount of hard work in rendering the earlier observations comparable with those taken under his own superintendence. But he is probably better known in connection with his contribution to the Philosophical Transactions of the Royal Society for 1880, in which he showed for the first time a relation between sun-spot frequency and terrestrial magnetic disturbance, a subject which he followed up with further contributions to the R.A.S. Monthly Notices. He strongly objected to the notion that the moon affects the weather, and so long ago as 1867 maintained in the *Philosophical Magazine* that the idea of the moon's clearing away clouds was nothing but a poet's fancy. To the subject of cloudiness he returned later, dealing in one of his presidential addresses to the Royal Meteorological Society with seventy years' cloud observations at Greenwich. His association with the Time Department is reflected in a highly interesting article in the Monthly Notices of the Royal Astronomical Society dealing with the rating of several clocks destined for use during the observations of the transit of Venus in 1874, in which he showed that the oscillation of one pendulum was distinctly affected by that of another in the vicinity, especially if the clocks were mounted on the same stand.

Ellis was a frequent contributor also to the Quarterly Journal of the Royal Meteorological Society, and for many years a member of the Institution of Electrical Engineers, in connection with which he investigated the effect of the City and South London Electric Railway trains on the earth-current registers at the Royal Observatory. He was keenly interested in the new magnetic instruments introduced at Greenwich by the present Astronomer Royal, which he was unfortunately unable to see for himself, as his sight had practically failed for some years before his death. He insisted to the last on attending the annual visitation of Greenwich Observatory, putting in his seventy-fifth consecutive appearance at that function last June, but no one who saw him then can be surprised that it was his last visitation day. He was able to appreciate a reference in the current issue of the *Observatory* magazine only a few days before his death, but had been for some weeks confined to his bed, though suffering from no specific ailment of any great importance. Though twice married he had no children, but he leaves a widow. He was buried at Charlton Cemetery on Saturday, December 16. W. W. B.

NOTES.

By the will of the late Mr. Percival Lowell, a fund amounting to 10 per cent. of the income of his total estate of a million dollars is set apart for the maintenance of the Lowell Observatory at Flagstaff, Arizona, to be used especially for "the study of our solar system and its evolutions." It is specified that the observatory is never to be merged or joined with any other institution. The fund devoted to this purpose is to be held in trust by the late astronomer's brother-in-law, Mr. W. Lowell Putnam.

We regret to announce the death on December 14, at seventy-three years of age, of Prof. T Purdie, F.R.S., emeritus professor of chemistry in the University of St. Andrews.

Capt. C. Bathurst has been appointed Parliamentary Secretary of the Food Control Department in the new Ministry, and not of the Board of Agriculture, as was expected last week. This office is held by Sir R. Winfrey, who occupied the same post in 1906–10, when Earl Carrington was Minister of Agriculture.

The death is announced of Dr. Hugo Münsterberg, since 1892 professor of psychology, and director of the psychological laboratory, Harvard University.

Mr. W. Kewley has been appointed secretary-superintendent of the Middlesex Hospital in succession to the late Mr. F. Clare Melhado.

Dr. A. Yersin, director of the Pasteur Institute of Indo-China, has been awarded the Lasserre prize for the present year for his work on anti-plague serum.

It is announced in the issue of *Science* for November 17 that the American Academy of Arts and Sciences on November 15 presented the Rumford medals to Dr. C. G. Abbot, of the Smithsonian Institution, for his researches on solar radiation.

We learn from the *Times* that Sub-Lieut. O. J. Hobbs, previously reported missing, is now reported killed on or about November 13. At the outbreak of war he was science master at the King Edward VI. Grammar School, Southampton. Announcement is also made that Lieut. J. C. Simpson, R.E., an associate of the Royal School of Mines and a fellow of the Geological Society, was killed on December 4.

We regret to note that *Engineering* for December 15 records the death, on December 11, in his sixty-fourth year, of Mr. Archibald Colville, the chairman of Messrs. David Colville and Sons, Ltd., the well-known steel-makers of Motherwell. Mr. Colville was chairman of the Scottish Steel Makers' Association, and was a member of the Board of Trade Iron and Steel Industries Committee.

A fund is being raised to purchase the very valuable scientific library of the late Prof. Silvanus Thompson and to present it to the Institution of Electrical Engineers as a memorial of his life and work, the library to be accessible to the public on the same conditions as the Ronalds Library. Those who wish to subscribe to this fund or to have further information regarding it are requested to communicate with Mr. W. M. Mordey, 82 Victoria Street, London, S.W.

At a recent meeting of the Anatomical Society of Great Britain and Ireland the following members were appointed to edit and manage the *Journal of Anatomy*:—Prof. T. H. Bryce, University of Glasgow; Prof. E. Fawcett, University of Bristol; Prof. J. P. Hill, University College, London; Prof. G. Elliot Smith, University of Manchester; and Prof. A.

Keith, Royal College of Surgeons of England—the last-named to serve as acting editor. At the same meeting a unanimous vote of thanks was given to Prof. Alex. Macalister, F.R.S., for the able manner in which he had managed and edited the *Journal* in past years and for his generosity in transferring its control to the Anatomical Society.

An expedition in the interests of the Smithsonian Institution will leave shortly for the French Congo and certain of the neighbouring parts of West Africa. It will be known as the "Collins-Garner Congo Expedition, in the interests of the Smithsonian Institution," and will be headed by Mr. A. M. Collins, of Philadelphia, a well-known explorer and sportsman, who has made several trips to Africa and other regions in search of big game. Mr. R. L. Garner, of New York, who has already made extensive investigations concerning the apes and monkeys of Central Africa, is manager of the expedition. The other members of the party are Prof. C. W. Furlong, of Boston, and Mr. C. R. W. Aschemeier, of Washington, who represents the Smithsonian Institution as collector of natural history specimens for the United States National Museum. The natural history collections will go to the United States National Museum.

The trustees of the Elizabeth Thompson Science Fund announce their readiness to consider applications for grants in aid of scientific work. Appropriations are restricted to non-commercial enterprises, and are intended solely for the actual expenses of the investigation, not for the support of the investigator or for the ordinary costs of publication. Grants are made only for those researches, not otherwise provided for, the object of which is, broadly, the advancement of human knowledge; requests for researches of a narrow or merely local interest will not be considered. Usually grants are not made in excess of three hundred dollars. Applications for grants from this fund should be accompanied by a full statement of the nature of the investigation, of the conditions under which it is to be prosecuted, and of the manner in which the appropriation asked for is to be expended. The application should be sent to the secretary of the board of trustees, Dr. W. B. Cannon, Harvard Medical School, Boston, Mass., U.S.A., who will furnish further details.

Much is being done all over the country to provide entertainment for our soldiers, but the Scientific Society of the Birmingham and Midland Institute appears to have opened up a somewhat new line. On a recent evening many members and friends of the society visited the Y.M.C.A. Hut at Sutton Coldfield to give the convalescents stationed there a "Popular Science Evening." The tables were crowded all the evening, and the soldiers evinced the greatest interest in the exhibits and experiments. Exigencies of time had been carefully considered, so that the preparations in the room took only about half-an-hour, whilst an even shorter time served for clearing away. The following list of some of the exhibits may be a useful guide to other societies desirous of organising similar exhibitions:—"Rainbow Cup," showing colours of very thin soap films; Cartesian diver; radiometer; spontaneous combustion; shocking coil; fire from flint, steel, and tinder; floating magnets under a controlling magnet; diffusion figures, formed by the spreading of dyes in blotting paper; harmonigraph (four-phase); several microscopes; gyroscope, spinning eggs, etc.; resonance experiments with tuning forks, resonators, swinging balls, etc.; soap bubble experiments.

In an address before the opening meeting of the Illuminating Engineering Society on December 15 Mr. L. Gaster referred to the great loss which the society had sustained in the death of Prof. Silvanus P. Thompson. A message of condolence from the Russian Electrotechnical Association, expressing admiration of Prof. Thompson's great gifts, was also read. The address dealt mainly with the problem of war economies in lighting, which, it was suggested, should take the form of avoiding waste of light rather than aiming at indiscriminate diminution. The prejudicial effect of the darkening of the streets was illustrated by the progressive increase in the number of accidents during the past few years, and the economic loss involved in the interference with traffic was considerable. The present methods of screening lamps were in general uneconomical and badly devised, and the conditions varied greatly in different districts. These anomalies appeared to be due to the conflicting claims of different authorities urging respectively the claims of economy, the convenience of traffic and safety, and precautions against hostile aircraft. After two years of war the time was surely ripe for a systematic study of the present lighting conditions and for the establishment of a central authority, acting under expert advice, to determine how these various requirements could best be met.

Mr. J. Reid Moir has sent us, as an excerpt from the Proceedings of the Prehistoric Society of East Anglia (vol. ii., part ii., for 1915–16), a paper on a series of pre-Palæolithic implements recently discovered at Darmsden Hall, Suffolk, a place about eight miles north-west of Ipswich. The sand underlying the pebble-bed is at present undatable, but the deposit was laid down prior to the excavation of the Gipping Valley, and the pebbles were deposited from the Woolwich and Reading beds. These Darmsden implements, which are precisely the same as the sub-Crag specimens, are more ancient than the Pliocene Red Crag, and can therefore be referred to an early phase of the pre-Palæolithic period. The human origin of the chipping is said to be certain. There is no evidence that they were fractured in the bed in which they are now found, and they show no signs of pressure flaking or scratches, the result of moving pressure. They have obviously been flaked by blows, and the angles at which the flakes were moved show that such blows were intelligently directed.

In the *Psychological Review* (vol. xxiii., No. 6) K. S. Lashley raises the problem of the importance of the human salivary reflex. He points out that the experiments of Pawlow have provided a method of investigation which has proved useful in the study of the sensory physiology of animals, and promises to be even more valuable in revealing fundamental factors of habit formation and of central inhibition and reinforcement. He suggests that an extension of the method to man is desirable, as in the few attempts already made to investigate the conditioned salivary reflex in man the results are not in harmony with one another, due probably to differences in technique and interpretation. The ease with which the quantity of secretion of the salivary glands can be measured, the consistency of their reactions, and their relative freedom from inhibition, make them especially promising for studies of the relation of the intensity of the stimulus to the organism, which studies have hitherto been restricted to the elaboration of the laws of psycho-physics.

A systematic entomological paper of much interest is one on the Dermaptera and Orthoptera of the coastal plain and piedmont region of the south-eastern United States by J. A. G. Rehn and M. Hebard (Proc. Acad. Nat. Sci., Philadelphia, lxviii., part 2).

The district studied extends over Virginia, the Carolinas, Georgia, and northern Florida, ranging from the Appalachian summits to the sea-level. Lists of species characteristic of the various regions are given, and in the systematic part of the paper variation is studied so far as possible in relation to geographical conditions.

"A SYSTEMATIC Account of the Prairie-Dogs," by N. Hollister, has lately been issued (No. 40, "North American Fauna," U.S. Dept. Agric. Biol. Survey). The genus Cynomys is divided into two subgenera and five species, in the descriptions of which nearly 900 specimens have been utilised. There are comparative photographs of skulls and distributional maps. It seems a pity that in valuable zoological memoirs such as this the ridiculous misnomer "dog" should be stereotyped for these animals, which, according to the author, are "true ground-squirrels, or spermophiles."

A CATALOGUE of the earthquakes felt in the Philippine Islands in the year 1915 has recently been published in the U.S. Weather Bulletin. The number of shocks recorded during the year is 170, only forty-eight of which reached the degree 4, or a higher degree of the Rossi-Forel scale, though fifty-seven were registered at the Manila Observatory. One earthquake, which occurred on March 12 in south-east Luzon, though it attained an intensity of only 6–7 (that is, of less than destructive intensity), disturbed an area of about 45,000 square miles, and was recorded at seismological observatories all over the world.

CAPT. GOURLAY'S note on a phosphorescent centipede, recorded in NATURE of November 23 (p. 233), has elicited some further facts worth putting on record. They have been sent us by Mr. S. Priest, hon. sec., Dartford Naturalists' Field Club, and relate to the experiences of members of the club residing at Stone and Dartford. He cites two cases of centipedes, seen during October and November, emitting a trail of light as they crawled along, and exuding phosphorescent matter on to the fingers when handled. Another specimen left "trail-like drops of green light" behind it. The light in this case was so brilliant as to show through the handkerchief in which it was placed after capture. Finally, Mr. Priest cites a case of this luminosity persisting in a crushed specimen.

THE purification of oyster-beds by means of chlorinated water has formed the subject of experiment by the Board of Fish and Game Commissioners, California. According to *California Fish and Game* (vol. ii., No. 4), a trace of calcium hypochlorite can be passed through the gills and alimentary canal of the oyster without any detrimental effect upon the animal, while any water-borne disease, such as typhoid, is effectually destroyed. In the same issue it is urged that more use should be made of the immense quantities of the edible mussel to be found along the rocky shores of Humbolt County Not only, it is insisted, do they provide a most nutritious food when eaten in the fresh state, but they are scarcely, if at all, less palatable when pickled. Finally, protective measures have been framed for the "Alabone," or Haliotis, which has been almost exterminated for the sake of its shell. It is urged that this mollusc can be made to produce pearls of extreme beauty by inserting foreign bodies between the mantle and the shell.

BULLETIN No. 61 of the Agricultural Research Institute, Pusa, gives an interesting review by Mr. A. Howard of the bearing of soil aeration upon crop production, with especial reference to the agriculture of India. Striking illustrations of the importance of this factor have been furnished by the experimental work of recent years in that country. The requirements of nodule-producing leguminous crops for supplies of nitrogen and oxygen in the soil render soil aeration a factor of obvious importance in their growth, and experience with the gram and indigo crops and in the general practice of green manuring fully bears this out. The distribution of gram in India follows the occurrence of well-aerated soils. Experiments at Pusa have demonstrated that the growth of gram in deficiently aerated soil can be greatly improved by the simple expedient of incorporating considerable quantities of tile fragments with the soil. The indigo plant provides an even more striking instance of dependence upon soil aeration, and much of the money expended in attempts to improve the production of natural indigo might have been saved had more attention been paid to the needs of the plant in this respect. Soil aeration has been shown also to have an important bearing upon the maturation and quality of grain, fruit, vegetables, and tobacco. Various practical applications of soil aeration are indicated, including more rational irrigation, manuring, improvement of crops and cattle, and the development of wheat and rice areas. With efficient aeration adequate nitrogen supplies can be derived directly from the air by bacterial activity, whilst soil fungi will liberate supplies of available phosphates and potash.

THE twelfth memorandum of the Health of Munition Workers Committee deals with the output of munition workers in relation to hours of work, and the question has been investigated from a statistical point of view by Dr. H. M. Vernon. It was found that, when the number of working hours per week was increased beyond a certain level, the output was not correspondingly increased, but tended to fall off owing to the occurrence of "broken time" from sickness or fatigue. The number of working hours per week which yielded the maximum output varied with the character of the work. For moderately heavy labour, the maximum output was attained with sixty hours' work a week, whereas those engaged in light labour worked as much as seventy hours a week in order to reach their maximum output. Dr. Vernon points out that the production of a maximum output day after day by the worker must impose a considerable strain, and that in many cases the strain became too great to be borne and the worker had to drop out altogether. Hence the optimum length of the working week, suited for peace times, is considerably shorter than that mentioned, although the principle of graduating the number of hours to the type of work performed still holds good. The memorandum also gives instances of considerable delay in starting the day's work and of a similar slackening just before the day's work ceases, and it is pointed out that the elimination of these causes of lost time would increase the worker's output without lengthening his working day.

THE September number of *Terrestrial Magnetism and Atmospheric Electricity* contains the results of the measurements of the deviation of the magnetic compass from true north made by the survey ship *Carnegie* during her circumnavigation of the Antarctic continent between December, 1915, and June, 1916. The great bulk of the observations relate to latitudes between 50° and 60° south, but in the neighbourhood of Australia many observations were taken north of this belt. According to the new survey, the British Admiralty Chart gives the deviation to the west in the South Atlantic a fraction of a degree too great, and the error south of the Cape of Good Hope rises to 6°. In the south of the Indian Ocean the chart over 10°

of longitude gives the deviation to the west 3° too small. South-west of Western Australia it is in error by 10° in the same direction. South of Australia it agrees with the new observations to within a small fraction of a degree. East of New Zealand there are a few points where the deviation to the east is given in the chart a degree or more greater than it is. In the middle of the South Pacific there is a considerable region over which the chart gives the deviation to the east 2° or 3° too small, while south of Cape Horn it is in fair agreement with the new observations.

In an address recently delivered to the Western Section of the Institution of Electrical Engineers, the chairman, Dr. D. Robertson, compared the field of scientific knowledge to a goldfield. The first-comers acquire the surface veins and nuggets with comparative ease and with the crudest equipment, but their successors must expend more and more preliminary labour without immediate result, and they must possess more and more knowledge if these labours are not to prove abortive. In the field of research we are past the first stage, and the investigator now must go through a long preliminary training and have behind him resources sufficiently great to support him during the non-productive period. We shall, Dr. Robertson said, never get a sufficient number of men of the right temperament until we offer them prospects comparable with those open to the other learned professions. Dr. Robertson insisted also on the necessity of the scientific man keeping in constant touch with the manufacturing side, if only by weekly visits to the workshops and chats with the managers and foremen. The remainder of his address was devoted to a consideration of new sources of energy for the time when our coalfields are exhausted. He estimated that a dam eight miles long across the Bristol Channel would furnish a million kilowatts of tidal power, and that one at a lower part, thirty miles wide, would give ten million kw. Another suggestion he put forward for consideration was that we should "grow our fuel"—that is to say, produce a plant of high calorific value suitable for use directly as fuel, or indirectly by distilling alcohol or other spirit from it, or, better still, by taking up the energy electrically from the plant so as to save the thermodynamic losses of the heat engine.

The Hardness Tests Research Committee of the Institution of Mechanical Engineers presented a report on November 17 giving particulars of tests made at the National Physical Laboratory by Dr. T. E. Stanton. After some preliminary investigations, it was decided to devise a wear test which would apply to cases in which the relative movement of the surfaces was considerable, and thus enable results to be obtained which would give information regarding shafts, or pins, working at high speeds under heavy loads. In the machine used, the specimen (diameter d) was revolved, and the load applied by means of an abrading ring (internal diameter D); by means of an Oldham coupling, both specimen and ring revolved at the same speed, hence in each revolution the slip of the ring over the specimen was $\pi(D-d)$. Abraded particles were removed by a strong air-blast. The wear was expressed as thickness of surface layer worn away in mils per 1000 ft. of slip, and the relative resistance to sliding abrasion as the reciprocal of this number. The results of the entire investigation show that the Brinell hardness number divided by 6 is approximately equal to the scleroscope number; the characteristic which distinguishes sliding abrasion from rolling abrasion is that the former does not cause any perceptible hardening of the surface under wear as the test proceeds. Comparison of the results for the resistance to sliding abrasion with the Brinell hardness numbers shows that the Brinell numbers are not a safe guide in predicting relative resistances to wear of a miscellaneous selection of steel. The report forms a valuable contribution to our knowledge of this important practical subject.

On Friday, December 15, the inaugural address to the Royal College of Science Chemical Society was delivered by Prof. Gilbert T. Morgan, the subject of his lecture being "Synthetic Chemistry and the Renascence of British Chemical Industry." Prof. Morgan congratulated the society on having this year reached its twenty-first anniversary, and referred to the developments which had taken place in the Royal College of Science since the foundation of the society by Sir William Tilden in 1895. Affiliation with the Imperial College of Science and Technology had given an increased bias to the college curricula in the direction of applied science, and the war had since revolutionised existing ideas as to the national importance of synthetic chemistry. Two chemical crises had arisen; first, the industrial dislocation produced by the stoppage of German dyes; and, secondly, the shortage of high explosives. These crises pointed the same moral, the vital importance to the nation of a well-organised coal-tar industry. This essential development can be attained only by the employment of large staffs of well-trained chemists. The prizes of the chemical profession will be greater, but the competition keener, than has hitherto been the case. The student can best prepare for this strenuous struggle by undergoing a thorough training in analytic and synthetic chemistry. On the practical side, he should aim at perfection in all the laboratory arts. On the theoretical side, he should endeavour to acquire that particularly chemical outlook sometimes termed "the chemical instinct," which is gained by a careful study of molecular theories of constitution, and especially of stereochemical relationships. If time permits, some knowledge of the industrial applications of chemical products will be a valuable addition to his fund of knowledge, and an acquaintance with the elements of mechanics and machine design will tend to render more harmonious his relations with his future works colleague, the engineer. The value of researches in synthetic chemistry, both inorganic and organic, was emphasised by many instances of recent date. Chemical synthesis moves forward unceasingly, and progress over one difficulty leads to many fresh advances at different points along the line. In order to ensure the willing co-operation of many trained workers, it will be necessary to introduce the collegiate spirit into our chemical factories and technical laboratories, so that the splendid team work displayed by our new armies in the field may be rendered available for industrial developments.

The first number of *Air*—the official organ of the Aeronautical Institute of Great Britain—has just been issued. It is hoped that this publication may stimulate public interest and encourage the study of aeronautics. Articles are included on the Air Board, by L. Blin Desbleds; on the cost of a pre-war aerial misconception, by A. J. Liversedge; and on the steel construction of aeroplanes, by G. C. Loening.

The following volumes have been arranged for, for appearance in the "Fauna of British India" Series (London: Taylor and Francis):—"Butterflies (Lycænidæ and Hesperiidæ)," H. H. Druce; the "Longicorn Beetles," C. J. Gahan; the "Ixodidæ and Argasidæ," C. Warburton; "Leeches," W. A. Harding; the "Brachyurous Crustacea," Lieut.-Col. A. Alcock; the "Apterygota, Termitidæ and Embiidæ," A. D. Imms; the "Diptera Brachycera," E. Brunetti; the "Rutelidæ," G. J. Arrow, and the "Operculata," G. K. Gude.

OUR ASTRONOMICAL COLUMN.

RÖMER'S DISCOVERY OF THE VELOCITY OF LIGHT ("Om Ole Romers Opdagelse of Lysets Toven": Høst & Søn, København).—When Römer in 1676 announced to the Paris Academy his discovery of the gradual propagation of light from observations of the first satellite of Jupiter in the course of eight years, he gave no details as to these observations. He merely stated that the period of revolution of the satellite deduced from immersions in the shadow of Jupiter (when the earth is approaching Jupiter) was always shorter than the period found from emersions observed when the earth was receding from the planet. The result was that light took about twenty-two minutes to travel over the diameter of the earth's orbit. (It appears from a letter to Huygens that this was found from observations made in 1671–73.) The only observation quoted in the short paper was one of an emersion on November 9, 1676, at 5h. 35m. 45s. p.m., ten minutes later than was calculated from observations in the previous August, as predicted by Römer in the beginning of September. Three years ago a sheet was found in the University Library at Copenhagen on which was written in Römer's hand a list of eclipses of the satellites observed in the years 1668–77. In a paper published in the Transactions of the Danish Academy of Sciences Mrs. Kirstine Meyer discusses these observations in order to find whether they represent a part of the material on which Römer's discovery was based, and shows that this is really the case. It is shown by several examples that the observations of 1671–73 give, in fact, the approximate result announced by Römer, but that the single results differ a good deal. It is interesting to see from some figures jotted down by Römer in the MS. in question that among the values found by him for the time light takes to pass from the sun to the earth is also the correct one of about eight minutes, but he probably rejected this result as founded on rather short intervals of time. The author calculates the amount resulting from the published observation of November, 1676, and finds that it is eight and a half minutes. Curiously enough, Newton, in his "Optics," gives eight minutes, though the only result published by Römer was about eleven minutes.

PARALLAXES OF TWO STARS WITH COMMON MOTION.—Some time ago it was found by Adams that the two stars, A.Oe. 14318 and 14320, though separated by 5′ in declination, had remarkably similar proper motions and radial velocities. The parallaxes and proper motions in R.A. of these interesting objects have since been determined by O. J. Lee from plates taken with the 40-in. refractor of the Yerkes Observatory (*Astronomical Journal*, No. 697). The resulting parallaxes are $0.025'' \pm 0.008''$ and $0.061'' \pm 0.012''$, and the proper motions in R.A. -0.0699s. and -0.0692s. respectively. More trustworthy determinations of proper motion by Prof. J. G. Porter give the total motions as $3.693''$ in the direction $195.7°$ and $3.675''$ in the direction $195.6°$. The difference of parallax, amounting to $0.036''$, agrees well with the value $0.031''$ previously given by Russell, and the evidence that the two stars are very widely separated in space, while having practically identical motions both in and across the line of sight, is now fairly conclusive. It may be recalled that the two stars are of magnitudes 9.6 and 9.2, and of types G4 and G5 respectively. The radial velocities are exceptionally great, being +307 km./sec. and +295 km./sec., according to the observations of Adams, and the difference is probably not greater than the errors of observation in the case of such faint stars. The two stars have the same R.A., 15h. 5.5m., while the declinations are $-16° \ 2.5'$ and $-15° \ 57.5'$.

THE DIRECT JOINING OF GLASS AT MODERATE TEMPERATURES.

IN a paper presented to the Faraday Society on December 18, Messrs. Parker and Dalladay described some interesting experiments on the direct joining of glass at relatively low temperatures which they have carried out in the research laboratories of Messrs. Adam Hilger, Ltd. The results described are not only of very considerable direct scientific interest, but afford great practical advantages in the construction of glass apparatus out of what is actually a single solid piece instead of using more or less unsatisfactory cements. The advantage of such solid construction is particularly evident in polarimeter tubes and absorption cells—the latter can now be constructed with truly parallel faces and with inside faces optically worked. The process of joining which the authors have worked out consists in placing the surfaces of glass to be united in good optical contact under pressure, and then raising the temperature to a carefully determined degree. The glass surfaces thus treated become perfectly united, so that the two pieces of glass will not separate along their former interface, and the composite piece acts as if it were a single solid mass; even a crack or a diamond-cut will pass through the junction without hindrance or deflection. The temperature employed is chosen as high as possible in order to lessen the time required for union of the surfaces, but if distortion of the optically worked surfaces is to be avoided, then the temperature must not be taken too near the limit, which the authors describe as the "annealing point." This point they determine by observing the strains set up in a piece of glass while being heated at a definite rate in an electric-tube furnace; for each kind of glass they find that these internal stresses—which are readily observed by means of polarised light—disappear quite suddenly. At this point, also, the glass becomes appreciably soft, and can be indented by a sharp tool. When similar kinds of glass are used, having similar "annealing points," then the welding of surfaces in optical contact takes place well below this annealing point. Very dissimilar glasses, however, cannot well be joined, since the softer becomes distorted before the harder is hot enough to weld freely.

THE EXPLOITATION OF INSHORE FISHERIES.[1]

MANY advisory and other committees, some in connection with the great Government departments and others among the leading scientific societies, are at present engaged in deliberations in regard not only to immediate and pressing war problems, but also to the later, and possibly equally important, after-war questions, which are bound to arise, affecting the prosperity of the country and the maintenance of the Empire. A large number of these matters turn upon the application of scientific knowledge and scientific methods to various industries, and amongst these not the least important are those concerned with the allied subjects of agriculture and aquiculture, or the scientific regulation and cultivation of our land crops and our sea-fisheries.

It is recognised that, with the view of making a rapid recovery from the effects of the war, amongst other things, agriculture and allied industries must be promoted, and it must be seen to that no suitable land is wasted, that none is applied to the wrong purpose, and that the most favourable treatment to ensure the best results is given to each area. In fact, a more

[1] Introductory address (abridged) given by Prof. W. A. Herdman, F.R.S., in opening the discussion on Inshore Fisheries in the section of Zoology of the British Association at Newcastle-upon-Tyne on September 7.

systematic study and more intensive cultivation of the land must be made. In quite a similar way, and for no less important reasons, the harvest of the sea must be promoted, the fisheries must be continuously investigated, and such cultivation as is possible must be applied to our barren shores. All such fisheries cultivation is one of the natural applications of biological science, and ought therefore to be supported and directed by the members of this section and other marine biologists.

Now that considerable areas of the British fishing grounds are either closed to trawlers or impracticable for the usual fishing operations, any increase of employment on the seashore and in shallow waters round the coast may be of direct and immediate advantage both to the men and to the country. Such industries as shell-fish cultivation, shrimping and prawning, whitebait and sprat fishing, and herring fishing and curing, if extended and exploited judiciously, will add to employment, will increase the food supply of the country, and may lead to the establishment of permanent industries of a profitable nature. On the west coast the Lancashire and Western Sea-Fisheries Committee has been alive to such possibilities for some time past, and much of its scientific fisheries work has been directed towards showing the improvements that might be introduced in connection with the local shell-fish industries. It has been shown in its annual reports how mussels and cockles can be fattened and greatly increased in value by transplanting to better feeding grounds, and how, if reared in sewage-polluted waters, they can then be cleansed and purified before being sent to market. The Lancashire Committee, realising the present opportunity of helping such deserving industries, has worked out several concrete cases where a moderate expenditure, either in transplanting or in purifying the shell-fish, or both, would be likely to give immediate beneficial results, and so far as opportunity offers it is endeavouring to promote such useful work.

This is not a time when it is easy to induce public bodies to undertake any fresh expense, but it will be unfortunate for the country if such directly productive expenditure, which may reasonably be expected to lead to the establishment of permanent shell-fish industries, be prevented or delayed for want of the comparatively small sums which are necessary to start the work.

As an example of what can be done at a small cost to improve the value of shell-fish by judicious transplanting, the work of the Lancashire and Western Sea-Fisheries Committee in 1903–5 may be cited.[2] It was carried out on the mussel beds at Heysham, in Morecambe Bay, probably the most extensive mussel-producing grounds on the west coast of England.

In 1903 the committee gave a grant of 50*l.* to be expended on labour in transplanting overcrowded and stunted mussels, which were not showing any growth, to neighbouring areas which were not so thickly populated. The result was most striking. Mussels, which in their original condition could never have been of any use as food, had been turned into a valuable commodity at comparatively little trouble and expense. The money value to the fishermen of these mussels that had been transplanted for 50*l.* was estimated a few months later to have been at least 500*l.* In 1904, again, a grant of 50*l.* resulted in the transplanting of under-sized mussels, which were later on sold at a profit of more than 500*l.* In the following year (1905) a grant of 75*l.* resulted in the sale of the transplanted mussels some months later for 570*l.* On that occasion more than 240 tons of the under-sized mussels had been transplanted in six days' work. It was found that on the average the transplanting increased the bulk of the mussels about two and a half times, and the increase in length to the original shell was in some cases well above an inch.

Experiments have also been made on the Lancashire coast in the transplantation of cockles from overcrowded to less crowded sands with equally favourable results.[3]

It is obvious that when, on the conclusion of war, many men return to work along our coasts any increase of employment in connection with such local fishing industries will be of direct and immediate advantage to the country. It is to be hoped that nothing will be allowed to interfere with this transplantation and purification work, and that whenever possible further funds will be devoted towards the promotion of schemes which seem desirable, if not, indeed, essential, from the point of view of the industry and of public health alike. In connection with the public health aspect of the matter, much of Dr. Johnstone's work on the Lancashire coast for some years past has dealt with the condition of the shell-fish beds in relation to sewage contamination, by means both of topographical inspections on the shore and of subsequent bacteriological investigations of samples in the laboratory.[4]

As an example of a local fishery which has been started as the result of a little ingenuity and enterprise, we may take the Morecambe winter sprat fishery which has developed during the last couple of years. The fish are being caught in great quantities by a new method, which is the "stow"-net modified to suit the conditions prevailing in the strong tidal currents of the Morecambe Bay channels. The sprats appear in September, then become very abundant off Morecambe in November, and remain in quantity until the end of January, after which the sprats become smaller and the fishery diminishes in value. During the height of the fishery fully 70 tons of fish were landed per day, and the money value of this catch to the fishermen was more than 300*l.* A ton of sprats contains on an average 130,000 fish. In a day's fishing, therefore, nine millions of sprats may be captured, and this goes on day after day without making any appreciable difference to the abundance of the fish. A full account of this recent fishery and the method of using the "stow"-net is given by Mr. Andrew Scott in the Lancashire Sea-Fisheries Report for 1915

Another interesting and very profitable local fishery, which has arisen or been resuscitated quite recently in the Irish Sea, is the summer herring fishery off the south end of the Isle of Man. In former days there seems to have been a regular summer herring fishery, but for the last thirty years or so it has failed—the fishermen say because of the absence of herrings, but more probably it is because these men have found more profitable employment on shore. A few years ago a firm of Scottish herring curers was induced to establish a branch at Port St. Mary, and this so stimulated the local fishermen that a fleet was equipped and sent to sea, and a profitable fishery ensued. That was in the summer of 1910, and the same conditions have held good more or less since. But the prices obtained by the men for their catch have fluctuated, notably in accordance with the market facilities and the amount of competition between rival buyers and curers. In 1910–12, with one buyer, the price was 18*s.* the cran; in 1913, with four buyers, the price rose to 40*s.*; in 1914, with two buyers, the price was 30*s.*; in 1915, with four buyers, the maximum price was 91*s.*; while in the present summer (1916), with five rival buyers, the record price of 97*s.* a cran was reached.

From this record of recent years, and from what one

[2] See Lancashire Sea-Fisheries Laboratory Report for 1905.

[3] For further details reference must be made to the successive Annual Reports of the Committee.

[4] All this work has been recorded in detail in recent Annual Reports of the Lancashire Committee.

can ascertain of conditions in the past, it is clear that —in addition to the presence of the fish, which can probably be relied upon in most years—it is necessary for a prosperous herring fishery in the Isle of Man either that a local market should be constituted by competing buyers and curers from Scotland or elsewhere, or that arrangements should be made to transport the daily catch by steam-carriers to a market on the mainland, such as Liverpool, Fleetwood, or Holyhead. As a result of the lack of market facilities, it may be noted that during the greater part of this summer herrings have been sold retail at Port Erin at twenty for a shilling, while in Liverpool they cost from three-halfpence to twopence halfpenny each.

After the war it will for some time probably be just as important as it is now to prevent money from leaving the country, and with a view to this, as well as for other reasons—in brief, the production of food and the employment of men—it is obviously desirable that all home productivity should be organised and stimulated. The exploitation of minor fishing industries along our shores naturally occurs as one step in this direction, and the economic need for developing these deserving industries seems obvious and urgent.

THE LONDON MATHEMATICAL SOCIETY.[1]

IN the midst of the universal cataclysm of the war, when all interests are strained towards the national defence, the London Mathematical Society has passed, without notice, its fiftieth year of activity. The first meeting was held at University College, on January 16, 1865, and heard an address by Prof. de Morgan on the aims and prospects of the society. The de Morgan medal is a reminder for us of his predominant share in the inauguration of the society, which he did not survive long to guide. In the early days the publications consisted of a series of pamphlets separately paged, containing single communications; the names of Sylvester, Cayley, Harley, Tucker occur as authors in the first year. There followed later brief reports of meetings, along with papers by de Morgan, Sylvester, Crofton, Cayley, H. J. S. Smith, Cotterill, and others. These publications now stand as vol. i. of the first series of the Proceedings. With vol. ii., which begins with the annual general meeting of November 8, 1866, the Proceedings became crystallised into a form which has persisted substantially, except as regards size of page, to the present time. The society began operations with twenty-seven original members, nearly all of them members of University College, London; at the end of the first year the number of members was sixty-nine, rising to ninety-four in November, 1866; and the society had already become representative of British mathematical science by having on its roll most of the eminent investigators in our subject belonging to Cambridge and Oxford, as well as London.

On January 15, 1866, it was resolved "That steps be taken to ascertain on behalf of the society whether and on what terms rooms can be obtained at Burlington House," and on November 8 a report was made that "by the kindness of the Chemical Society in lending their rooms, the society had been enabled to hold their meetings at Burlington House, where they now meet for the first time." By 1868 most of the British authorities on pure and applied mathematics of that time, who were resident within reach, including de Morgan, Cayley, Sylvester, Hirst, Crofton, H. J. S. Smith, Archibald Smith, Clerk Maxwell, Spottiswoode, S. Roberts, Clifford, Stirling, had been taking active share in the work of the society by attendance and service on the council, as well as by the contribution of papers for discussion at the meetings. We must not omit from this list Lord Rayleigh, whose memoirs illuminated our Proceedings for many years; who, stimulated by the increasing importance of the society, became the donor of our most substantial benefaction, which has largely increased our resources for publication ever since the early days. In November, 1870, the society migrated to rooms occupied also by the British Association, in the house of the Royal Asiatic Society, 22 Albemarle Street, where accommodation was found for the library, of which a nucleus had been formed by the books of Sir J. W. Lubbock, the physical astronomer, presented by his son, afterwards Lord Avebury; and there by successive forms of tenancy we have remained until now.

For some years past the library, rendered valuable by accumulation of scientific journals through exchange, and by donations of books, has quite outgrown the accommodation available; and weighty complaints became frequent that, by overcrowding, the books had become, notwithstanding the zeal of successive honorary librarians, almost inaccessible to members of the society. The problem, thus pressed upon them from many sides, was taken in hand resolutely by the council during the last session, and after various plans had been proposed and closely considered, a solution was reached.

It came to the knowledge of the council that the Royal Astronomical Society would probably be willing to extend hospitality to the Mathematical Society, as regards both place of meeting and general headquarters, thereby establishing, or rather renewing, an alliance between British mathematicians and astronomers, whose activities have always interpenetrated with the closest mutual benefit. Following on the confirmation of this plan, subject to the approval of the Office of Works, arrangements have also been made with great cordiality by the authorities of the Science Museum at South Kensington, whereby our library will be deposited in their scientific library under a scheme which will maintain full use of it by the members of the society, in surroundings where the cognate scientific literature, and extensive mechanical applications of mathematical principles, will be accessible for study.

We have, therefore, the pleasure now of holding the first of our meetings under the new conditions, at Burlington House, in very congenial surroundings.

The necessities of the national emergency have mobilised with striking success the industrial resources of science, hitherto neglected too largely in our defensive organisations. A most welcome result is the increased sense that has arisen of the national value of scientific pursuits; but danger is by no means absent that, in the haste to secure the material fruit, the welfare of the tree of knowledge, the pure and fertile source from which it springs, may be neglected or even impaired, and, like others of ancient days as well as recent times, we may succumb to the temptation "propter vitam vivendi perdere causas."

It is our duty here to take into consideration how our own special energies may best be rejuvenated and renewed, so as to become more effective in the enhanced and purified national life which, as we trust, will emerge from our present ordeal. Mathematical knowledge, in all ages the ally of sustained and exact activities, is now more indispensable than ever, when our material well-being depends so much on scientific engineering in its mechanical, electrical, and chemical forms. The highest commendation of any growing department of research is to be able to say that it is approaching the quantitative, the mathematical, form; many sciences, formerly descriptive and

[1] From an address delivered at the anniversary meeting of the London Mathematical Society on November 2 by the retiring president, Sir Joseph Larmor, M.P., F.R.S.

classificatory, are even now struggling to assimilate a mathematical method. But if it is just to claim that other sciences, nowadays even the biological, aspire with increasing success to become mathematical—that is, exact—in structure, there is, on the other hand, a duty enjoined on mathematicians to see to it that the main stream of their discipline is kept accessible—free from specialities and complexities, which, valuable and promising as they may be, and usually are, on their own account, to those capable of cultivating them, are yet for the present outside the current of the main advances of human knowledge. The play of human thought knows of no boundaries; it can pursue and clarify itself without limitation into endless mazes. All the more, we must be careful, in reclaiming and cultivating our boundless domains of mental evolution, not to lose touch of one another; if a theorist cannot command the attention of his own generation, he is scarcely likely to attract the interest or serve the purposes of posterity. The one criterion that is available of the value of an addition to pure knowledge is the human mental interest it can excite. We have our very being inside a well-ordered cosmos, intellectual and material, which it is our highest mental pleasure to explore in all directions and learn to comprehend; and we have a not unsafe guide in trained instinct and sense of fitness and symmetry, industriously applied, to appraise aright the value of each new departure. Knowledge thus cultivated on a broad basis for its own sake, so far from obstructing industrial applications, is their profound source. The study of curves, especially the conic sections, by the Greeks, at home and afterwards at Alexandria, is not, as is sometimes asserted, an example of mere useless mental ramifications happening to receive an application in later ages; it was on the direct path of progress, and formed the material, adequate and effective because not unduly complex or abstract, on which the ideas of the infinitesimal calculus—and may we add the mechanics of Archimedes and Galileo?—were gradually matured. And if it became in Newton's hands the weapon for the elucidation of the doctrine of universal gravitation, whereby human science first reached out securely into the illimitable universe, what analyst will deny the preordained fitness of the association?

There was a time, when the annual output of the Mathematical Society was smaller in bulk than it is now, that many of us made a point of taking an interest in all the papers that it published. It would be a great thing if we could get back again towards that state of affairs. At least two of our most distinguished analysts have in my hearing traced the aloofness, and even aridity, of much recent work to the neglect of geometrical ideas, the potent source in the past of mathematical progress and consolidation, and the vehicle for the diffusion of our science. It seems a strange phase of development, when we consider the preponderant graphical, tentative, and practical bent of the national intellect, and remember how much of our most characteristic progress and originality in theoretical physics has been, for the sake of being comprehensively grasped and mastered by the mind, so concisely wrapped up in geometrical imagery, and so freed from analytical technicalities, as to have been even obscure to communities trained in more formal and syllogistic methods.

There is always risk in getting too far from the main currents of our times; there is the danger, not always avoided, that in the fog of ignorance and the lack of interest we may encourage expansion in artificial and unfruitful, and even tedious, ramifications, while criticising and suppressing with rigour worthy, but immature, attempts in the well-explored regions of our science, where improvements are so important and originality is so difficult. The contrast with the difficulty of obtaining publication at all a century ago, except in brief summary, gives ground for reflection.

Of recent years the question must have presented itself to not a few of our authors whether the Proceedings, developing in so abstract a direction, are now quite as suitable a place for the publication of mathematical physics as they were in the days when Maxwell and Kelvin, and Rayleigh and Routh, were frequent contributors. Yet the potent source of even the most abstract branches of modern analysis has lain in the seizure and orderly cultivation of the intuitional ideas, largely cast in geometrical mould, that are forged by physical science in the effort to systematise its observations of the uniformities of the rational world around us. To renew our strength for wider flights we must return frequently to mother earth. The main feature of the technique of physical mathematics is that we are seldom dealing with a completed; and therefore strictly limited, logical complex; it is of its essence that the specification of the problem is fluent and provisional, always ready to take on new features as the discussion opens out. The student of mathematical physics cannot with safety afford to be a specialist; every department of physics is dovetailed into the other departments and progresses by their aid; knowledge must be so far as possible on an intuitive basis, to prevent it from becoming top-heavy, and all the threads must be in hand. For intuition sees, however imperfectly, all round a problem at a single glance; while analysis afterwards consolidates a permanent structure by fitting brick to brick. Even the most abstract of analysts must work at a disadvantage if he has no informed interest in the problems of external nature for which his analysis might be of assistance; and conversely, even the most recondite constructions of pure analysis would be of interest to a wider audience if they could be expounded in a non-technical manner, without the great detail that is sometimes thought to be essential to the necessary degree of precision. Nature is never irrational, but our main intellectual aim is the redemption of our views of her operations from that reproach; it is the freshly detected and systematically traced concatenations of her working that enlarge our stock of ideas, and become for us a source of new generalisations in abstract procedure, giving fresh points of view to be developed and to react in their turn. It is sufficient to cite the names of Cauchy and Riemann, not to mention the supreme examples of Lagrange and Gauss, to show that the most brilliant originality in abstract analysis, and habitude in the intuitions of physical science, can go together, to great mutual advantage.

Fortunately there are signs, abundant on both sides, that the repulsion which somehow arose with us in the last decades between the tentative, yet essentially progressive, though concise, prospecting of mathematical physics, and the stern but limited rigours associated with undiluted pure analysis, is now beginning to be recognised as cramping and unnatural; it may thus melt away in a better mutual understanding, and may one even say mutual interest, to the great advantage of both disciplines. Our analysts have been turning with success, and with a zest of a kind that seems familiar to their more physical colleagues, to semi-empirical methods in the theory of numbers; speculative interest has again arisen even in divergent series, such as would have rejoiced the soul of de Morgan, logician though he was; and the time-worn problems of partitions and combinations have been yielding their secrets to the powerful leverage of an apparatus of arrays and lattices, that may remind us of crystallography and even of thermodynamics.

Our society has lost by death not a few of her veteran members during my two years of office.

Notices of the work of Morgan W. Crofton, W. H. H. Hudson, Benjamin Williamson have already appeared in the Proceedings. In Sir James Stirling, Senior Wrangler of 1860, lately Lord Justice of Appeal, we have lost another of the survivors of our early days, whose interest in our science never flagged, whose mathematical training and gifts were the foundation of a legal and judicial eminence not often arising in a generation. In William Esson, Savilian professor, and John Griffith we have lost two Oxford mathematicians long connected with us. Though F. W. Frankland, an early member, had passed out of sight owing to distance of domicile, his combination of mathematical and philosophical interests had not become dormant. I may be permitted to add the name of John Henry Poynting; though his life-work attached him to sister societies, his wide physical outlook, combined with mental exactness and penetration, has made for him an enduring name in mathematical, as well as experimental, physics.

It is our pride and sad privilege to recall the names of the cultivators of our science who, in response to their country's appeal in time of national peril, have already laid down their lives on her behalf. In E. K. Wakeford, scholar of Trinity College, Cambridge, not a few of us had recognised a future leader in geometrical science. A colleague more senior and more widely known, S. B. McLaren, professor of mathematics at Reading, coming from Australia, and taking a high degree at Cambridge, had become a learned and philosophical inquirer in the difficult domain of statistical molecular dynamics and the relations of the æther to material systems; the work which formed the basis of the recent award of an Adams prize may remain, I fear, unpublished in any finally revised form. We are entitled also to recall the name of H. G. J. Moseley, who, though he would not have claimed to be a mathematician, had in a brief and brilliant career at Oxford and Manchester contributed fundamentally to the data of the mathematical physics of the future, by revealing the earliest universal and unmistakably quantitative relation in the fascinating domain of the correlations of the chemical elements.

Such heavy sacrifices of colleagues who could so ill be spared we must deeply deplore, but not as if they were made in vain. May we not detect beyond them, and on account of them, the promise of nobler and more disinterested times, when the vast destruction of perishable material resources will be far more than compensated in the remembrance of the heroism of the youth of our generation, and in the gain in moral and intellectual wealth that it will stimulate as an abiding possession?

> The world's great age begins anew,
> The golden years return,
> The Earth doth like a snake renew
> Her winter weeds outworn.
>
> * * * *
>
> A brighter Hellas rears its mountains
> From waves serener far:
> A new Peneus rolls his fountains
> Against the morning star.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The title of emeritus professor of physics in the University of London has been conferred by the Senate on Dr. F. T. Trouton, who held the Quain chair of physics at University College from 1902 to 1907, and after the incorporation of the college held it in the University from 1907 to 1915.

The following doctorates have been conferred:—In anthropology, Mr. B. G. Malinowski, an internal student, of the London School of Economics, for a thesis entitled "The Natives of Mailu"; in botany, Mr. F. J. F. Shaw, an internal student, of the Imperial College of Science and Technology (Royal College of Science), for a thesis consisting of five papers on mycology; in economics, Miss E. D. Proud, an internal student, of the London School of Economics, for a thesis entitled "Welfare Work: Employers' Experiments for Improving Working Conditions in Factories"; in physics, Mr. David Owen, an external student, for a thesis consisting of two papers on "Solid Rectifying Contacts," and subsidiary contributions; in psychology, Mr. G. H. Miles, an external student, for a thesis entitled "Preference and Affective Influence as Factors in Recall," and subsidiary contributions; in engineering, Mr. N. W. McLachlan, an external student, for a thesis entitled "Magnetic Properties of Iron," and subsidiary contributions.

IT is announced that friends of the University College of Wales, Aberystwyth, have expressed their intention of contributing 100,000*l.* to the funds of the college, subject to a reservation of their right to make proposals to the council as to either the capital or the income.

THE governors of the Royal Technical College, Glasgow, at the request of certain donors, offer prizes, amounting to 70*l.*, for essays on the best methods of training and employing in industries, other than agriculture, returned soldiers and sailors, maimed or otherwise. The prizes will be awarded by a committee of the governors, and may be withheld in the event of no essay of sufficient merit being submitted. Essays must be sent in not later than March 1, 1917, addressed to the director, the Royal Technical College, Glasgow.

WE learn from the issue of *Science* for November 17 that the General Education Board and the Rockefeller Foundation have each granted 200,000*l.* for the establishment of a medical department in the University of Chicago. This gift brings Mr. Rockefeller's contributions to the University up to nearly 7,400,000*l.* The University will set aside at least 400,000*l.* for the same purpose, will give a site valued at 100,000*l.*, and will raise a further sum of 660,000*l.* The medical school will therefore start with an endowment of some 1,600,000*l.*

AT the request of the Right Hon. A. Henderson, when President of the Board of Education, the Royal Drawing Society has presented to the Committee on the Teaching of Science a memorial setting forth the value to the scientific worker of drawing and the cognate crafts, and the need for including drawing as an integral part of general education. This, the society maintains, is best accomplished, not by special classes, but by encouraging the faculty which is manifested in nearly all children, and by making it a natural mode of expression in the various branches of school work, *e.g.* history, geography, nature-study, and physical science. The memorial is signed by H.R.H. the Princess Louise, as president, and by many distinguished workers in pure and applied science, some of whom are members of the society's council. In connection with the Conference of Educational Associations, the society has arranged a discussion on the subject, with lantern illustrations, at the University of London, on January 1, at 5.30 p.m. Among the speakers will be Dr. P. S. Abraham, Dr. F. A. Bather, Mr. J. P. Maginnis, and Mr. Ablett.

THE first meeting of the Senate of the new University of Mysore was held on October 12. The proceedings are reported in the *Educational Review* (Madras) for October. In 1913–14 two educational officers of the State studied modern university conditions in foreign countries; a draft scheme drawn up in November last year embodied the joint views of the

Government of India, the deputation, and various public officials; in April last a committee was appointed to give effect to the draft scheme, and the Bill to establish and incorporate a university in Mysore was unanimously passed last July. There are at present two constituent colleges, the Maharaja's College at Mysore and the Central College at Bangalore. Degrees (B.A. and B.Sc.) may be obtained after a continuous three-years' course, and a course leading to a degree in teaching is to be established in the near future. There are 890 students under university supervision, and there are twenty-two professors or assistant-professors. The new University is the first offshoot of the University at Madras, and it is foreshadowed that other universities may be founded at Travancore and Hyderabad. A scheme of university extension work is under consideration. The Chancellor, H.H. the Maharaja, in his speech, stated that the new University was the first to be established outside the limits of British India.

THE "Handbook" of the West Riding of Yorkshire Education Committee is published in parts, which deal respectively with the various grades of education aided by the committee. The pamphlet numbered Section X. of Part II. gives full particulars of the scholarships and exhibitions to be offered in 1917 for the pursuit of higher education. The committee appears to have made provision for the needs of every class of student in the area over which it presides. Among the scholarships and exhibitions offered may be noticed the fourteen county major scholarships of the estimated value of 60*l.* to 65*l.* per annum to be held at universities, university colleges, or other institutions of higher education; the four county technological scholarships of the value of 60*l.* per annum; and others of the value of 50*l.* or less, tenable for day courses or for combined day and evening courses at institutions where higher technical instruction is carried on, and intended for young workmen having three years' general practical experience in an occupation; the county scholarships for women to enable them, for example, to be trained in midwifery and nursing, horticulture, and other vocations; the county agricultural exhibitions; and the travelling scholarships awarded as occasion may arise. Full particulars of the scholarship scheme may be obtained from the Education Department, County Hall, Wakefield.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7.—Sir J. J. Thomson, president, in the chair.—J. T. **Carter**: The cytomorphosis of the marsupial enamel-organ and its significance in relation to the structure of the completed enamel.—Margaret **Tribe**: The development of the pancreas: the pancreatic and hepatic ducts in *Trichosurus vulpecula*. The history of the three pancreatic primordia has been followed out in detail. Their development is traced through the earlier stages where the three are separate from one another; through the later stages where fusion has occurred, but where the primordia are still individually recognisable, up to the late pouch-fœtus in which the identification of the various component parts of the gland is still possible.—H. J. **Watt**: The typical form of the cochlea and its variations. The data and conclusions may be summed up by saying that the cochlea is built according to a constant plan, of which the scale alone varies from case to case. This scale shows a decidedly high correlation with the size of the organism as a whole. A change of scale will obviously alter all the dimensions recorded except the number of whorls. But even that number, when it varies independently, does not alter the other dimensions of the cochlea. The only other variant thus far detected is the rate of curvature of the spiral, which is greater in the bigger scale organs.—Dr. A. D. **Imms**: The structure and biology of Archotermopsis, together with descriptions of new species of intestinal protozoa, and general observations on the Isoptera. *Archotermopsis wroughtoni*, Desn., is exclusively confined to coniferous forests in the N.W. Himalaya, and lives in dead timber, no true nest being constructed. The queen exhibits no indications of degeneration or increase of size common to most species of Termitidæ. True workers are absent, but gynæcoid, egg-laying, worker-like forms occur. The soldiers are remarkable in retaining the external secondary sexual characters, and the gonads in this caste, and in the worker-like forms also, are fully developed. Abundant protozoa occur in the large intestine of the "sterile" castes and nymphs, they are scarce in the winged forms, and absent in the queens and young larvæ. These organisms usually have been regarded as parasites, but it appears more probable that they are symbiotic in their relations to their hosts. By breaking down ligneous matter they contribute towards the digestion of the latter by the Termites. Polymorphism in Termitidæ is not adequately explained on the grounds of special nutrition, nor does the theory of "castration parasitaire" account for the observed facts. The Mendelian inheritance of mutations appears to offer a reasonable solution of several of the outstanding difficulties associated with polymorphism and the inheritance of germinal characters in sterile castes. Archotermopsis is one of the most primitive of the Termitidæ, and its structure and bionomics throw light upon important biological problems.—J. J. **Guest** and F. C. **Lea**: Torsional hysteresis of mild steel. In this paper a series of experiments is described which show that, when mild steel is subjected to a torsional reversal of stress, the material does not follow Hooke's law, and that there is a distinct stress-strain hysteresis loop even for comparatively small ranges of stress.

Physical Society, November 24.—Prof. C. V. Boys, president, in the chair.—H. R. **Nettleton**: The measurement of the Thomson effect in wires. The paper describes how absolute measurements of the Thomson effect may be made in wires. The theory is fully worked out, and the sources of error likely to arise—especially owing to the smallness of the area of cross-section—are considered. The method is sensitive, consistent, and very rapid; its ultimate object is to determine the Thomson effect at different temperatures in a number of metals, both rare and base, at the same time, and with the same specimens, finding their thermo-electric powers.—C. R. **Darling** and A. W. **Grace**: The thermo-electric properties of fused metals. One of the authors has for some time been investigating the possibility of using base metal thermo-couples at temperatures above the melting point of one of the constituents. For this purpose it was necessary to determine whether any peculiarities in the thermo-electric behaviour of metals occur at fusion. In the case of lead, tin, zinc, and cadmium there is no perceptible break in the continuity of the curves obtained. In couples containing bismuth, however, several cases were noted in which the E.M.F. remained constant for a wide range of temperature after the fusion of the bismuth. This occurs with silver, aluminium, iron, or nichrom as the other element. Useful applications of this property are discussed.

Geological Society, December 6.—Dr. Alfred Harker, president, in the chair.—G. C. **Crick**: Recent researches on the belemnite animal. Attention was confined to the restoration of a typical belemnite animal and its shell, as shown particularly by examples in the British Museum collection. Mr. Crick first demonstrated, by means of a rough model, the construction of the belemnite shell, including the guard or rostrum, the phragmocone with its ventrally situated siphuncle, and its thin envelope, the conotheca, with its forward prolongation and expansion (on the dorsal side) known as the pro-ostracum. He then exhibited photographic slides of examples in the British Museum collection showing these various characters, and noted the abrupt termination of the chambered cone on the lower part of the pro-ostracum, of which the dorsal surface may have been partly or almost completely covered by a thin forward extension of the guard.

Mathematical Society, December 14.—Prof. H. M. Macdonald, president, in the chair.—Prof. W. **Burnside**: The efficiency of a surface of discontinuity regarded as a propeller.—G. H. **Hardy** and S. **Ramanujan**: (1) Proof that almost all numbers N are composed of about $\log\log N$ prime factors. (2) An asymptotic formula for the number of partitions of a number.—G. N. **Watson**: The harmonic functions associated with the parabolic cylinder (second paper).—Prof. D. **Buchanan**: Orbits asymptotic to an isosceles-triangle solution of the problem of three bodies.—Prof. H. S. **Carslaw**: Diffraction of waves by a wedge of any angle.—Prof. L. J. **Rogers**: Two theorems of combinatory analysis and two allied identities.—Prof. W. H. **Young** and Mrs. **Young**: (1) The internal structure of a set of points in space of any number of dimensions. (2) The inherently crystalline structure of a function of any number of variables.

EDINBURGH.

Royal Society, November 6.—Dr. J. Horne, president, in the chair.—The President opened the session with a short address on the relations of industry and science.—Dr. J. **Tait**: Experiments and observations on Crustacea. Part i. Immersion experiments on *Ligia oceanica*. In distilled, or in tap, water Ligia dies within two days. When sea-water is added the period of survival is increased, and in full sea-water, steadily aerated, Ligia can live without food for three months. Size and condition as regards moult influence the period of survival. Part ii. The moulting of Isopods. Isopods appear to moult in two stages. Splitting occurs (1) transversely between the fourth and fifth free thoracic segments; (2) longitudinally at junction of coxopodite with tergite, thus revealing otherwise invisible lines of concurrence of segments. Ligiæ kept for weeks without food in sea-water moult normally. The opinion expressed by Réaumur that a crustacean moults because it has grown too large for its coat is incorrect.

November 20.—Dr. J. Horne, president, in the chair. —Prof. E. T. **Whittaker**: The adelphic integral in dynamics. The adelphic integral is defined to be such that the infinitesimal transformation corresponding to it transforms the members of a family of periodic orbits (corresponding to the same value of the constant of energy) into each other. It is shown that a dynamical problem with two degrees of freedom possesses only one really distinct adelphic integral, and that the finding of this integral is the most natural way of obtaining the complete solution of the problem. The integral is obtained as an infinite series, and it is shown that the difficulties connected with Poincaré's theorem on the non-convergence of the series of celestial mechanics may be surmounted by its means.—Dr. J. **Tait**: Experiments and observations on Crustacea. Part iii. Limb flexures and limb taxis in the Pericarida. The design and arrangement of the limbs in five orders were described, the mode of inquiry being physiological, advantage being also taken of the principle of analogy. A series of swimming limbs (Mysidacea) develop tri-alternate flexures when the animal passes from a homogeneous fluid medium to a fixed bounding surface. The proximal segments of these limbs are at first directed laterally outwards from the body (Cumacea, Tanaidacea), and the limbs from two groups, anterior and posterior. By a process akin to the rotation that occurs in vertebrate limbs the principal plane of flexure comes to lie anteroposteriorly in the Cammaridea. In the Isopoda further rotation has occurred, producing a taxis suitable for clinging. In the isopodan limb the most proximal joint is a universal hinge like a spheroidal bony joint. The author discussed the application of functional conceptions to the study of structure.

DUBLIN.

Royal Irish Academy, November 30.—The Most Rev. J. H. Bernard, Archbishop of Dublin, president, in the chair.—H. **Ryan** and W. M. **O'Riordan**: The tinctorial constituents of some lichens which are used as dyes in Ireland. Four species of lichens, viz. *Parmelia saxatilis*, Ach., *Ramalina scopulorum*, Ach., *Ramalina cuspidata*, Nyl., and *Physcia parietina*, De Not, were examined. The first three of these are known to have been largely used in the west of Ireland, and also in parts of Scotland, for dyeing wool a brownish colour. The chief constituents of these three lichens were found to be as follows:—*Parmelia saxatilis*, Ach., contains stereocaulic acid and salazinic acid, $C_{30}H_{24}O_{16}$; *R. scopulorum*, Ach., contains scopuloric acid, $C_{31}H_{26}O_{16}$, and *d*-usnic acid; *R. cuspidata*, Nyl., contains cuspidatic acid, $C_{31}H_{32}O_{20}$, or $C_{17}H_{16}O_{10}$, and *d*-usnic acid. The tinctorial properties of the lichens were found to be due to the presence in them of salazinic acid, scopuloric acid, and cuspidatic acid respectively. The fourth lichen, *Physcia parietina*, De Not, is not largely used as a dye. It contains, however, a yellow substance, physcione, which, when demethylated by means of strong sulphuric acid, yields emodin, which dyes wool an orange colour.—H. **Ryan** and P. **Ryan**: The condensation of aldehydes with ketones. III.—Benzaldehyde with methyl *iso*propyl ketone. Benzaldehyde condenses with methyl *iso*propyl ketone to form the benzylidene derivative of diphenyldimethyltetrahydropyrone, which was previously obtained from benzaldehyde and dimethylacetylacetone. Monomethylacetylacetone with benzaldehyde forms another compound melting at 157° C. Benzaldehyde also condenses with ethylacetoacetic ester to yield cinnamoylbutyric acid.—J. **Algar**: Unsaturated ketones derived from diaceto-orcinol. In this communication is described the preparation of diaceto-orcinol from orcinol-diacetate. It is identical with the diaceto-orcinol obtained by Collie from diacetylacetone. Diaceto-orcinol condenses with aldehydes in the presence of alcoholic caustic soda, and in this manner unsaturated ketones were prepared. A description is given of the preparation of dibenzylidene-, dianisylidene-, diveratrylidene-, and dipiperonylidene-diaceto-orcinol.

PARIS.

Academy of Sciences, November 27.—M. Camille Jordan in the chair.—E. **Picard**: The integrals of total differentials relating to regular algebraical surfaces.—G. **Bigourdan**: The position and co-ordinates of the astronomical station of the island of Notre-Dame. The works of Auzout. This station was where Auzout made a part of his observations, constructed his telescopes, the largest up to that time, and invented the micrometer with movable thread.—C. **Guichard**: The K networks of a quadric of revolution. — F. **Gonnessiat**: A star with a large proper motion.

Barnard noted a star on the photographs made at the Yerkes Observatory with an annual displacement of 10·3″, the largest known. This star has been found in the photographic catalogue of Algiers, and gives an annual displacement of 10·286″. It is the nearest star known; its parallax corresponds to 3·26 light years. Full details of the method of reduction will appear shortly in the *Bulletin Astronomique*.—Ch. Ed. **Guillaume**: Modifications of the expansibility of invar by mechanical or thermal actions. Both in annealed and tempered invar wires drawing down causes a rapid lowering in the coefficient of expansion; the coefficient is also affected by the heat treatment. Prolonged heating to 100° C. not only renders the condition of the metal after wire-drawing stable, but gives a material with a coefficient of expansion which is practically zero under the tension used in geodesic operations, and hence eliminates temperature errors.—G. **Kœnigs**: The general geometrical form of the properties of the second order of plane movements with two parameters.—M. **Mesnager**: Formula of the thin plate, with edges fixed on a plane rectangular contour.—L. **Fabry** and H. **Blondel**: The elements of the planet discovered by M. Sy at Algiers, May 26, 1916. It is proved that the elements of the Sy comet do not coincide with those of 562 Salomé. It would appear probable that this planet is new.—H. **Arctowski**: The fluctuations of the solar constant. It is shown that besides the sun-spots, other phenomena affect the solar constant in a manner sufficiently strong partially, or even totally, to mask the effect of the spots.—R. **Ledoux-Lebard** and A. **Dauvillier**: Theoretical and experimental researches on the bases of radiological estimations. In the special form of X-ray tube described by the authors, giving intense K spectra, the energy supplied (continuous current) being known, the estimation is reduced to a time measurement.—J. **Repelin**: The geology of the islands of Pomégnes and Ratonneau (Bay of Marseilles). The islands have been erroneously assumed to be a continuation of the massif of Notre Dame de la Garde, but are now shown to be constituted by Urgonian limestones arising from an accident altogether independent of this massif, and spreading out as a layer on a substratum of the upper Aptian.—A. **Boutaric**: Nocturnal radiation. A theoretical expression is developed for the nocturnal radiation, the loss of heat per minute of 1 sq. cm. of a black surface exposed to the air. Some experimental data obtained at Montpellier in 1913 and 1914 are in fair agreement with the formula, and show at least that the results of calculation and observation are of the same order of magnitude.—F. **Gérard**: Four new Ochnaceæ of Madagascar.—A. **Béclère**: The inoculability of variole in the vaccinated, but not completely immunised, calf.

BOOKS RECEIVED.

University of Sheffield. Calendar for the Session 1916–17. Pp. 742. (Sheffield.)

A Defence of Classical Education. By R. W. Livingstone. Pp. xi+278. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*. net.

A Text-Book of Organic Chemistry for Students of Medicine and Biology. By Prof. E. V. McCollum. Pp. xiii+426. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s*. net.

The World as Imagination. By E. D. Fawcett. Series I. Pp. xlii+623. (London: Macmillan and Co., Ltd.) 15*s*. net.

Decennial Index of the *Analyst*. Vols. xxxi.–xl. Compiled by M. A. Baker. Pp. 733. (London: Simpkin, Marshall and Co., Ltd.)

What is Instinct? By C. B. Newland. Pp. xv+217. (London: John Murray.) 6*s*. net.

The Control of Hunger in Health and Disease. By A. J. Carlson. Pp. vii+319. (Chicago: University of Chicago Press; Cambridge: At the University Press.) 9*s*. net.

Second-Year Mathematics for Secondary Schools. By E. R. Breslich. Pp. xx+348. (Chicago: University of Chicago Press; Cambridge: At the University Press.) 4*s*. net.

The High Price of Sugar and How to Reduce It. By H. H. Smith. Pp. iv+54. (London: John Bale, Ltd.) 1*s*. net.

Highways and Byways in Nottinghamshire. By J. B. Firth. Pp. xviii+426. (London: Macmillan and Co., Ltd.) 6*s*. net.

Some Questions of Phonetic Theory. By Dr. W. Perrett. Pp. vi+110. (London: University of London Press, Ltd.) 2*s*. 6*d*. net.

Charts: Their Use and Meaning. Prepared by Dr. G. H. Fowler. Pp. iv+47+charts viii. (London: J. D. Potter.) 4*s*.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 21.

CHEMICAL SOCIETY, at 8.—Studies on the Walden Inversion. V. The Kinetics and Dissociation Constant of α-Bromo-β-phenylpropionic Acid: G. Senter and G. H. Martin.—The Alcohols of the Hydroaromatic and Terpene Series. III. The Isopulegols corresponding with *l*-Menthol and *d*-Neomenthol: R. H. Pickard, W. Lewcock, and H. de Pennington.—Lead Sub-iodide, with Details of the Preparation of Lead Suboxide: H. G. Denham.—Note on the Solubility of Lead Iodide: H. G. Denham.—Chromium Phosphate: A. F. Joseph and W. N. Rae.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—The Economic Geology of the Insizwa Range: W. N. Goodchild.

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

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THURSDAY, DECEMBER 28, 1916.

THE LIFE-WORK OF DR. E. K. MUSPRATT.

My Life and Work. By Dr. E. K. Muspratt. Pp. xi+320. (London: John Lane, 1917.) Price 7s. 6d. net.

THE author of this autobiography comes of a family which has exercised a marked influence on the industrial development of South Lancashire. Its members, moreover, have played no inconsiderable part in the social and intellectual life of Liverpool. To his father, James Muspratt, belongs the credit of founding the alkali manufacture in Lancashire. His life is one of the romances of chemical industry. Born in Dublin, of English parents, in 1793, he was apprenticed, when fourteen years of age, to a wholesale druggist in that city, but losing both his parents when he was scarcely eighteen, he broke his indentures and embarked for Spain in the hope of obtaining a cornetcy in a cavalry regiment in Wellington's army. A youth of fine physique and of a splendid constitution, Muspratt had all the physical qualifications for a successful soldier, but unfortunately he had no social influence, and in those days commissions in mounted regiments were reserved for those favoured in high quarters. Still, he had some experience of the Peninsular campaign, was stricken with fever in Madrid, and was in Hill's retreat down the valley of the Tagus. He then joined the Navy, and as a midshipman in the *Impetueux* took part in the blockade of Brest and in one or two frigate actions. He soon threw up this career, and making his way back to Dublin, started chemical manufacturing with the aid of a small inheritance which had been saved from the results of a Chancery action.

On the abolition of the salt duty in 1823, Muspratt saw his opportunity, and, moving to Liverpool, established, in the face of difficulties that would have crushed a weaker man, the manufacture of soda by the Leblanc process. He rapidly acquired wealth, and eventually built Seaforth Hall, a fine large house in the classical style, and a prominent landmark in what was then a remote suburban district among the sandhills at the mouth of the Mersey. He died at the age of ninety-three, after a vigorous, active life, full of excitement and incident. He had a large family, one of whom, Dr. Sheridan Muspratt, the well-known editor of the "Dictionary of Chemistry," a work which had a considerable vogue in its day, founded the Liverpool College of Chemistry.

The author of this memoir was the youngest son of the father of the alkali trade. He was born in 1833—the same year as his friend, the late Sir Henry Roscoe, with whom he went to school at Gateacre. When young Muspratt was about four years old the British Association happened to meet at Liverpool, an event which was destined to have a considerable influence on his after-life. Among the distinguished foreign visitors was Justus Liebig, the chemist, then a comparatively young man of thirty-five, but already almost at the summit of his fame. With him the elder Muspratt, now an acknowledged leader of English chemical technology, and a man of social influence in Liverpool, contracted a firm friendship which eventually included both their families.

After a good school training on Pestalozzi's system young Muspratt was sent in his seventeenth year to Giessen to study chemistry under Liebig and Will, and physics and mathematics under Buff and Zamminer. "When I first arrived at Giessen," writes our author, "Liebig, who was only about fifty or fifty-one years of age, appeared an old and broken-down man. When he entered the lecture-room he could hardly walk firmly, but glided in and appeared exhausted with the effort. In a few minutes all was changed, when he became inspired by the subject of his lecture."

Liebig, shortly afterwards, was invited to a far less strenuous position in the University of Munich, a circumstance which, no doubt, prolonged his life, and Dr. Muspratt elected to follow him, not so much with the view of studying chemistry as of studying medicine, to which at that time he had some inclination. He and the other members of his family who from time to time joined him at Munich were now on terms of close intimacy with the Liebigs, and were, in fact, part of their social and home life. This section of Dr. Muspratt's reminiscences constitutes, indeed, one of the most interesting features of his book, and in a few graphic touches, done with the artlessness which conceals art, we gain a vivid impression of German university life and of the condition of German society in the early fifties of last century. It is not without its lights and shades. Nothing could be more striking, for example, than the contrast between the drab and humdrum life at Giessen, its atmosphere of strenuous study, its simple, homely pleasures, and the social whirl and political excitements of the gay and light-hearted Bavarian capital. We trace the influences already at work of which we see the outcome in this later time. The "foreigners," as the North Germans, who had been invited to Munich by Maximilian, at the instigation of his Prussian tutor, von Dönniges, were called, were never really popular in the city of their adoption. Their influence from the outset was, and with good cause, dreaded by the Ultramontanes, and there can be little doubt that it was used to promote Bavaria's adhesion to the North German Confederation, and, ultimately, to bring about its absorption into the German Empire. The potential political value of professors, of which we hear so much to-day, is no new thing in Germany.

The space at our disposal, unfortunately, does not permit us to follow Dr. Muspratt at greater length through the many episodes of his long and varied career. But before we leave his account of his Munich life it may be of interest to note it was the circumstance that his sister, Miss Emma Muspratt, afterwards Mrs. Harley, was attacked with typhoid fever when on a visit to the Liebigs that indirectly led to the invention of the world-famous "extract of meat."

The growing anxieties of a large and complex business at length compelled Dr. Muspratt to leave Germany in order to assist his father, and henceforth most of his life and energies were spent in his native city and its neighbourhood, varied only by not infrequent interludes of foreign travel, accounts of which form a considerable portion of his narrative.

But in spite of the constant demands upon his time and activities, owing to the changing and progressive character of manufacturing chemistry during the last few decades, Dr. Muspratt has found abundant opportunity to associate himself with the social, political, municipal, and intellectual development of Liverpool, and there have been few public movements of any importance in that city with which he has not been connected in greater or less measure. All this he sets out, with a pardonable pride, in this autobiographical record. His has been a singularly full, active, and useful life, of many and varied interests, fruitful in achievement and in unselfish personal service. The book is written in a simple, unaffected manner, with no pretensions to literary style. It has suffered in a very slight degree from the fact that the author's failing eyesight compelled him to seek the aid of an amanuensis. This doubtless accounts for the occasional misspelling of proper names and certain lapses in expression which ought not to have escaped the attention of the proof-reader. T. E. THORPE.

STUDIES OF THE RESPIRATORY EXCHANGE.

The Respiratory Exchange of Animals and Man. By Dr. A. Krogh. Pp. viii+173. (London: Longmans, Green and Co., 1916.) Price 6s. net.

THE fact that Dr. August Krogh is perhaps better known in this country than any other foreign contemporary physiologist is chiefly owing to the attention which was attracted by his researches on the mechanism of the respiratory exchange. A treatment of the subject from this point of view might have been expected of one whose own work has been of such fundamental importance in this direction; such expectation is, however, not realised in the volume before us, for it contains no reference to this department of the author's labours.

The study of the respiratory exchange has now grown to be a large subject divisible into subsidiary branches, and the monograph deals only with a limited aspect of one of these, namely, the quantitative aspect of the material and energy exchanges of the body as judged by the criterion of the total respiratory exchanges. The influences of functional activity are not considered.

The work opens with a short, clear account of the significance of the respiratory exchanges, and of the principles involved in direct and indirect calorimetry. The methods used in the investigation of the respiratory exchanges are described, and then follows the chief subject-matter of the volume. Great stress is laid throughout on the importance of referring all determinations of total respiratory exchange to a "standard metabolism," *i.e.* the metabolism of the organism when in a state of minimal functional activity, and the author ruthlessly sets aside the results of many admittedly interesting series of observations where this essential has not been observed.

The influences of various intrinsic factors and of chemical and physical factors are discussed, and then follows one of the most interesting chapters in the book, that on the variations in standard metabolism during the life-cycle. The sections of this chapter which deal with hibernation and that treating of the pupal life of insects are of first importance.

Some of the author's own work in this direction is highly interesting; for instance, he shows that by raising the temperature the duration of pupal life may be shortened even by two-thirds, yet in all cases the carbon dioxide produced during pupal life by unit weight of chrysalides is the same. The most diverse forms of animal life, from sea-urchin eggs to brooding pythons, are introduced to illustrate specific points, or to indicate useful lines for future work, the outlook being essentially biological.

The final chapter, which deals with the respiratory exchange in different animals of the same and of different species, shows careful treatment of results which are still very far from complete; the portion dealing with the relation of metabolism to surface and weight is logically dealt with. The bibliography is carefully chosen so as to present the pith of the very voluminous literature on the subject.

GNOMONICS AND CELESTIAL MOVEMENTS.

(1) *Gnomonica: L'Orologio Solare a Tempo Vero nella sua Moderna Applicazione.* By G. Bottino Barzizza. Pp. viii+199. (Milano: Ulrico Hoepli, 1915.) Price 2.50 lire.

(2) *Lezioni di Cosmografia.* By Prof. Giovanni Boccardi. Pp. x+233. (Milano: Ulrico Hoepli, 1916.) Price 3 lire.

(1) THIS is a short text-book on gnomonics, and is not intended for people who merely want to put up a nice sun-dial as an ornament in their garden or grounds. There is not a single picture of an article of that kind: only geometrical diagrams. The aim of the author is a much higher one, and has been well accomplished by showing how in careful hands a sun-dial may be used to control a clock sufficiently well for ordinary purposes. After explaining the diurnal and annual motion of the sun, the necessary formulæ are developed for tracing the hour-lines on horizontal and vertical dials and for correcting their indications for errors of adjustment. Convenient auxiliary tables are also given of the various

trigonometrical functions, the equation of time, and the declination of the sun.

(2) The author of this little book on the rudiments of astronomy has endeavoured to avoid dealing with matter already treated in other books of the Hoepli series (entitled "Astronomy," "Gravitation," etc.) by explaining mainly the apparent phenomena on the celestial sphere. The word cosmography is thus used in a sense which is scarcely the usual one, as descriptive astronomy, astrophysics, and the orbits of the planets are omitted altogether; but phenomena like the libration of the moon and the tides are briefly described. Beginning with the figure of the earth and its daily rotation, the author passes on to the apparent annual motion of the sun, defines parallax, both daily and annual, and gives a table of twenty-seven stars the annual parallaxes of which are supposed to be best known, ranging from α Centauri with 0·76″ down to Polaris with 0·07″. The motion of the earth comes next, after which precession and nutation are briefly alluded to, and aberration more fully. The distances and periods of the satellites of the planets (including the recently discovered ones) are given in tabular form, but the motion of the moon and the effects of its principal perturbations are described in greater detail. The treatment of every subject throughout the book is concise; the explanations are given in simple and unadorned language, and ought to give beginners a clear idea of the principal phenomena of the heavens within the limits the author has set for himself.

OUR BOOKSHELF.

British and Foreign Marbles and other Ornamental Stones: a Descriptive Catalogue of the Specimens in the Sedgwick Museum, Cambridge. By J. Watson. Pp. x + 485. (Cambridge: At the University Press, 1916.) Price 5*s*. net.

The Sedgwick Museum, Cambridge, is indebted to the industry of Mr. Watson for its useful exhibit of polished marbles. This volume, which is supplementary to the one by the same author on "Building Stones," is essentially a descriptive guide to the marbles and other ornamental stones in the collection, about eight hundred in number. The specimens have been assembled from many parts of the world, and a number of well-known varieties are represented, as well as some that will be less familiar.

The geological arrangement adopted in the companion book has been wisely discarded in favour of a geographical one, but a short account of the distribution and geology of the marbles prefaces the detailed catalogue of each country's products.

As a handbook to the collection this volume is admirable; the descriptions are clear and, on the whole, adequate, and the remarks on the examples to be found in buildings have been prepared with care, but the major title is rather misleading, for as a work of reference its utility is lessened by the circumstance that it deals only with specimens which happen to have been acquired by the museum. Thus steatite is represented only from Central Africa and India, and while there is a considerable amount of space devoted to fluorspar and jade, there is no reference to chalcedony. Again, dolerites and felsites are represented by only a single sample of each, from India, and only two porphyries are mentioned. In view of the fact that so many of the igneous rocks are used primarily as ornamental stones, the inclusion of these few examples serves merely to emphasise the omission of the others.

Here and there statements of doubtful accuracy appear, as in the suggested coral origin of Rosewood marble; and some of the information is a trifle stale—for example, the remarks on the popularity of Derbyshire black marble.

The index is good and greatly enhances the value of the book for general use, but for practical purposes a list of the marbles grouped according to their prevailing colour should be added in another edition.

The Rain-children. A Fairy-tale in Physics. By T. H. Orpen. With seven illustrations by C. E. Brock. Pp. vi + 112. (London: Society for Promoting Christian Knowledge, n.d.) Price 2*s*. 6*d*.

In designing the plan of this book the author seems to have thought of the nursery expedient of administering a medicinal powder in a spoonful of jam. His object appears to be to explain to children the formation and uses of the forms of water, but, having doubts of the intrinsic interest of the subject for his readers, he creates characters like Aunt Cold, Aunt Heat, Colonel Lightning, Sergeant Thunder, and Rain-children to describe to a little heroine he has created how natural phenomena can be explained. The result is a tale which little girls may like, but we believe boys usually prefer to keep their lessons and stories for separate occasions.

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.]*

University Doctorates.

I see from an announcement in the *Times* of December 22 that facilities are to be offered to advanced students of other universities by the University of Oxford in order to allow them to take the degree of Doctor of Science or of Doctor of Letters under new conditions.

It is to be hoped that, before any such scheme is discussed, a serious attempt may be made to introduce something like a uniform standard of attainment among our own universities for the doctorate, which is at present awarded for very different degrees of attainment and under very different conditions. When that uniformity has been adopted, any scheme offering facilities for the doctorate to graduates of the United

States and other universities should be framed by joint representatives of all our universities.

It would be a misfortune if anything in the nature of competitive schemes for attracting students were to be evolved independently by different university authorities.

J. B. COHEN.

Leeds, December 23.

The Deterioration of the Atmosphere in the Swiss Alps.

DR. MAURER, Director of the Swiss Federal Meteorological Service, sends a further communication about the deterioration of the atmosphere of the Swiss Alps, referring to Prof. Riccò's letter in NATURE of November 9 on the occurrence of an eruption at Stromboli. I am forwarding a translation for your information.

NAPIER SHAW.

Meteorological Office, South Kensington, London, S.W., December 11.

This remarkable optical deterioration of the atmosphere was visible here (Zurich) until about the middle of November. The thin, cirrus-like layer could be seen on clear mornings just before sunrise at a height of about 14–15 km. above the earth's surface, according to our reckoning—that is to say, it was situated considerably above the usual cirrus region. It consisted of thin horizontal bands, extremely delicate and soft, which soon disappeared after sunrise. A curious fact was that no appreciable effect, either actinometric or photometric, was produced by this thin, mist-like layer. The impression made was that of a most delicate, comet-like veil of mist, yet not dimming the starlight. After sunrise absolutely nothing was to be seen of the phenomenon, in spite of the keenest observation through field-glasses of a weak magnifying power. Synchronising with this remarkable phenomenon, the sun had a large aureole with a diameter of 100°. Here and there the extreme outer edge of this ring was of a pale brown colour. So far we have not been able to offer any explanation as to the cause.

During the period of maximum visibility of the thin veil (twilight cirrus), such a conspicuous layer was to be seen in the eastern sky, shortly before sunrise and at a height of 40°, that even an unskilled observer would have noticed it at once. The structure of the layer was often so regular and definite in its remarkable horizontal stratification that it looked as though an artist with a coarse brush had coloured the whole eastern sky with long horizontal strokes not too neatly laid on.

Each time this peculiar veil of "twilight cirrus" reached a maximum of intensity we had a colourless morning twilight with interrupted "purple light." What can be the cause of all these remarkable phenomena?

Winter Thunderstorms.

A YEAR ago (December 16, 1915) I asked readers of NATURE if they would let me know when they observed thunder or lightning during the first three months of the year. I made a similar request to the observers of the British Rainfall Organisation. The number of replies I received amounted to nearly one thousand, and the rather remarkable fact came to light that during the period in question thunder or lightning occurred somewhere in the British Isles on sixty-four out of the ninety-one days. So numerous were the replies received that I was unable to answer each one personally, but I wish to thank those correspondents who kindly sent information, and to assure them that every report was of value.

The information obtained last winter was so remarkable, and the number of days on which thunder or lightning occurred so unexpected, that I am anxious to collect information again. Readers of NATURE could assist if they would send me a note by postcard or letter if they observe thunder or lightning between January 1 and March 31, 1917. The following points are of interest:—(1) Time when storm was nearest or overhead; (2) direction of storm when first observed, and time; (3) direction when last observed, and time; (4) note if there was a change of wind during the storm and if there was a drop in temperature; (5) any other information as to heavy rain, hail, snow, or any remarkable feature; (6) if an observer has accurate time, a list of the times of occurrence of flashes would be useful.

Many observers may not have the time or opportunity to record all these points, but I should be grateful for information on even one of them; No. 1 is the most important. The information is of real value, and every record, however short, is of use.

C. J. P. CAVE.

Meteorological Office, South Farnborough, December 20.

GRAVITATION AND THE PRINCIPLE OF RELATIVITY.

ACCORDING to the principle of relativity in its most extended sense, the space and time of physics are merely a mental scaffolding in which for our own convenience we locate the observable phenomena of Nature. Phenomena are conditioned by other phenomena according to certain laws, but not by the space-time scaffolding, which does not exist outside our brains. As usually expressed, the laws of motion and of electrodynamics presuppose some particular measurement of space and time; but, if the principle is true, the real laws connecting phenomena must be independent of our framework of reference—the same for all systems of co-ordinates. Of course, it may be that phenomena are conditioned by something outside observation—a substantial æther which plays the part of an absolute frame of reference. But the following considerations may show that the ideal of relativity is not unreasonable. Every observation consists of a determination of coincidence in space or time. This is suffcently obvious in laboratory experiments; and even the crudest visual observation resolves itself into the coincidence of a light-wave with an element of the human retina. If, then, we trace the path of adventure of a material particle, it intersects in succession the paths of other particles or light-waves, and these intersections or coincidences constitute the observable phenomena. We can represent the course of Nature by drawing the paths of the different particles—on a sheet of paper in a two-dimensional case. The essential part of the diagram is the order of the intersections; the paths between the intersections are outside observation altogether, and are merely interpolated. The sequence of phenomena will not be altered if the paper is made elastic and deformed in any way, because the serial order of the intersections is preserved. This deformation of the paper corresponds to a mathematical transformation of the space in which for convenience we have located the phenomena.

Until recently the application of the principle of relativity was limited to one particular transformation, namely, a uniform translation of the axes. In this case there is a wide range of experimental evidence in support of the principle. In 1915 Prof. A. Einstein[1] finally succeeded in developing the complete theory by which the postulate of relativity can be satisfied for all transformations of the co-ordinates. Gravitation plays a part of great importance in the new theory, and therein lies much of the practical interest of Einstein's work.

No attempt is made to explain the cause of gravitation—as a kink in space or anything of that nature. But the extended law of gravitation is determined, to which Newton's law is an approximation under ordinary conditions. It has long been suspected that there must be some modification of the law when the bodies concerned are in rapid relative motion; moreover, the "mass" of a moving body no longer has a unique meaning, so that a further definition, if not extension, of Newton's law is clearly needed. Now, although we do not seek a *cause* of gravitation in the properties of space, it may well happen that the *law* of gravitation is determined by these properties. The inverse-square law represents the natural weakening of an effect through spreading out in three dimensions; we may say that it is determined by the properties of Euclidean space. There is, therefore, nothing unreasonable in proceeding, as Einstein does, to examine whether a more extended law is suggested by the properties of generalised space—that is, by geometry.

The way in which gravitation enters into the discussion may be seen from the following example. Suppose an observer is in a closed lift; let the supports break and the lift fall freely. To the observer everything in the lift will now appear to be without weight; gravity has been suddenly annihilated. The acceleration of his frame of reference (the lift) is equivalent to an alteration of the gravitational field. Now an acceleration of the axes is one of the transformations contemplated by the general principle of relativity, and it is therefore necessary to allow that the gravitational field depends on the choice of co-ordinates. There is a "local" gravity, just as there is a "local" time or magnetic field depending on the co-ordinates selected.

We can now take a brief survey of Einstein's procedure. Suppose that space and time are measured by a system of co-ordinates x_1, x_2, x_3, x_4; x_4 is the time, but there is no need to discriminate between it and the others. If there is a gravitational field at any point, it can be abolished (as in the example of the lift) by choosing new co-ordinates x_1', x_2', x_3', x_4' accelerated with respect to the old. The necessary transformation could be specified in various ways; the way chosen involves the element of length ds, measured by coincidences with a standard scale, and therefore independent of the choice of co-ordinates. Since in the x' co-ordinates there is no gravitation to complicate matters, we can safely use the usual formula,

$$ds^2 = dx_1'^2 + dx_2'^2 + \ldots$$

and this when transformed to the old co-ordinates takes the most general form,

$$ds^2 = g_{11}dx_1^2 + g_{22}dx_2^2 + \ldots + 2g_{12}dx_1dx_2 + 2g_{13}dx_1dx_3 + \ldots$$

The ten g's depend on the transformation, and can be used to specify it. But they do more than that; they define the original gravitational field, since they specify how it can be got rid of. They usually vary from point to point, because a different transformation is needed to eliminate gravity at different points. In the new theory the g's are regarded as ten gravitational potentials specifying the field; and, in fact, one of them, g_{44}, is approximately the same as the Newtonian potential ϕ, except for a factor.

The inverse-square law can be expressed by the well-known differential equation $\nabla^2\phi = 0$. Evidently the new law of gravitation must be a generalisation of this—an equation, or set of equations, involving the ten potentials instead of one. Also, to conform to relativity, the new equations must be unaltered by a change of co-ordinates. If new co-ordinates are used the g's will be different, but the relations between the new g's and new co-ordinates must be the same as those between the old g's and old co-ordinates. The possible sets of relations which satisfy this are very limited in number. This subject, known as the theory of tensors, has been worked out very fully by Riemann, Christoffel, and others, and the possible sets of equations can be classified and enumerated. From this limited choice we have further to pick out a set of equations which will reduce to $\nabla^2 g_{44} = 0$ as a first approximation, and that is found to leave only one possibility. There is just one set of ten differential equations (of which, however, only six are independent) which satisfy both conditions. Einstein takes these as expressing his generalised law of gravitation. It is important to notice exactly how much of this is geometry. Geometry shows that *if* the equations hold for a particular set of co-ordinates, they hold for every set. We abolish the "if," and so assert a new law of Nature.

It is further necessary to consider what must be the generalised equivalent of Poisson's equation $\nabla^2\phi = -4\pi\rho$, which supplants Laplace's equation when matter is present. The extension is not difficult, since it is found that the ten equations above mentioned are the expression of a generalised principle of least action as applied to gravitational energy. Now mass is considered to be simply electromagnetic energy, and since there is no reason to believe that electromagnetic energy will behave differently from gravitational energy in regard to least action, we have only to include both forms of energy together in the equations, treating them as equivalent. It is not possible to write down here these final equations, since a very elaborate notation is needed for their expression.

[1] Einstein, "Die Grundlage der allgemeinen Relativitätstheorie." (Leipzig: J. A. Barth, 1916.) A detailed account appears in *Monthly Notices*, 1916, No. 9, by Prof. W. de Sitter, giving the astronomical applications. See also an article by de Sitter in the *Observatory*, October, 1916.

Though highly complicated in form, they can be applied without excessive labour to the more simple problems.

One or two of the more elementary consequences of this theory were given by Einstein some years ago. A ray of light must be bent in passing through an intense field of gravitation; thus a star seen close to the limb of the sun during an eclipse should appear displaced $1 \cdot 7''$ from its usual position. The vibrations of an atom must be slower in an intense field, so that the lines of the solar spectrum should be displaced slightly to the red as compared with terrestrial spectra. It has not yet been possible to put these predictions to a satisfactory test, and it has been left to the completed theory to furnish the first opportunity of an appeal to observation. In this the new theory has scored a most signal success, for it has cleared up the most celebrated case of discordance in gravitational astronomy.

From his generalised law of gravitation Einstein has deduced that the elliptic orbit of a planet will rotate in the direction of motion at the rate of

$$\frac{24\pi^3}{V^2} \frac{a^2}{T^2(1-e^2)} \text{ radians per revolution of the planet.}$$

Here V is the velocity of light, and a, T, e are the semiaxis, period, and eccentricity of the orbit. If v is the velocity of the planet, the amount is practically $6\pi v^2/V^2$ radians per revolution. For Mercury this works out at $43''$ per century—just the amount of the outstanding discordance between observation and theory. The theory also gives rotations for Venus and the earth, but their orbits are so nearly circular that the effect is imperceptible to observation. For Mars, with its strongly elliptic orbit, the correction is more important, and sensibly improves the accordance between theory and observation.[2]

It is rather difficult to grasp the fact that the same laws of Nature may hold when some bizarre system of co-ordinates is chosen. Suppose an observer A uses rectangular co-ordinates, and B, through some kink in his mind, uses polar co-ordinates without realising that he is doing anything unusual. For A a ray of light can travel along the straight line x = constant; but evidently it cannot travel along the circle r = constant, which is B's idea of a straight line. The answer is that B through his peculiar system of measurement will suppose that he is in an intense gravitational field; he will calculate the curvature in the ray of light produced by this field; and, making allowance for it, he will find that the light actually travels along its theoretical curve (*i.e.* curve for B, but straight line for A). Thus the same general laws of Nature are satisfied for B as well as for A; and it might be difficult to decide which of them had got hold of the absolute rectangular co-ordinates.

A. S. EDDINGTON.

[2] The discordance of the perihelion of Mercury (now removed) was nearly 30 times its probable error. Of the sixteen secular variations of the four inner planets, all are now accordant, except the node of Venus, which deviates by $4\frac{1}{2}$ times its probable error. Among sixteen residuals we should expect to find one of three times the probable error, so that the evidence for the remaining discordance is not very strong. There are besides unexplained variations of the longitudes of the moon and planets, but these are in a different category.

PLANTS IN HEALTH AND DISEASE.[1]

PROF. WEISS and his colleagues have done well in publishing in book-form abstracts of their lectures on Plants in Health and Disease. The lectures were delivered at the University of Manchester during 1915-16, and had for their object the giving of botanical guidance to the many small gardeners and allotment-holders who were, and are, endeavouring by the cultivation of their several plots to add to the food supplies of the country.

Although only its friends recognise the fact, science in this country suffers from the virtue of modesty. Accompanying that quality—as is so often the case—is often a certain hauteur. Hence it is that those who—only too rarely, it must be confessed—come seeking guidance from science are often sent empty away. It would be well for science, and also for the country, if this attitude of aloof detachment were to cease to be habitual. It is true that biological science has at present not overmuch to offer to horticulturists; but that is an added reason why closer relations should be established between those who cultivate the land and those who study the science of biology. It is by such means as those adopted by Prof. Weiss and his colleagues that this contact may be best established.

It is no adverse criticism on this little book to say that if and when science and practice go hand in hand a thoroughly good botany for gardeners will make its appearance, and not before. One of the results of such a book will be to teach the gardener to do scientifically and better what he now does empirically and well. The day of publication of that perfect book is far off, and botany will have not only to grow but to be pruned very heavily before it is written. The science will have to cast off the pseudo-encyclopædic habit, woven in Germany, which it wears. For example, when talking to gardeners of the importance of restricting water supply in order to provoke flower and fruit formation (p. 2), why not give an account of the current method of tomato-growing instead of citing examples from "tropical climes"? In the cultivation of the tomato the check imposed after the first truss of fruit is set, the pinching-out of side-shoots, the stopping of the leader, and the reduction of leaf surface, all have for their purpose the regulation of the water supply and the reduction of vigour of vegetative growth. Apart, however, from the fact that those who are habitually engaged in gardening might not infrequently suggest more cogent illustrations of botanical principles, the general account given in these lectures of the life of a plant is admirable. Occasionally we discover a lapse, as, for example (p. 7), the omission to mention the chief virtue of the hoe, namely, that by its use water is conserved in the soil.

The less difficult parts of the book, those which

[1] "Plants in Health and Disease: being an Abstract of a Course of Lectures delivered in the University of Manchester (1915–16)." By Prof. F. E. Weiss, Dr. A. D. Imms, and Wilfrid Robinson. Pp. 143. (Manchester: At the University Press; London: Longmans, Green and Co. 1916.) Price 1s. 6*d*. net.

deal with disease, are no less excellent than the account of the normal life of the plant. In the chapters devoted to fungi such diseases as finger-and-toe, black scab, late blight, rust, and mildews are described. It is curious that no reference appears to be made to the fact that many varieties of potato are now known to resist attack by black scab—a fact of the greatest importance to allotment-holders and town gardeners. The remedies suggested for use in the case of mildews certainly do not apply to American gooseberry mildew, a disease which is so widespread and so disastrous in its consequences that it might well have received more thorough treatment. Much useful information is provided on the subject of animal pests, but gardeners with a knowledge of their ravages might look for a fuller account of eelworms, which pests are probably responsible for more damage in gardens than is any other fungus or insect. The accounts of such pests as the cabbage-root fly and the onion fly, which have been very active this year, are particularly clear. We could only wish that the measures whereby these pests are to be combated were half as good; but for more perfect measures we must look to future research, for at present they are unknown. To the reviewer at all events the absence of illustrations is no drawback; it may be, however, that the layman may find it difficult to see mentally the pests and processes without their aid. We trust not; for we hold the belief that pictures are overdone in popular books on science and in science teaching generally. F. K.

PROF. DANIEL OLIVER, F.R.S.

With deep regret we record the death at Kew on December 21, in his eighty-seventh year, of Emeritus Prof. Daniel Oliver. The eldest son of another Daniel Oliver, the deceased was born at Newcastle-upon-Tyne on February 6, 1830, and was educated partly in private schools, partly at the Friends' School, Brookfield, near Wigton. Attached from an early age to botanical study and a youthful member of a local scientific society, we find him in 1847 contributing to the *Phytologist* a list of rare plants from different geological formations, and in 1850 adding a new genus to the flora of the United Kingdom. In 1851 he became a fellow of the Edinburgh Botanical Society, and in 1853 of the Linnean Society. His reputation as a keen and critical worker, gained in the North of England, was already such as to prompt Sir William Hooker to invite him to assist his son in the heavy task of arranging and distributing the botanical collections accumulated by the East India Company and to induce him in 1858 to become an assistant in the herbarium at Kew. On settling there Oliver instituted in 1859 a course of lectures on botany, which he continued to conduct until 1874, for the benefit of the young gardeners. He proved so excellent a teacher that in 1861 he was appointed to the botanical chair which had been occupied by Lindley at University College, London. The extent and accuracy of his botanical knowledge led to his election to the Royal Society in 1863 and to his appointment, on the retirement of Mr. A. Black in 1864, to the keepership of the herbarium and library at Kew. The chair at University College, now held by his distinguished son, Oliver retained until 1888; the keepership at Kew he occupied until he retired from the public service in 1890. After his retirement he succeeded Sir Joseph Hooker as editor, on behalf of the Bentham Trustees, of the "Icones Plantarum." This duty he fulfilled for five years, so that his connection with the institution where he worked so long, and for which he did so much, was not finally severed until 1895.

The salient features of Oliver's contributions to botany, too numerous to be recounted here, are the accuracy of his observations, the soundness of his conclusions, and the combined fidelity and artistic skill of his illustrations. But his published works represent only a fraction of his botanical knowledge, so exact as to have earned the justifiable confidence of Sir Joseph Hooker and Mr. Bentham while engaged in preparing their great "Genera Plantarum," so wide that Darwin, when seeking the benefit of his great knowledge of flowering plants, spoke of him to Hooker, only half in play, as the "omniscient" Oliver. This wide knowledge, the outcome of the long and patient devotion to duty of a keen and active intellect, was readily placed at the disposal of all serious students who chose to consult him. If he never sought, neither did he avoid, the outside duties that devolve on men of his capacity; he served twice on the council of the Royal, twice on that of the Linnean Society. He did strive to avoid, but could not wholly escape, honours and distinctions. In 1882 the Edinburgh Botanical Society elected him, after thirty years of ordinary membership, one of their six British honorary fellows. In 1884 the Royal Society recommended him as the recipient of a Royal medal. In 1891 the University of Aberdeen conferred on him the degree of LL.D. In 1893 the Linnean Society awarded him its gold medal, and a number of friends arranged for the painting of his portrait by Mr. J. Wilson Foster for presentation to the herbarium at Kew. On his attaining his eightieth birthday in 1910 old colleagues united with the existing herbarium staff in offering him an address of congratulation.

After his definite retirement from botanical pursuits in 1895, Oliver devoted himself to his garden and to the further cultivation of that artistic gift to the possession of which his botanical illustrations testify, with such results as to warrant the belief that, had he chosen to make Art his mistress, he might well have merited in her service the eminence which his devotion to Botany deserved.

Oliver married in 1861 Miss Harriet Wall, of Sheffield, by whom, by his son, and by two daughters he is survived. Those whose privilege it is to have known Oliver mourn with them the loss of a true and highly gifted friend.

PROF. CLEVELAND ABBE.

THE death of Cleveland Abbe near Washington, D.C., on October 28, in the seventy-eighth year of his age, makes a gap of a special character in the ranks of meteorologists, and particularly among those who use the English language. From 1871 until August last, when he retired, Abbe was professor of meteorology in the United States Weather Bureau. That is the title which the bureau gives to the professional meteorologists on its staff. Born and educated in New York, he had been a teacher of mathematics in New York and of engineering at the State University, Ann Arbor, Michigan. From there he went to Harvard University, 1860–64, being at the same time aid in the U.S. Coast Survey under B. A. Gould; thence to the Central Observatory of the Russian Meteorological Service at Petrograd for two years; aid in the U.S. Naval Observatory, 1867–68, and director of the Cincinnati Observatory, 1868–73.

The work at the Weather Bureau for which he is best known is the editing of the *Monthly Weather Review*, which was in his charge from 1893 until his retirement, with a break of a few years from 1909, during which the Bulletin of Mount Weather Observatory took its place. Besides original papers, it includes the best monthly epitome of progress in meteorology in English, and ranks for that purpose with the *Meteorologische Zeitschrift*. This work gave Abbe an unrivalled knowledge of meteorological literature. He was a sort of college-tutor for the Weather Bureau, and with his encyclopædic knowledge he was to a large extent the force behind the organisation. He was a very keen advocate of the study of dynamical meteorology. Every student of the subject knows his collections of translations into English of classical papers in French and German which are published by the Smithsonian Institution. He founded a meteorological library at Johns Hopkins University and was professor of meteorology in the George Washington University of Washington. He was specially the promoter of meteorology. We owe to his instigation the installation by the Meteorological Office of the station now in operation at St. Helena. He wrote a large volume on the Maryland Weather Service, with a discourse upon aims and methods. That represents his interest. In an article in the "Encyclopædia Britannica" it is the observation of clouds at sea that claims attention. He took part in a number of scientific expeditions for eclipses and other purposes, and he started the reform in civil time, reckoning by even hours from the Greenwich meridian, a reform which in Europe has over-shot itself into "summer-time."

Abbe's services to meteorology were recognised by the Royal Meteorological Society by the award of the Symons Medal in 1912. He was a man of most genial disposition. His wife, the daughter of W. G. H. Percival, of St. Kitts, whom he married in 1909, survives him. One of the sons of his first marriage, Cleveland Abbe, junior, succeeds him as editor at the Weather Bureau.

NAPIER SHAW.

NOTES.

OFFICIAL information has been received from Paris that from January 1, 1917, the millibar (1000 C.G.S. units) will be used in the publications of the Bureau Central Météorologique for atmospheric pressure, instead of the millimetre of mercury. The same unit has been in use in the publications of the British Meteorological Office since the beginning of 1914; the Colonies of British Guiana and Mauritius have already adopted the unit, and it has also been used in some of the publications of the Weather Bureau of the United States, of Harvard University (Blue Hill Observatory), and of Berkeley University, California. The question raised by Prof. McAdie, of Blue Hill, as to whether the proper name for the unit is not a "kilobar" has still to be considered, on the ground that the name "bar" was already appropriated by chemists to mean 1 dyne per sq. cm. It is one of the questions which should have been discussed at an international meeting projected for September, 1914.

AN interesting discussion took place in the House of Lords on Wednesday, December 20, on a motion by Lord Sudeley requesting H.M. Government to take the steps necessary to provide funds to enable the Imperial Institute to carry out its functions adequately and completely. Lord Sudeley pointed out that, although the institute's work is of great importance in connection with the war and with the development of the resources of the Empire, and though these services have been publicly acknowledged in various ways, yet the institute is greatly hampered in its work by want of funds. The motion was supported by Lord Rathcreedon, who gave some examples of the institute's work, and emphasised the need for more funds and more space in order that full advantage may be taken of the organisations which the institute has developed for the investigation of the resources of the Empire and the dissemination of information regarding them. Viscount Haldane, whilst in sympathy with the motion, pointed out that so far as research is concerned care must be taken to secure co-operation with the work of the Advisory Council for Scientific and Industrial Research, as otherwise confusion might arise. In his reply Lord Islington gave an account of the developments which have taken place at the Imperial Institute since the passing of the new Management Act eight months ago. Committees are being appointed by the various Dominions and Colonies to consider their needs and interests, and the special committee for India has been requested by the Government of India to undertake an important inquiry into the possibility of increasing the usage of Indian raw materials within the Empire. A number of technical committees has also been formed to advise with regard to investigations and other work on minerals, timbers, silk, rubber, etc. The Executive Council also hopes to work in close co-operation with the newly established Department of Scientific and Industrial Research, especially in those cases where more purely scientific investigation is needed. The question of funds is being carefully considered, and the Executive Council of the institute intends to approach the Government in due course with a statement of needs, in order that the work may be maintained and, as opportunity offers, developed. It is hoped that further support will be forthcoming from the Dominions, Colonies, and India, which already provide the larger part of the funds available to the institute.

By the death of Mr. F. W. Levander the British Astronomical Association loses one of its most retiring and yet most useful members. Mr. Levander was for many years on the staff of University College School, then in Gower Street. His duties in this connection were too onerous to allow him much time for the practical pursuit of astronomy, in which science he always took a deep interest; but so early as 1860 he described, in "Recreative Science," vol. ii., p. 212, his detection of markings on the surface of Mars with an object-glass only 1½ in. in diameter. In 1899 he presented to the Royal Astronomical Society a discussion of the colours of 4984 stars as described by various observers, with the special purpose of reducing such descriptions to a uniform scale; and in 1891 he described, before the British Astronomical Association, an instrument which he had devised—the star chromascope—for obtaining definite measures of star colours. But it is to his work in connection with the literature of astronomy that his colleagues in the science owe most to Mr. Levander. He was an original member of the British Astronomical Association, and in 1895, when the association had accumulated the nucleus of a library, he became librarian, and administered this department for twelve years. In 1900 he was elected editor of the Journals and Memoirs of the association, a post that he fulfilled most efficiently until his death. While editor he drew up a complete index to the first eighteen volumes of the journal of the association, having some years earlier prepared a similar index to the volumes of the *Astronomical Register*. In 1906 he was elected president of the association, and held the chair for the customary period of two years. Mr. Levander died on December 20, after a very short illness, aged seventy-seven. He was interred at the Hampstead Cemetery, Fortune Green, on December 23.

THE attention given in the Press to the sudden death, on December 15, of Prof. Hugo Münsterberg is due much less to his scientific eminence than to his notorious activities as a pro-German propagandist in the United States. Born at Dantzig in 1863, he took his doctorate in philosophy at Leipzig and in medicine at Heidelberg, and began his teaching career as a *Privatdozent* at Freiburg-im-Breisgau. While engaged in this University he produced his first considerable work, "Die Willenshandlung" (1888), described by William James as "a little masterpiece," and commenced the publication of the "Beiträge zur experimentelle Psychologie," of which the "Grundzüge der Psychotechnik" may be regarded as the completion. In 1892 James, who admired the acuteness and vigour of "the irrepressible young Münsterberg," invited him to come to Harvard as first director of the psychological laboratory—the forerunner of institutions that have become specially characteristic of American universities. His success as a lecturer and publicist led him to write a series of English works dealing in a semi-popular way with the applications of psychology to law, medicine, education, and the problems of society and industry. The last books of this series were a "Business Psychology" (1915) and a study of the "Photoplay" (1916). While these works undoubtedly did much for the popularisation of psychology, and contain matter of considerable value, they have scarcely added to their author's reputation as a man of science. His last serious book in English, "Psychology, General and Applied" (1914), is an extremely interesting exposition of his psychological doctrine, in which the results of the modern experimental and the older philosophical methods were happily and ingeniously combined.

MR. R. PROTHERO, President of the Board of Agriculture, attended the first meeting of the War Emergency Committee of the Royal Agricultural Society of England, under the chairmanship of Mr. Adeane. He outlined the Government's proposals for increasing the production of food, and after his departure the committee passed the following resolutions, which are being forwarded to the Board of Agriculture :—(1) That this committee is of opinion that a price should not be fixed for any agricultural produce unless the cost of production is taken into consideration and unless the price of feeding stuffs, fertilisers, etc., is also fixed. The committee questions the wisdom of fixing prices, but in the event of the price of wheat being fixed at 60s. per quarter, the opinion of the committee is that the price of oats should be fixed at not less than 40s. per quarter. (2) The committee is of opinion that where spring sowing of wheat is undertaken care should be taken to ensure that the varieties used should be especially suitable for the purpose—such as Red Marvel, April Bearded, or, in districts where it is known to succeed, Red Fife. (3) The committee feels that the land of this country cannot be made to produce more food unless there be an increase in the supply and use of artificial manures. The manufacturer of these manures is dependent upon a larger amount of sulphuric acid being made available for the use of the makers of artificial manures, and the committee urges the Government to set free for the use of those manufacturers such acid as they may require. (4) The committee is of opinion that in view of the great difficulty experienced in obtaining artificial manures in this country, the Government be requested to prohibit the export of sulphate of ammonia and basic slag, except to our Colonies, until the requirements of agriculturists in this country have been met.

THE King has conferred the honour of knighthood upon the Very Rev. John Herkless, principal of the University of St. Andrews.

MR. F. J. H. MERRILL, State geologist of New York from 1890 to 1893, has died at Los Angeles at the age of fifty-five. For the last three years he had been field-assistant to the California State Mining Bureau.

DR. HJALMAR ÖHRVALL is retiring from the chair of physiology at Uppsala University, having entered his sixty-sixth year on December 15.

THE astronomical institute of Lund University has at last obtained the seismograph for which it prepared an underground chamber two years ago.

THE removal of the natural history collections from the building of the Swedish Academy of Science in Drottninggatan, Stockholm (see NATURE, November 30, p. 255), has afforded temporary accommodation therein for the ethnographical collections, which have long had wholly insufficient lodging. Prof. C. V. Hartman intends to make the most of the eight months' tenancy promised him. When the public sees a larger selection from these valuable stores it will surely insist on a suitable and permanent home for them.

IN this country, where many of our leaders in science have been amateurs, we do not always realise the rarity of such workers in some other countries or the difficulties met with by those who do exist. In Sweden, however, the number of serious amateur workers in biology has so greatly increased of late years that a proposal has emanated from the University of Lund to hold, in one or other place, a yearly meeting at which professional biologists may be brought into closer personal relations with their amateur colleagues. The proposal is also supported by Prof. Lönnberg and others.

It is announced that a school of mothercraft will be opened in February. The scheme is intended for educated women wishing to complete their qualifications for posts as health visitors, superintendents of infant welfare centres, matrons of babies' homes, and the like. Mothers with babies will be resident, and students will have the care of them and be instructed in breast-feeding and in various methods of artificial feeding. The course will extend over nine months, of which the first five will be spent in routine nursery work, and the last four at infant welfare centres, home visiting, etc. The school, named the Marlborough School of Mothercraft, is under the presidency of the Duchess of Marlborough.

The second meeting of the Society of Glass Technology was held on December 14, in the University of Sheffield, the president, Mr. W. F. J. Wood, in the chair. Dr. H. Frank Heath, secretary of the Department of Scientific and Industrial Research, addressed the meeting, pointing out the good services the society could render to the nation, and assuring it of the Government's interest and support. The remarkable developments that have taken place in the glass industry during the last two years were emphasised by an exhibition of various types of glass, including (1) scientific ware, (2) optical glass, (3) artistic glass, (4) miscellaneous exhibits. Many firms and private individuals sent collections for exhibition, and it was apparent that in chemical ware and other scientific glass there was no necessity to depend on German production in the future. Beautiful specimens of artistic glass, both ancient and modern, were shown, whilst there were several interesting and instructive exhibits of glasses illustrating the various effects met with in glass production.

A meeting of makers and users of refractory materials was held in the Chemistry Theatre of the University of Manchester on Wednesday, December 13, and was well attended. Mr. A. Cliff occupied the chair, and practically all the important manufacturing centres were represented. The opinion was generally expressed that a technical society of some kind ought to be formed, and that it should emphasise the manufacturers' side and develop a close relationship with the users in the various industries, so that all may work together in harmony for the general good. After discussion, it was decided to form a special section of the Ceramic Society, which has its headquarters at Stoke-on-Trent. This section is to work independently of the parent body in electing its own officers and in the management of its own meetings, to be held in the different centres. A provisional committee was appointed, which met at Newcastle-upon-Tyne on Wednesday, December 20, to formulate a scheme for the election of officers, to consider what modifications of the rules of the Ceramic Society are necessary to suit the requirements of the new section, and to appoint a place for the next general meeting. It was decided to hold this meeting of the section at Leeds early in the new year, when Dr. J. W. Mellor, of Stoke-on-Trent, is to read a paper on "The Spalling of Magnesite Bricks."

A study of the individual and sex differences resulting from fasting is reported by H. D. Marsh in the *Psychological Review* (vol. xxiii., No. 6). The writer and his wife undertook a fast of three weeks. During the first of the three weeks the food was gradually reduced from normal to very little; during the second no food was taken except about 600 c.c. of water daily; the third week reversed the procedure of the first week. The immediate effects of the fast, as shown by the tests, indicate a depletion of vitality and strength and to some extent a slowing down in the speed of activities, more for the motor than the mental. Some improvement in both sexes is shown in mental clearness and accuracy, and a most pronounced effect upon memory, disadvantageous for the masculine subject and advantageous for the feminine. It is certainly desirable that the ultimate effects of fasting upon both health and ability should be made the subject of definite study, and this article is interesting as an example stimulating to further inquiry. The sex differences found, though, may possibly prove to be individual rather than sexual.

The Royal Anthropological Institute has been presented with a collection of fifty-nine photographs of Welsh Baptist ministers, dated about 1860–65. This collection was studied by the late Dr. John Beddoe, and notes have been made on each photograph with the view of determining the various types—Mediterranean, Kymric, Bronze, or Saxon—to which they belong. The question is discussed by Mr. H. J. Fleure in the December issue of *Man*, who pleads for contributions to a series which is likely to interest anthropologists.

In spite of delay caused by the war and the loss of powerful supporters like Lord Ninian Crichton Stuart and Sir John Rhys, the National Museum of Wales is making steady progress, a considerable portion of the new buildings now approaching completion. The appeal of the court of governors for exhibits has been well responded to, but specimens are still much wanted to illustrate the geology and mineralogy of the Principality. The exhibition of Mr. E. Lovett's collection of dolls was very popular; the governors are now making arrangements for an exhibition to illustrate the methods of education adopted in bygone times, and an effort is being made to establish a collection of mining appliances, especially such as were used in the past, to illustrate the development of the Welsh mining industry. A special appeal is being made for assistance in carrying out these useful projects.

In the Museum Journal of the University of Philadelphia for June, recently received, Mr. C. W. Bishop gives an account of his expedition to the Far East in search of specimens for the museum. In Japan he was permitted to inspect the Imperial treasury of the Shoshoin, a collection practically unknown to foreigners. It consists chiefly of the palace furniture of the Emperor Shomu, who reigned during the eighth century, when the capital of Japan was at Nara. The collection comprises a wide range of objects, many of Korean, Chinese, and even Persian or Roman-Syrian origin, and includes bows and arrows, swords, spears, javelins, a curious form of halberd with a blade shaped like a lambent flame—a type peculiar to this period—decorated boxes, collections of Buddhist *sutras*, masks used in sacred ceremonies, musical instruments, games, robes, shoes, banners, tapestries, jewelry, glassware, and many other articles of great artistic value. Nowhere else in the world does such a collection exist, in particular, containing objects of the T'ang and preceding Chinese dynasties. Early Korean art is nowhere represented with such completeness as in this plain log building in the quiet groves of Nara.

An interesting paper "On Plotting the Inflections of the Voice," by Mr. B. Bradley, well known as a comparative philologist, appears in the University of California Publications in American Archæology and Ethnology (vol. xii., No. 5). Vocal sounds, and more especially words, appeal to the ear with various inflections, such as "high" or "low," "rising" or "falling," etc., and the inflection, both as regards "pitch" and "duration," often gives a certain character and meaning to the word. This is indicated in many languages by the use of "accents," as in Greek. Mr. Bradley has investigated the nature of such inflections by a new method, unlike the usual methods of the registration of sounds by those interested in phonetics. Recognising that an inflection is determined by pitch and duration, he registers vocal sounds by Rousselot's apparatus, and then he plots on co-ordinate paper, by an ingenious and most laborious method, the curve obtained by an examination of pitch and duration. The result is, to take an illustration from the Siamese language, with which Mr. Bradley is acquainted, that certain curves represent a rise, or a circumflex (rising and falling), or a more uniform mesial movement, or depression, or falling, all of which can be recognised by the ear. The remarkable thing, however, is that when such curves are studied with care, and with appropriate corrections, variations (often slight) may be observed in the wave-like movement which are not recognised by the ear, and the sound heard conveys a definite meaning, with a wave form different from that of the same word with different inflections. Thus, in Siamese, the syllable *nā*, with a rising inflection, means *thick*; with a circumflex, *uncle* or *aunt*; with a middle, *ricefield;* with a depressed, *indeed*; and with a falling, *face* or *front*. Tonal inflections or modulations "are essential features of every spoken word" in such languages as Chinese. The paper is accompanied by interesting curves.

In 1879 Capt. Kirby, of Gloucester, while fishing for cod and hake south of Nantucket, brought up a new fish, which has been named *Lopholatilus chamaeleonticeps*. Since then, from time to time, other specimens of the fish, popularly known as the "tile-fish," have been obtained. In the *American Museum Journal* for November Mr. G. H. Sherwood describes an expedition in search of specimens. The flesh of the fish is said to resemble cod, and the remarkable discovery of a new edible fish seems likely to prove of some economic importance.

In their third report on the improvement of indigo in Bihar (Agricultural Research Institute, Pusa, Bulletin 67, 1916) Mr. A. Howard and Mrs. Howard again insist that sound scientific cultivation is the first essential in the resuscitation of the natural indigo industry. Regarding "indigo wilt," they explain that, though cure be impossible, prevention, under intelligent treatment, is not difficult. The occurrence in the indigo plant of two "nitrogen cycles" makes the planter's task something more than the harvesting from a given area of a maximum crop, a given weight of leaf of which shall yield a maximum of indican. The chemical advice under which during recent years this, without due regard to the physiological characteristics of the plant, has been the grower's aim is unwittingly responsible for damage to the industry. Seed of single plants of a wild indigo, separately collected in Natal in 1913 for cultivation at Pusa, yielded a progeny more uniform than the Java indigo first introduced into Bihar in 1898. Colour, it is said, is thereby lent to the idea that Java indigo has arisen as a cross between the Natal plant introduced into Java three-quarters of a century ago and some species formerly cultivated in Java. The identity of the latter species is not suggested, nor is it stated where in Natal the seed imported in 1913 was gathered. When, shortly after 1898, attempts to import Natal seed into Bihar were first made, no dye-yielding indigo could be found in Natal; the seed then secured was that of the Zulu indigo plant. All those engaged in the natural indigo industry will welcome this report and look forward with interest to further information from its authors on this important subject.

The only part of the British Empire that can be looked upon as a producer of thorium minerals in quantities of economic importance is the island of Ceylon, and a good account of their occurrence and distribution will be found in the September Bulletin of the Imperial Institute (vol. xiv., No. 3). The minerals in question are monazite and thorianite, the former containing about 8 per cent. and the latter about 55 per cent. of thoria. The most profitable sources of the former appear to be certain of the beach deposits, where the monazite, together with much black sand, mainly ilmenite, has been concentrated by the action of the sea, whilst the thorianite is obtained from alluvial deposits in the river valleys, being often met with as a by-product in gem-mining operations. Both these minerals have been traced to their parent rocks, their main source being apparently pegmatite veins or lenses in granite, granulite, and charnockite. Up to the present none of these primary occurrences have been found sufficiently important to be capable of economic exploitation; the minerals capable of being worked to advantage are all obtained from clastic deposits, resulting from the degradation of the primary deposits and the subsequent concentration by natural causes of the material thus broken down.

The meteorological observatory at the South Orkneys, founded by Dr. W. S. Bruce in 1903, is still being maintained by the Argentine Government. Mr. R. C. Mossman, who was in charge of the observatory for the first two years of its existence, contributes some notes to *Symons's Meteorological Magazine* for November (vol. li., No. 610) on the observations during 1915. The year was a remarkably cold one at the South Orkneys, the mean temperature (20·6° F.) being the lowest on record at the islands, and 3·4° below the average. In February, the warmest month, the mean temperature was 31·3°. Mr. Mossman points out that abnormally low temperatures were not prevalent during 1915 in the southern hemisphere; many observatories in middle latitudes showed mean temperatures above the normal. Other departures from the average conditions at the South Orkneys were the low rainfall and cloud amount, while the mean annual wind velocity was the lowest on record. These observations for 1915 will be of great value in conjunction with Sir Ernest Shackleton's observations further south in the Weddell Sea at the same time.

The Meteorological Institute of the Netherlands has published a revised edition of the oceanographical and meteorological observations in the Indian Ocean for the months of September, October, and November, which completes the series for the year. The observations embodied are for the years 1856–1914. Results published by the English and French Meteorological Offices have been incorporated, and have added much to the value of the discussion. The work has been carried out under the superintendence of M. E. Van Everdingen, chief director of the Netherlands Meteorological Institute. The discussion is comprised in letterpress of 240 pages, which give the mean values of the principal meteorological elements for each single-degree square over the Indian Ocean. In a separate volume charts are given for the several months of ocean currents and winds, also isobars and isotherms of air and sea, with routes, trajectories of cyclones, limits of fog, ice, and of the trade-winds and monsoons. For the charts the observations are in some cases grouped into 5° squares, and in others into 2° squares. The results are of a very high order owing to the large number of observations available over the greater part of the Indian Ocean, and the method of dealing with the observations is about all that could be wished. The data are limited solely to the sea, but probably in some cases land data might have been combined with advantage. In the pressure charts isobars are given for each 2·5 millimetres. There are numerous islands over the Indian Ocean at which long series of observations have been maintained; the entry and use of these stations would have enhanced the value of the work.

UNDER the joint auspices of the New York State Commission on Ventilation, the American Museum of Natural History, and the American Museum of Safety, an investigation of three of the best methods of determining the amount of dust in air has been carried out by Messrs. G. T. Palmer, L. V. Coleman, and H. C. Ward, and the results obtained are given in vol. vi. of the *American Journal of Public Health*. In the first of the methods investigated the dust-laden air is forced against a surface smeared with glycerine, and the number of dust particles caught by the glycerine on selected areas of the surface counted under the microscope. In the second method the air is drawn through syrup, which is afterwards diluted with water, a drop of which is placed in a shallow cell under the microscope, and a count made in the same way. In the third method the air is drawn through a spray or curtain of water, which is then examined under the microscope as in the second method. In the second and third methods a rough determination may be made by a comparison of the turbidity of the water with that of a series of prepared samples. The authors conclude that the water-spray method is the best and most convenient to use under normal conditions, and they give a number of directions as to the best way of carrying out the observations.

ACCORDING to the *Chemical Trade Journal* of December 9, the Secretary of the U.S.A. Department of Agriculture has decided to erect on the coast of southern California a Government plant for the production of potash from kelp. Unlike the private companies which are already manufacturing potash from this source, the Government is determined not only to produce the potash at the minimum cost, but also to conserve the nitrogen, iodine, and other by-products. In the Government plant the kelp will first be dried in a series of rotary driers. It will then be distilled in a modified coke-oven in such a way as to prevent the loss of the nitrogen, iodine, and other by-products. The potash salts will be dissolved with water out of the resulting charcoal, which may afterwards be used as fuel. The combustible gas obtained by the distillation may also be used as fuel. The U.S.A. Government experts hold that by such economical methods the process can be made to pay in ordinary times.

WE have received from Messrs. Dulau and Co., Ltd., their December catalogue of botanical and natural history works. It is classified under botany and horticulture; orchids and orchid culture; mammals, birds, and reptiles; entomology; mollusca, and periodical publications. Many rare and out-of-print books are included. We notice that a set of NATURE from 1869 to 1907 is listed at a low price.

OUR ASTRONOMICAL COLUMN.

MERCURY AN EVENING STAR.—Mercury will be at its greatest elongation east on the morning of January 3, and visible on several evenings before and after that date over the W.S.W. horizon about ¾h. or 1h. after sunset. The planet will be visible to the unaided eye should the atmosphere be very clear at the important time, though this apparition will not be so favourable as the one which will occur on April 24 next. Between about December 28 and January 10 next Mercury will set about 1½ hours after the sun, and, with good weather conditions, the ruddy, scintillating light it emits ought to be detected without difficulty, though it will be at a very low altitude.

TOTAL ECLIPSE OF THE MOON.—This phenomenon will take place on the morning of January 8, and the following are the astronomical times of its various stages:—

	January 7 h. m.
Moon enters penumbra	16 36
Moon enters shadow	17 50
Beginning of total eclipse ...	19 0
Middle of eclipse	19 45
End of total eclipse	20 29
Moon leaves shadow	21 39
Moon leaves penumbra	22 53

Magnitude of eclipse = 1·369 (moon's diameter = 1·0). At Greenwich the moon sets at 20h. 10m., while the moon is totally eclipsed. The various phases of the event may therefore be watched until after the middle of the eclipse. It will be interesting to observe whether the earth's shadow proves a very dark or light one on this occasion. At some lunar eclipses the disc of our satellite has remained quite bright, at others it has been scarcely visible at all. It usually happens that, at the time of a lunar eclipse, the atmosphere is sufficiently favourable to allow successful observation.

LONG-PERIOD VARIABLE STARS.—A valuable contribution to the investigation of variable stars was recently made by the Rev. T. E. R. Phillips, in a presidential address to the British Astronomical Association (Journ. B.A.A., vol. xxvii., p. 2). Observational data for such stars have been much extended by the carefully determined light-curves of twenty-one long-period stars observed by the members of the Variable Star Section of the association, and by sixty-seven light-curves published in the Harvard Annals. Mr. Phillips has analysed the curves of eighty stars, and from a comparison of the phases of the second and third harmonics he finds that the long-period variables fall into two distinct groups. This grouping is supported by the evidence of the ranges of variation, and, in a somewhat less degree, by the coefficients, brightness, and periods. The general characteristics of the two classes are also shown in the light-curves. In Group I. the intervals from maximum to minimum, and from minimum to maximum, are not very unequal, and there is a tendency for the curve to show a pause on the rise. In Group II. there is a sharp rise to maximum, followed by a long period of decline. As a rule it is possible to determine the group to which a star belongs by mere inspection of the light-curve, but harmonic analysis is necessary to fix its place in the group. The stars of Group I. are brighter than those of Group II., and it is possible that they may be found to include "giants" and "dwarfs" respectively. The inequalities in the intervals between successive maxima, and in the brightness at different epochs, call for much further investigation.

INTERNATIONAL ELECTRIC AND MAGNETIC UNITS.

THE U.S. Bureau of Standards has issued a useful and interesting critical *résumé*[1] of the principles underlying the establishment of the present international system of practical electric and magnetic units, together with a survey of the various attempts that have been made to "rationalise" them so as to make the factor 4π one of less prominence in the equations most used in practice.

The international system of C.G.S. units is not strictly a C.G.S. system, for it is actually defined in terms of two arbitrary units, the international ohm and the international ampere, together with length and time. Nevertheless each unit in the system is the representative for practical purposes of the corresponding unit in the C.G.S. electromagnetic system, and differs from it only slightly. The small differences are determined by absolute measurements made from time to time. One of the advantages of the international system is that it does not give undue prominence to magnetic pole strength; as Mr. Dellinger puts it: "The complexity of the dimensional expressions of the electromagnetic system and its poor correspondence to the conditions of practice are in part due to its being based upon an unimportant phenomenon." He points out that a free magnetic pole does not exist in Nature, magnetic pole strength does not appear in engineering formulæ, and it is consequently a satisfaction to find that it can be dispensed with in theory also.

Magnetic units, however, are not entirely free from confusion, notwithstanding the casting into oblivion of the once useful but now unnecessary conception of the free magnetic pole. Gauss was a great man with an ugly name. Physicists and "practicians" alike have always been partial to employing the names of great men for electrical and magnetic units (even if the great man in question had not been more particularly identified with the quantity to be christened than with others of the same category), and ugly names for units have had a strange fascination for them. So "gauss" has been seized upon both for the unit of induction and for the unit of magnetising force. This double usage is recognised by the American Society for Testing Materials, and, provisionally, by the American Institute of Electrical Engineers, but Mr. Dellinger clearly voices the disapproval of the Bureau of Standards. It is true that the numerical equality of B and H in non-magnetic media, and their appearance as terms in the equation $B = H + 4\pi J$, both tend to encourage the idea that they are of the same physical nature, but "the argument that dimensional identity indicates physical identity is refuted by the example of energy and torque. Who would measure torque in joules or calories?" B, in fact, characterises the magnetised state of the medium, and H is the agency tending to produce that state, just as the deflection of a spring is physically different from the mechanical force producing it. There is no authority for considering μ to be a purely numerical ratio. μ is one of the two quantities (μ and K) which are effective in the propagation of electromagnetic waves, and must therefore be an actual physical property unless K involves both the physical properties which are dynamically necessary in a medium for the propagation of waves. The possibility of comparison is rendered worse by the fact that the name "gauss" was tentatively adopted in 1895 by the B.A. Committee on Electrical Standards as the C.G.S. unit of magnetomotive force. Mr. Dellinger suggests that the "gauss" be retained as the unit for B only, or that it be avoided altogether. The "gilbert" has been adopted as the C.G.S. unit of magnetomotive force, and the gilbert per cm. is already widely used as the C.G.S. unit of H. The C.G.S. unit of magnetic flux is the "maxwell," and B can always be called the maxwell per sq. cm.

The attempts to "rationalise" the units to make 4π less conspicuous date back to Oliver Heaviside's publications in 1882.[2] His proposals involved, however, an entirely new set of practical units. Perry, Fessenden, Fleming, and Giorgi followed with other proposals between 1889 and 1901, and the matter was revived again by Ascoli last year,[3] and, finally, by Prof. V. Karapetoff. Prof. Karapetoff uses the international ohm and ampere as fundamental units, the ampere-turn as the unit of magnetomotive force, and the C.G.S. units for magnetic flux and induction. The system of "ampere-turn" units is treated at some length in Mr. Dellinger's paper, and the equations required to make the ampere-turn fit in with the units of other magnetic quantities are given; but he concludes by expressing the opinion that none of the proposed changes in some, or all, of the existing systems of international electric and magnetic units offer advantages sufficient to justify the confusion and inconvenience that would be involved.

[1] Scientific Papers of the Bureau of Standards. No. 292, "International System of Electric and Magnetic Units." By J. H. Dellinger, Assistant Physicist, Bureau of Standards. (Washington: Government Printing Office, 1916.) Price 10 cents.

[2] The *Electrician*, vol. x., p. 6 (1882); "Electrical Papers," vol. i., pp. 190, 262, 432; vol. ii., pp. 543, 575 (1892).

[3] *L'Elettrotecnica*, vol. ii., p. 731 (1915); *Electrical World*, vol. lxvii., p. 876 (1916).

ARGENTINE METEOROLOGY.[4]

EVIDENCE of the activity and progress of the work carried on under the direction of Mr. W. G. Davis in the years preceding his retirement in March, 1915, after thirty-five years' service in the Meteorological Department of the Argentine Republic, is contained in the undernoted memoirs.

In the work dealing with the "History and Organisation" of the Oficina Meteorológica, Mr. Davis gives a succinct account of the initiation and development of the service founded in 1872 by Dr. A. B. Gould, first director of the Cordoba Astronomical Observatory. In 1884, when Dr. Gould retired, there were fewer than twenty meteorological stations in operation. In 1901 the number had increased sixfold, with, in addition, 240 rainfall stations, while in 1914 there were no fewer than 212 stations, of which forty-two were of the first class, *i.e.* provided with automatic instruments. The rainfall was then being recorded at no fewer than 1930 points. The great strides made in the meteorological representation of the country during the period covered by the directorship of Mr. Davis is well shown on maps indicating the position of the various classes of stations in 1884, 1901, and 1914. A Daily Weather Map was started in 1902, and is now based on reports from more than 200 ordinary stations and 1350 rainfall stations, including observations from the neighbouring Republics.

An excellent series of maps is given showing seasonal and annual values of all the elements of climate except cloud amount and humidity. A selection of the data on which these are based is given on pp. 154 to 181.

[4] (1) "Servicio meteorológico Argentino: Historia y organización, con un resumen de los resultados." (In Spanish and English.) Pp. 181+maps and charts. (Buenos Aires, 1914.) (2) Anales, tomo xv., "Clima de Buenos Aires," 2 parts. Pp. 1221. (Buenos Aires, 1912.) (3) Anales, tomo xvii., parte 1, "Observaciones de las Islas Orcadas en los años 1905 á 1910." (In Spanish and English.) Pp. 720. (Buenos Aires, 1912.) (4) Anales, tomo xvii., parte 2, "Clima de las Islas Orcadas del Sud. Discusión de las observaciones meteorológicas y magnéticas en la Isla Laurie." (In Spanish and English.) Pp. vi+314+22 plates. (Buenos Aires, 1913.) (5) Boletin No. 4, "La termodinámica de la atmósfera terrestre, desde la superficie hasta el plano de desvanecimiento." Por F. H. Bigelow. (In Spanish and English.) Pp. 142. (Buenos Aires, 1914.) (6) Boletin No. 5, "Resultado de las observaciones del magnetismo terrestre." Por Luis G. Schultz. (In Spanish and English.) Pp. 12+4 plates. (Buenos Aires, 1914.)

Unfortunately, no heights are given, and there are many errors in the geographical co-ordinates of the stations, some of considerable magnitude. The remainder of the meteorological section of the volume is devoted to an important paper by H. Helm Clayton on "Atmospheric Circulation and the Weather in Argentina."

The hydrometric section was founded in July, 1902, and there are now 109 gauges at work on the principal rivers and lakes, daily forecasts being made of the probable height at important points. The elevation of the underground water is also gauged at twenty-two stations. The magnetic branch of the service was established in 1904, with a central station at Pilar, near Cordoba, in charge of Mr. L. G. Schultz, who, with assistants, prosecuted field-work at regular intervals, notably in 1908 and during 1912–13. This work is "sufficient to give a very fair knowledge of the values of the magnetic elements in all parts of the country, as well as their respective secular variations." Lines of equal declination, inclination, horizontal intensity, and vertical intensity for the epoch January, 1914, are given in graphic form, while mean hourly values of the principal magnetic elements registered at Pilar from 1905 to 1914 are shown for the months, seasons, and the year (pp. 56–145). Bulletin No. 5 contains a condensed summary of the magnetic results with special reference to the field-work accomplished. Vol. xv. of the Anales contains the hourly and other meteorological observations made in Buenos Aires from 1877 to 1910, in continuation of the series published in vol. i. of the Anales. The printing of the discussion, which is ready, has been meanwhile postponed owing to the reduction of appropriations.

The hourly meteorological and magnetic observations made at Laurie Island, South Orkneys (lat. 61° S.), from 1905 to 1910, with a discussion of all the available material since 1903, appears in vol. xvii. of the Anales. This station was taken over in February, 1904, from the Scottish National Antarctic Expedition, and is now completing its thirteenth year under Argentine auspices. The maintenance of this observatory involves the dispatch every summer of a relief expedition from Buenos Aires. The climate of the South Orkneys is in general insular from October to March, and continental during the rest of the year, when the surrounding seas are frozen. At all seasons the island is enveloped in a current of Antarctic origin, so that the mean temperature of the warmest month (February) does not exceed 0·6° C. The coldest month is July, with a mean of −11·9° C., and the mean annual temperature is −4·4° C. The extremes noted have been 8·8° and −40°. Föhn is not uncommon, and during its occurrence the temperature, even in midwinter, rises considerably. The mean annual pressure is 744 mm., with extreme readings of 774·7 and 709·1 mm. Pressure is low from January to May, and again in November, and relatively high from June to October, and also in December there is much cloud and the air is very humid. Storms are comparatively rare, and are most common at the equinoxes, and least frequent at the solstices. The station lies in the west-wind system, and winds from the east are seldom observed. The upper currents are also from the west, and the cloud drift becomes more and more towards the east as the height increases. The lower clouds are at a greater height in summer than in winter. The precipitation, mostly in the form of snow, and difficult to measure owing to drift, amounts to 447 mm. (17·60 in.) annually. The snow is deepest a month before the winter solstice, and in some summers does not disappear at sea-level. The diurnal range of all the elements, although distinct, is very small. An interesting chapter on the frequency and distribution of the ice in the seas surrounding the South Orkneys, showing the very variable conditions experienced from year to year, concludes the meteorological summary of the results. The rest of the volume is taken up with a discussion of the magnetic data to 1912. The analysis of the whole material is very complete, and there are twenty-two plates, some of which possess new features.

Bulletin No. 4, by Prof. Bigelow, as the title suggests, is highly mathematical, and does not lend itself to condensation.

R. C. M.

A PLAGUE OF VOLES IN ITALY, AND ITS CONTROL.

DURING the past summer the province of Foggia in Apulia has suffered great depredations by field-voles (*Pytymys savii*), the grain crop having been almost entirely destroyed. Prof. Splendore has given an account (in two papers in *Rendiconti R. Accad. Lincei, Classe fis. mat. nat.*, vol. xxv., July and August, 1916) of his investigations, carried out in Prof. Grassi's laboratory in Rome, with the view of finding some method of destroying the voles. Of about forty voles sent to him from Cerignola (province Foggia), some died *en route*, and had been partially eaten by the survivors; the others died a few days after arrival in Rome. In all these a coccobacillus was present in the blood, in the internal organs, and in the lymphatic glands. Around Cerignola there was a remarkably high mortality among the voles, attributed by Prof. Splendore to the coccobacillus which was found in all the voles examined. This spontaneous epizootic, which spread extensively, presents the features of a septicæmia, the internal organs being congested, especially the spleen and liver, which are always enlarged. Prof. Splendore has compared the coccobacillus with *Bacillus typhi murium* and the *typhi-coli* group, and considers that it presents such clear differences as to justify him in placing it, provisionally at least, in a new species *Bacterium pytymysi*.

Healthy, well-nourished voles from a locality where the epizootic was not known to occur died in less than twenty-four hours after subcutaneous inoculation with an emulsion of the spleen or liver of an infected vole; others fed with infected material died in three or four days. When dead or infected voles were placed among healthy ones, the latter developed the disease in a few days. The organism was found to be pathogenic also to mice, rats, and rabbits.

Prof. Splendore isolated the organism from the intestine of fleas found on an infected vole. The intestinal contents of three similar fleas were inoculated subcutaneously into a healthy vole, which died in less than twenty-four hours. Another healthy vole, placed in a vessel with three vole-fleas, died three days later. Both voles were found to exhibit the usual congestion of the internal organs and to contain the coccobacillus. Prof. Splendore considered that these experiments confirmed his previous suspicion that the natural method of propagation of the infection is by means of fleas. He recommended that voles infected by inoculation should be distributed in the areas invaded by voles, where the epizootic has not yet appeared, so that the disease would be propagated by fleas and would continually extend until the areas were freed from the rodents. It will be interesting to see how far this method has been successful in ridding the country of a destructive pest. Possibly the new organism may be found useful in attacking other species of destructive rodents, *e.g.* rats, but investigations will no doubt first be made as to its pathogenic relations to domestic animals and man.

SCIENCE AND INDUSTRY, WITH SPECIAL REFERENCE TO THE WORK OF THE NATIONAL PHYSICAL LABORATORY.[1]

AFTER a reference to the work of the Privy Council Committee, the speaker pointed out that, in the words of their first report, "the object of the scheme is to bring scientific knowledge to bear practically upon our everyday industrial and commercial life." He continued:—In this process, as we shall see, and as has been well pointed out by various recent writers—see Dr. Rosenhain's paper before the West of Scotland Iron and Steel Institute, "The National Physical Laboratory: its Work and Aims," and Dr. Mees's pamphlet on "Science and Industry," issued by the Advisory Committee of the Privy Council—three distinct stages may be observed. We need:—

(1) The work of the man of science in his research laboratory.

(2) Investigations which go on in an industrial research laboratory, developing new processes or introducing new products.

(3) The works laboratory proper, controlling the quality of raw materials, finished products, and processes.

Let us note then, in the first place, we must have scientific knowledge. That point I need not labour, but note also that to be successful that knowledge must be pursued for its own sake. Each of the modern practical applications of science had its foundations in purely scientific work, and, to quote Prof. Gregory, in his recent book, "Discovery; or, The Spirit and Service of Science," "was not the result of deliberate intention to make something of service to humanity." It is scarcely necessary to illustrate this; let me, however, give one classical example. The discovery of the laws of electromagnetic induction is due to Faraday, and is described in his first three series of "Experimental Researches," published in 1831–33. Oersted, Ampère, and Arago had investigated some of the phenomena connected with the magnetic force produced by an electric current, and to Faraday it appeared clear that, conversely, it should be possible to produce electricity from magnetism, as he put it. It is difficult to picture the world to-day without electric power, and yet the whole development of electrical machinery, as we know it, rests on the laws described in these brief scientific papers. Each advance of knowledge brings its benefits to mankind, and in a general way Faraday may have hoped to be a benefactor to his race by widening the sphere of knowledge, but it was the desire to know the truth which led him on and to which we owe such tremendous consequences.

We must have the student of pure research, the genius who goes on his way discovering new truths, irrespective of consequences, laying bare more and more of Nature's secrets and unravelling her mysteries.

In England we have never lacked such men; our roll of great discoverers has been a glorious one. Too frequently their lives have been hard and difficult, prophets without honour they have lived; to-night it is not my task to speak of them beyond urging the importance of giving every encouragement to such men by supporting, in the most generous spirit, any among you here in your University or elsewhere who are advancing the bounds of knowledge, searching for truth in some of its difficult byways. The endowment of pure science is essential; without it the attempt to apply science to industry fails.

This, however, is not my subject to-night; let us turn for a short time to the third need among those enumerated above—the works laboratory proper. My audience will appreciate perhaps more fully than I can the need for this.

It is necessary, if for no other reason, to maintain the standard of the output, to secure that the proper grade of material is supplied to the works, to check the instruments in use, and to test the product in its various stages of manufacture. The days are gone when successful manufacture could be carried on entirely by rule of thumb, trusting to the skill of some trained workman for the success of each delicate operation, when the hereditary instinct, passed down from father to son, was sufficient to produce each year practically the same results. New processes come, which appear likely to improve production or to reduce its cost; the works laboratory serves to test these. New products are suggested, which may or may not have the advantages claimed for them; this can be investigated in the works laboratory, and all these investigations and tests must go on in the works themselves under the eyes of men familiar with the process of manufacture in its every stage. The works laboratory must extend, and others are more competent than I to outline the direction of extension and to guide its growth.

Now between these two—the man of science researching in his university or college, and the works chemist toiling in his shop—there is a gap. Some means are needed to make the discoveries of science available to the manufacturer, to secure to him the advantages which come from the growth of knowledge to keep him in the forefront of his trade. This, if I grasp the problem aright, is the function of a laboratory of industrial research, and among such laboratories the National Physical Laboratory should hold a prominent place. The National Physical Laboratory has another function to fulfil—it is a great standardising and testing institution. I will recur again to that aspect of its work; for the present let us consider what is required in a laboratory for industrial research and see how far these requisites are supplied at Teddington. Quoting again from Dr. Mees's paper, already referred to, "This kind of research work," he says, "involves a laboratory very different from the usual works laboratory, and also investigations of a different type from those employed in a purely industrial laboratory. It means a large, elaborately equipped and heavily staffed laboratory engaged largely on work which for many years will be unremunerative, and which for a considerable time after its foundation will obtain no results which can be applied by the manufacturer."

This work clearly needs a special home; it cannot be done in the laboratory of a technical institute. The main work in a laboratory such as that of a technical institute must be educational. The object of the professor is to educate his pupils so that each may apply his knowledge to his lifework in the future. For this he will teach them to research. They will help him in his own investigations, and these may well have a bearing on the industry of the district. They may commence to solve for themselves simple problems akin to those they will meet with in their future work, but their power and opportunity to apply the new discoveries of science to the manifold problems of industry must be limited. For such work training is required, and full and elaborate equipment; the plant of a technical school laboratory must be designed to serve many purposes, all aimed at educating the pupils to apply science, and at teaching them the methods to follow. It is not their work, while still at college, to solve the conundrums of the manufacturer. The research laboratory is necessary if progress is to be made. Abbe realised somewhere about 1876 that British optical in-

[1] Abridged from an address delivered to the Birmingham and Midland Institute, on December 4, by Dr. R. T. Glazebrook, C.B., F.R.S.

struments had reached the highest possible development unless a radical change could be produced in the optical properties of glass, and the researches of Schott and himself, aided by subsidies from the Bavarian Government, lasted a number of years before the first catalogue of Jena glass was produced. Synthetic indigo was discovered by von Baeyer about the year 1880; it was not until some twenty years later that it was put commercially on the market, and in that time it is reported that no less than 1,000,000*l.* was spent by the Badische Anilin- & Soda-Fabrik before this desired end was reached.

Standardisation in all its branches is an important function of such a laboratory, and this involves research. The methods of measurement, the materials in which the standards can best be expressed, the accuracy of reproduction, and the conditions of use, all need investigation.

One other aspect of the matter remains to be considered, though very briefly. If we are to have a National Industrial Research Laboratory, who is to pay for it, who is to support it? The obvious answer is, the nation, but this in some quarters at once raises a difficulty. It is claimed that the results of any successful research bring profits, in the first instance, to some particular class, and that class ought to pay. For example, the discovery of some new and valuable alloy would profit, in the first instance, the manufacturer of the alloy and the persons employing it in their special trade. Before, therefore, you undertake an investigation you must secure, so it is said, the co-operation and financial support of a limited class who will presumably benefit by the success of the investigation. And no doubt, as a general rule, in cases in which it can be applied, this principle is a sound one, but such cases are limited. If a manufacturer comes with a conundrum, which he desires to have answered for his own private benefit, he must pay; but if a competent committee controlling an industrial research laboratory concludes that a research is of importance and likely to lead to knowledge of benefit to the whole industry with which it is concerned, I would plead that the cost of such a research should be met out of national funds. It is very difficult to say what individual will profit most in the end. An improvement in an industrial process leading to more employment and to a cheaper method of manufacture benefits a wide circle beyond the man who introduces the process. Germany—not merely Messrs. Schott and Zeiss—has profited by the labours of Abbe and his co-workers at Jena, labours rendered possible in the first instance by State help. No doubt there are cases where the co-operation of an industry can, and should, be secured; sometimes, too, it will be in the public interest to protect a discovery by a patent, if only to prevent action by a private firm restricting the free use of the discovery, but, in my opinion, it is not well to hamper those who control the laboratory by conditions aimed at securing support from industry before any special research is commenced.

The needs of the nation at the present time are too serious, the danger of delay too pressing, and the State may well devote large sums to industrial research without minute inquiry as to whether the research is going to benefit Messrs. A. B. specially, and what share, therefore, of the expense Messrs. A. B. must be asked to guarantee. In America the Bureau of Standards, in Germany the Reichsanstalt and the Material-Prüfungs-Amt, work thus for the national good, and this should be the task of our English industrial research laboratory.

And here let us note the importance of keeping the test work a live thing by the aid of research. Instruments are tested to see, among other objects, if they come up to standard, but the standard of to-day is too low some years hence; the tests must be so regulated as to tend to a gradual improvement in the product, and this can be done only by accompanying the tests with continuous research—research into methods of construction, into the materials most suitable for use, into the scheme of tests most helpful towards forming a correct opinion of the value of the instrument. Research must go hand in hand with testing. Without such close co-operation routine tests grow obsolete and cease to be of value; worked thus they prove an important aid to the manufacturer and a most desirable check on his production.

I trust I have convinced you—probably you did not need convincing—that laboratories of industrial research are necessary.

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

There is much for us all to do, and I ask your active support to make the National Physical Laboratory more efficient, more worthy of its name.

Increased funds must be provided, and it is only through the aid of the manufacturers, and of those who from experience have profited by the work of the laboratory, that the authorities can be induced to do all that is needed to establish the laboratory in a secure position.

On Friday, December 1, in the hall of the Institution of Civil Engineers, some of us listened to an address by Lord Crewe, President of the Privy Council Committee, on the subject of industrial research. It was in reply to a deputation from the Joint Board of Scientific Societies. Sir J. J. Thomson, president of the Royal Society, had spoken eloquently on the claims of pure science, Sir Maurice Fitzmaurice dealt with engineering, and Prof. Baker with industrial chemistry.

Lord Crewe announced that a large sum—the exact figure was not mentioned—is to be at the disposal of the committee during the next five years, and outlined the scheme for its expenditure. Associations are to be formed representing various trades or industries; the representatives of these will discuss with members of the Advisory Committee and other experts questions needing scientific investigation, and when these are determined the grant, supplemented in most cases by funds raised privately or contributed by the industry, is to be used to carry them out. Such work needs laboratories, and it is here, it seems to me, that the future of the National Physical Laboratory lies. Lord Crewe spoke in generous terms of the work of the laboratory in the past; its many friends who heard him were grateful for his cordial recognition of our labours, and he indicated a sphere of wider usefulness under less difficult conditions in the future. Let me picture to you what I trust that sphere may be.

In many cases, no doubt, the researches contemplated must go on in special laboratories arranged and equipped for the purpose—laboratories closely connected with the industry it is desired to help, situated at the great manufacturing centres; but there are many other researches of wide interest and great importance for which a central laboratory is the proper home, a laboratory fitted and equipped in an ample manner, with a trained and competent staff animated, like those, my colleagues, who have built up the National Physical Laboratory, with a love for science, and yet withal with a keen appreciation of the practical side of the question discussed and a real desire to help our country by the application of science to industry.

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

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

COAL AND FUEL ECONOMY.

It may be hoped that nowadays no one needs to be reminded about the importance of the economical use of coal. We require all, and more than all, of the power and by-products which can be obtained from it, and are beginning to realise the value of the thousands of tons poured annually into our atmosphere with none but deleterious effects.

A committee of no fewer than forty-six members appointed by the British Association at the 1915 meeting, and containing representatives qualified to speak on the various aspects of the problem, presented its first report at the Newcastle meeting last September, when it was the subject of a joint discussion between the Chemical and the Engineering Sections.

At the same meeting there was also a discussion by the geologists and the chemists on the chemical and microscopical characters of different varieties of coal with a view to their more effective utilisation as fuel and to the extraction of by-products. The two discussions, though at the meeting quite distinct, may well be considered together, since they deal with different aspects of the same question. It is not proposed here to deal with the many papers seriatim, but rather to review the general lines of the discussion.

When chemists, geologists, and engineers meet to consider the coal question, three different views are ever present. The chemist regards coal as *the* valuable source of raw material for the manufacture of synthetic drugs, dyes, and certain high explosives and ammonium sulphate, and would have us carbonise all our coal in by-product recovery plants so as to waste none of these precious substances. Though these substances represent only a small percentage by weight of the coal, their value to chemical industry is such that he cannot sit idly by and see them burnt away, particularly as the consumption of the resulting coke would help to diminish the smoke nuisance. The geologist looks upon coal as a rock of varying physical properties and chemical composition, and, feeling that his duty is to find coal by mapping outcrops or stratigraphical evidence, regrets, in his endeavours to extend our coalfields, that the chemist does not come to his assistance in assigning a particular value to the coal in each seam. The chemist investigates a sample of coal for some specific purpose, benzol or ammonia content, for example, but the geologist would like him to come forward with a definite classification, saying which coals were best for steam or domestic purposes, etc. He feels that both ultimate and ordinary commercial analyses should be carried out, and that the chemist should know the nature of the roof and floor of the seam from which his sample was taken. The palæobotanist might be of great value in association with chemistry, for, as it is known that coal consists of an assemblage of the remains of very many kinds of plants, if it could be shown that particular by-products resulted from particular plants or parts thereof, palæobotanical investigation would show the commercial value of coal from any one seam.

There are, however, certain difficulties. Though much has been discovered by the action of solvents, chlorine, etc., on coal as regards the cellulose and resinic constituents, so many secondary changes may have taken place in the history of a seam that to associate them with individual plants or parts of plants may not be justified, for the decomposition of the original vegetable constituents might prove to be more important than the constituents themselves.

The engineer would have us turn our coal into cheap power, preferably electrical, on account of the ease of distribution. Just as there are trunk lines of railway, so there should be trunk lines of electric power generated from the largest and most economical machines in stations situated in the best localities for the needs of any district where land is cheap and coal and water plentiful. But just as the branches from a trunk railway enable the towns at their termini to develop in a way impossible without the trunk line, so trunk power mains would enable collieries to use their friable coal unfit for transport by turning it into electrical energy, at the same time extracting the by-products, for they would have a means for distributing their power which at present they do not possess.

It would really seem that for industrial purposes this is the line for advance, having in view economy, and the North-East Coast power system may be taken as an example in this country of the theory put into successful practice. It goes a long way to satisfy the chemist in his reasonable desire for by-products, and the efficiency of the conversion of coal into electricity is great if properly developed.

Economy in the domestic consumption of coal is more difficult. Gas is acceptable for cooking purposes, but the Englishman has a strong preference for warming himself by the direct radiation from a fire instead of the far more economical stoves so common in other countries. People must be educated in this matter, and no doubt the Domestic Fuel Sub-Committee of the General Committee mentioned at the commencement of these remarks will see to it that this is attempted. Manufacturers realise that smoke pouring from their chimneys implies bad stoking, and this means waste, and is consequently avoided so far as possible, but smoke from a domestic chimney conjures up visions of the crackling fire and genial warmth within the house.

The two discussions at Newcastle, if not producing any very new points, helped greatly in showing how we stand in relation to this most important question, and it is to be hoped that the committee will be in a position to present much valuable information in their next report. A *rapprochement* between chemists and engineers seems to be coming about, but the chemist and the geologist look as though they would continue grubbing for some time yet in a coal-seam on individual purposes intent. The satisfactory solution of the problem will require all three to work hand in hand, and now is the time, when co-operation is on everyone's lips, to achieve this happy result in the interest of the nation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IN reply to an inquiry, official confirmation has reached us of the announcement made by the registrar at the meeting of the council of the University College of Wales, Aberystwyth, on December 15, to the effect that friends of the college had expressed their intention of contributing the sum of 100,000*l*. to the funds of the college, subject to a reservation of their right to make such proposals as they may deem expedient to the council, either as to the capital or as to the income therefrom. The sum of 20,000*l*. will be set aside annually by the donors for this purpose for the next five years.

THE annual meetings of the Geographical Association will be held on Friday and Saturday, January 5–6, at the London Day Training College, Southampton Row, W.C. After the presidential address a discussion on the value of modelling in the early teaching of geography will be opened by Miss N. Catty, and a lecture on regions in human geography, with special reference to Europe, will be given by Prof. H. J. Fleure. There will also be a discussion on the resolutions drawn up by the Five Associations (now the Council for Humanistic Studies), to be opened by Mr. H. J. Mackinder. On January 6 a joint meeting of the Geographical and Mathematical Associations will be held to discuss "The Teaching of Map Projections." This discussion will be opened by Prof. T. P. Nunn.

THE Journal of the British Science Guild for November contains several reports and memoranda on the organisation of science and the improvement of facilities for education. In the "Memorandum on the Encouragement of Teaching and Research in Science in British Universities" attention is directed to the great variations in the salaries of professors in the faculty of science at different institutions. Liverpool and Manchester head the list with average salaries of 853*l*. and 885*l*. respectively, Southampton and Aberystwyth coming last with 325*l*. and 320*l*. Reference is particularly made to the inadequate arrangements as regards salaries and facilities for scientific education in the University and colleges of Wales, and it is suggested that such institutions should receive additional State support. Other suggestions include the elimination of temporary and associate professorships at State-aided universities, and the substitution of "Regius Professorships," appointment and dismissal resting with the Crown or with a body appointed by the Crown. Another important matter is the provision of an adequate scale of pensions. The "Report on Reforms necessary in National Education" covers wide ground, a series of concrete recommendations being made. Various steps are suggested to eliminate the gaps between elementary schools, secondary and technical schools, and the universities. It should be incumbent on employers to provide facilities for persons between the ages of fourteen and seventeen to attend continuation schools for six hours per week within the hours of employment, "leaving certificates" should be established at elementary and secondary schools, and scientific method and training should be more generally encouraged. Teachers at training colleges should be given a larger measure of freedom and responsibility. Here again salaries, superannuation schemes, and conditions of tenure require to be placed on a more satisfactory footing. In elementary schools the physical development of the children and the encouragement of manual and other work developing initiative should be given especial attention.

THE Proceedings of the Institute of Chemistry, part iv. (November, 1916), contains the proposed new regulations for the admission of fellows and associates, originally promulgated in the 1914–15 report, as amended in the light of conditions resulting from the war. For admission to the associateship a candidate may proceed under either Regulations A or B. The former comprise (1) an approved preliminary examination of matriculation standard; (2) (*a*) four years' day training at a recognised university or college, or (*b*) three years' such training and two years under a fellow of the institute, or (*c*) a degree in chemistry and physics taken at a recognised university, with, in the case of pass graduates, a subsequent year's training in chemistry at a recognised university or college, or two years' experience under a fellow; and (3) an examination in general, theoretical, and practical chemistry conducted by the institute, the candidate having in every case produced satisfactory evidence of training in physics and mathematics. Under Regulations B a candidate is to be admitted if he has a degree with first- or second-class honours in chemistry, or a degree or diploma recognised by the council as equivalent, obtained after a three years' day course, with three years' subsequent experience of a standard and character approved by the council, or such degree or diploma obtained after a four years' day course, with two years' subsequent experience. The regulation as to training in physics and mathematics is again applicable. The qualifications for the fellowship are to consist of three years' continuous occupation in the study and practical work of applied chemistry since admission as associate, and either the production of records of original research, or the devising of processes or inventions of sufficient merit in the opinion of the council, or the production of evidence of knowledge and ability equivalent to such conditions, or the passing of an examination in a special branch of chemistry.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Anthropological Institute, November 28.—Prof. A. Keith, president, in the chair.—Prof. G. Elliot **Smith**: The common objections to the reality of the migrations of early culture. After citing a series of instances which proved the reality of the cultural migrations, and exposing the lack of cogency in the arguments commonly brought forward in opposition to the admission of the only possible explanation of the facts, the fashionable speculation of the present generation of ethnologists was then examined, that, "in order to meet similar needs" and "in similar circumstances," two peoples "in a similar stage of culture" may independently develop essentially identical customs, arts, and beliefs. Attention was directed to the fact that such cultural identities frequently occur among peoples whose "needs," "circumstances," and "states of culture" are as dissimilar as it was possible for them to be. Moreover, of kindred peoples—even members of the same race—living side by side for many centuries, in similar circumstances and with identical needs, one of them may possess the whole of the complex outfit of the megalithic culture, whereas the other may be totally free from any trace of it. As W. J. Perry has shown, the coincidence of the presence of ancient mines or pearl-beds reveals the fact that the stone-using culture-complex was introduced by immigrants who came to exploit these sources of wealth.

Linnean Society, December 14.—Sir David Prain, president, in the chair.—Miss I. **McClatchie**: Observations on the root-system of *Impatiens Roylei*, Walp. The primary root-system of *Impatiens Roylei* consists of a somewhat short tap-root, a whorl of four robust lateral roots, and a number of accessory laterals. These soon become obsolete and are replaced by a large superficial root-system of adventitious origin derived from the lower half of the hypocotyl. In plants in which the first and subsequent nodes trail along the ground, additional roots are produced from these. Abortive roots commonly arise at the bases of lateral branches, and further development can be induced also in these by suitable manipulation. Various other factors, such as wounding, increasing the height of the soil, etc., also induce accessory root-formation. —Miss A. J. **Davey** and Miss M. **Gibson**: The distribution of monœcious plants, and the occurrence of hermaphrodite flowers in *Myrica Gale*, with observations on variations of sex. *M. Gale*, the common bog myrtle, is described as being typically diœcious, but mention has been made by several authors of the occasional occurrence of the monœcious condition. Observations during several successive years on a large area of Myrica in the peat moors of Somerset show that there is always a small proportion of monœcious plants, which present all gradations between the normal pistillate and staminate types. Further, it has been found that the sex of a plant may vary from year to year.

Optical Society, December 14.—Mr. F. J. Cheshire, president, in the chair.—L. C. **Martin**: The refractometry and identification of glass specimens, especially lenses. The determination of the refractive index generally requires at least one plane-polished surface in the specimen, but the method described could be used for lenticular, irregular, or unpolished pieces of glass. By immersing the specimen in a liquid of equal refractive index the system became optically homogeneous for light of a particular wave-length. The liquid, which may be a mixture of carbon disulphide and alcohol or a solution of mercuric potassium iodide, is contained in a prism cell on the table of a spectrometer, and is kept mechanically stirred. Spectra from the usual sources are observed by refraction through the prism, of which the sides are plane parallel glass. The introduction of the specimen diffuses the light, but any particular spectrum line may be focussed by adjustment of the strength of the liquid. The refractive index of the liquid and specimen is then found in the usual manner.—Dr. R. S. **Clay**: A workshop method of determining the refractive index of a block of glass of which only one face is polished. The method was shown to be based, as are the Abbe and Pulfrich refractometers, upon the determination of the critical angle when light passes from the medium of which the refractive index is to be found into one of which the index is known. The hemispherical ball of Abbe or the cube of the Pulfrich refractometer is replaced by an isosceles right-angle prism. This must, of course, have a higher refractive index than that of the substance it is required to measure. A simple telescope, composed of two spectacle lenses with a cross-wire at their common focal plane, is used to take the readings. A drop of liquid of high refractive index (*e.g.* quinoline or oil of cassia) is placed on the hypotenuse face of the prism, and this is placed upon the polished face of the glass of which the refractive index is required. Sodium light is caused to fall on one side of the block of glass, and the light emerging from one face of the prism is received by the telescope. The latter is turned until the critical angle is obtained, shown by one-half of the field of the telescope becoming black, and the dividing line of the field being on the cross-wire of the telescope. The observation is repeated for light falling on the opposite side of the glass block, and emerging from the other face of the prism. The angular distance between the two positions of the telescope determines the refractive index of the glass by a simple calculation, or the scale can be divided to give the refractive index directly.

Royal Meteorological Society, December 20.—Major H. G. Lyons, president, in the chair.—C. **Salter**: The measurement of rainfall duration. Save for an article by Mr. Baldwin Latham in 1880, practically no attention appeared to have been paid to this subject until 1903, when Dr. H. R. Mill commenced collecting records for the British Isles, the number of which has grown until, in "British Rainfall, 1915," as many as forty-eight records were published. An examination of these records revealed certain inconsistencies which were probably due to personal and instrumental causes. The differences appeared to be due principally to the varying degrees of sensitiveness of the recording instruments to very light rain, and the suggestion had been made that if rain of very low intensity were omitted from the records a closer approximation to homogeneity would be attained.—Prof. H. H. **Turner**: Discontinuities in meteorological phenomena: third note. In two previous papers it has been suggested that meteorological history is divided into definite chapters of average length $6\frac{1}{3}$ years, the separating dates being assigned according to a regular law. Further, that if these chapters are numbered consecutively those with even numbers differ in certain essential respects from those with odd numbers. The present paper gives the systematic analysis of fifty-five years' monthly rainfalls at twenty-eight European stations. The division into alternating chapters is clearly brought out, and it is apparently possible to assign the separating dates from this material within a month. This precision is made possible by the existence of a five-monthly periodicity, for which some evidence was given in a former communication, but which is clearly established by the mass of evidence here submitted. The division into chapters has been connected in a former paper with the movements of the earth's axis. In the present paper some earthquake statistics are put forward which appear to be favourable to this view.

Manchester.

Literary and Philosophical Society, November 28.—Mr. T. A. Coward, vice-president, in the chair.—H. **Bolton**: The Mark Stirrup collection of fossil insects from Commentry, Central France. This collection of insects is now in the Manchester Museum, and was obtained by the late Mr. Mark Stirrup from his friend, Charles Brongniart, author of the classical memoir, "Recherches pour servir à l'histoire des Insectes Fossiles des Temps Primaires." It consists of nine specimens, of which five are blattoids, one is a fragmentary wing of *Goldenbergia* (*Microdictya*) *hamyi*, two belong to new genera and species, and one is indeterminable. All the insect remains occur in a compact and thin flaggy mudstone. The blattoid wings belong to five species, of which two are referable to the genus Necymylacris, and three to the genus Phylloblatta. Four of the species are new; the fifth is an example of *Phylloblatta brongniarti* of Handlirsch. Of the two new genera, one is considered to have close relationships with the family Perlidæ, whilst the second is regarded as an archaic type of the family Panorpidæ.—J. W. **Jackson**: Faceted pebbles from Pendleton, Lancashire.—Dr. F. E. **Bradley**: Presence of arsenic in baking-powder.—W. H. **Todd**: Behaviour of a blackbird.

Dublin.

Royal Dublin Society, November 28.—Prof. G. H. Carpenter in the chair.—Prof. W. **Brown**: The fatigue of nickel and iron wires when subjected to the influence of transverse alternating magnetic fields. The fatigue under these conditions is less than that due to longitudinal alternating magnetic fields by 8·5 per cent. for nickel and 25 per cent. for iron, and in both cases the time taken to attain the maximum value of fatigue with the transverse field was about double that with the longitudinal field.—Prof. E. A. **Letts**: The chemistry of foul mud deposits. The sulphides and carbonates usually present in foul mud deposits are those of iron, calcium, and, more rarely, magnesium and sodium. It has been stated, but also denied, that the action of hydrogen sulphide on carbonates, and the opposite, namely, that of carbon dioxide on sulphides, is a reversible reaction, *e.g.*:

$$FeS+\overset{\text{Excess}}{\overline{2CO_2+2H_2O}}\rightleftharpoons Fe(HCO_3)_2+\underset{\text{Excess}}{H_2S}.$$

In the first part of their paper the authors prove that the actions are reversible. The second part of the paper deals with actual analyses of foul mud deposits before and after keeping.—E. J. **Sheehy**: Abnormality in arterial arches in a rabbit. The right subclavian artery is absent. A blood-vessel which originates from the aorta behind the left subclavian runs dorsal to the œsophagus and trachea, and appears on the right side, where it serves as a subclavian, *i.e.* it branches into the right vertebral artery and blood-vessels to the arm. The recurrent laryngeal nerve associated with the abnormal blood-vessel is quite normal, even though the vessel which it usually embraces is absent. Persistence of an unusual portion of the embryological blood system, namely, the right descending aorta, explains this exceptional condition, and the normal position of the recurrent nerve suggests that the nervous system was well developed previous to the obliteration of the embryonic arches.

PARIS.

Academy of Sciences, December 4.—M. Camille Jordan in the chair.—W. **Kilian** and J. **Révil**: Discontinuities of sedimentation and the levels of the breccias in the French Alps.—W. **Sierpinski**: The *rôle* of Zermelo's axiom in modern analysis.—G. **Julia**: The forms of Dirichlet and the loxodromic substitutions of the Picard group.—M. **Brillouin**: Fundamental solution in a heavy liquid with free surface.—M. **Baticle**: The calculation of thick arches submitted to uniform pressure.—B. **Globa-Mikhailenko**: A new figure of equilibrium of a fluid mass in rotation.—L. **Roy**: The problem of the wall and its application to the discharge of a condenser on its own dielectric.—L. **Gentil**: The "Trouée de Taza," northern Morocco. The Miocene deposits found at Taza confirm the view put forward in earlier papers, that there was communication between the Mediterranean and the Atlantic during the Neogene epoch, the narrowest point being at the gap of Taza.—J. **Boussac**: The existence, between Modane and the Col de Chavière, of a *fenêtre* showing the Trias under the Permian.—P. de **Sousa**: The earthquakes of the eighteenth century in the neighbourhood of the oval Lusitania-Spain-Morocco depression.—F. **Baco**: Variations of a sexual hybrid of the vine by grafting on one of its parents.—C. **Sauvageau**: A Laminaria new for the French coast, *Laminaria Lejolisii*.—J. **Georgévitch**: The various forms of *Ceratomyxa Herouardi*.—A. **Lumière** and E. **Astier**: Tetanus and frost-bite. Evidence that precautions against tetanus should be taken in cases of lesions caused by frost-bite.—A. **Arnoux**: The mechanical protection and preservation of eggs. The newly laid egg is wrapped up in layers of a material impregnated with a solution of sodium silicate, and air-dried for twelve hours. The preservative properties of the alkaline silicate are well known. The above method of applying it gives mechanical strength; the treated eggs can be allowed to roll down a flight of stairs without breaking.

BOOKS RECEIVED.

Fertilizers. By the late Dr. E. B. Voorhees. Revised edition by J. H. Voorhees. Pp. xv+365. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

The Fauna of British India, including Ceylon and Burma. Coleoptera, Rhynchophora, Curculionidæ. By Dr. G. R. K. Marshall. Pp. xv+367. (London: Taylor and Francis.) 15*s*.

A Memoir on British Resources of Sands suitable for Glass-making. By Dr. P. G. H. Boswell, with Chemical Analyses by Dr. H. T. Harwood. (London: Longmans and Co.) 1*s*. 6*d*.

The Principles of Electric Wave Telegraphy and Telephony. By Prof. J. A. Fleming. Third edition. Pp. xvi+911. (London: Longmans and Co.) 30*s*. net.

The "Wellcome" Photographic Exposure Record and Diary, 1917. Northern Hemisphere and Tropical Edition. Pp. 256. (London: Burroughs, Wellcome and Co.) 1*s*.

DIARY OF SOCIETIES.

TUESDAY, JANUARY 2.

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

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THURSDAY, JANUARY 4, 1917.

GEOLOGY AND SCENERY OF THE LAKE DISTRICT.

The Geology of the Lake District and the Scenery as Influenced by Geological Structure. By Dr. J. E. Marr. Pp. xii+220. (Cambridge: At the University Press, 1916.) Price 12*s.* net.

EVER since the days of Jonathan Otley and of Sedgwick the Lake District has attracted much attention from geologists, largely on account of the variety and difficulty of the problems that it presents. As is well known, Dr. Marr has devoted a very large part of his life to the study of these problems, and the present volume contains an admirable summary of the results obtained by his predecessors, by his contemporaries, and by himself in this field. Although comparatively small when measured in square miles, there is, perhaps, no other well-defined area where so much variety of topography and of geological structure is to be found, or where the connection between geology and scenery is so clearly marked. On this latter feature the author rightly lays much stress, pointing out that each formation gives rise to its own particular type of scenery, easily distinguishable even in the distant view.

The arrangement of the book is historical. Beginning with the oldest known rocks, a clear and connected account is given of the origin and characters of each formation, and also of the events that occurred during the intervals when no deposition was in progress. The chapters dealing with the periods of non-deposition are in some ways the most interesting sections of the book, as they give more scope for originality and speculation. Even yet there remain problems among the older rocks still awaiting a final solution; perhaps the most important and the most difficult of these is the question of the true age and tectonic relationships of the Borrowdale volcanic series. The similarity of these rocks to the Charnian volcanics was long ago noted by Prof. Lapworth, who suggested that they may possibly be of pre-Cambrian age, owing their present position above the Skiddaw Slates to overthrusting. As a result of the researches of Dr. Marr and Mr. Harker, and the more recent work of Mr. J. F. N. Green, the balance of evidence seems to show that they are in reality, as they appear to be, of Llandeilo age; the question may eventually be settled by a study of the graptolites of the uppermost Skiddaw Slates. Should these be found to contain, as is possible, a Glenkiln fauna, a place would have to be found for the Borrowdales elsewhere, since the overlying Coniston Limestone Series is undoubtedly of Carodocian age. The relationship of the Eycott lavas to the Borrowdales and to the Carboniferous rocks which immediately follow them also offers an interesting field for investigation.

In the Lake District the connection between topography and glaciation is naturally close, and this is a subject on which the author is particularly competent to speak with authority. The development of the drainage system, together with its later modifications, as well as the origin of the lakes and tarns, are dealt with in a masterly manner. It is made abundantly clear that both ice-erosion and glacial deposit have played an important part in producing the characteristic types of scenery to which so much of the present beauty and interest of this region are due.

The author has succeeded admirably in the difficult task of producing a book which will be both interesting and instructive to the general reader as well as valuable to the serious student. The portions printed in large type form a continuous narrative of the main features of the geological history of the district, while the sections in smaller type provide a wealth of descriptive detail with ample references to the original literature, which will be of the greatest value to those who wish to carry out further work along special lines.

The book is well printed and the illustrations are numerous and well chosen, a feature of special interest being several reproductions of maps illustrating, among others, the classical papers of Dr. Marr and Mr. Harker on the Shap granite and of Mr. Harker on the gabbro of Carrock Fell. Both the author and Dr. H. H. Thomas are to be heartily congratulated on the beautiful coloured geological map of the district; possibly this helps in part to account for the very high price at which the book is published.

R. H. R.

A HAUSA BOTANICAL VOCABULARY.

A Hausa Botanical Vocabulary. By Dr. J. M. Dalziel. Pp. 119. (London: T. Fisher Unwin, Ltd.). Price 6*s.* 6*d.* net.

DR. DALZIEL deserves imperial thanks for producing a little book of imperial importance: the names in Hausa of all the more striking and important trees and plants in the flora of Northern Nigeria. The scope of the book, so far as botanical regions extend, is probably limited by the Sahara Desert on the north, the river Benue on the south, the Chad region on the east, and the course of the Middle Niger on the west. It does not, therefore, extend into the almost oppressively rich flora of Southern Nigeria, because nearly all of Southern Nigeria lies beyond the experiences of the Hausa-speaking folk, though, it is true, that experience does cross the Benue.

Companion works to this book ought to make their appearance in all parts of British Tropical Africa. Some years ago the Scottish missionaries of Blantyre (see the present writer's work on British Central Africa) endeavoured, with the assistance of their native pupils, to print similar researches, at any rate to give the native name of every important tree and plant in Nyasaland. But, unfortunately, they were not able to combine with this in all cases correct botanical identification. We ought to have from British East Africa and Uganda, from British Central Africa (Rhodesia and Nyasaland) and each separate colony or protectorate of British West Africa, works similar to that under review, giving in the leading native language or languages the designation of the striking and commercially important trees and plants, and side by side the correct botanical identification.

Dr. Dalziel's book is the model to be followed. It possesses an excellent index which reverses the process of identification by supplying a long list of the botanical names of trees and plants with the number of the page on which they are dealt with. It also throws much light on native drugs, poisons, and aphrodisiacs, and is further a useful catalogue of the outstanding features in the flora of Eastern Nigeria.

Hitherto botanical research—and linguistics—have not been sufficiently encouraged by the Colonial Office in our African possessions. Perhaps after the war—if those of us now writing and working live to see an after—we shall be wiser. We shall realise that Africa is as important to us and the rest of the world for its flora as it is for its minerals, and do everything we can to increase native and European knowledge of the same.

H. H. JOHNSTON.

A GERMAN PSYCHOLOGIST ON THE EVOLUTION OF CULTURE.

Elements of Folk Psychology: Outlines of a Psychological History of the Development of Mankind. By Wilhelm Wundt. Authorised translation by Prof. E. L. Schaub. Pp. xxiii + 532. (London: George Allen and Unwin, Ltd., 1916.) Price 15*s*. net.

PROF. WUNDT has been a voluminous writer on psychological and philosophical subjects, and has had a profound effect in Germany and to a large extent also in the United States of America, but of the real value of his psychological investigations this is not the occasion to form an estimate. The "Elemente der Völkerpsychologie" (1912), of which the book under notice is a translation, breaks new ground, and we have to thank Prof. E. L. Schaub for rendering it available to the English-speaking public.

The book gives a synthetic presentation of various stages of human civilisation and of the mental products which are created by communities of human beings at these several stages. The author divides the development of civilisation into four stages: Primitive Man, the Totemic Age, the Age of Heroes and Gods, and the Age of Natural States and Religions—the first three being alone dealt with at length. Prof. Wundt makes certain deductions from the data which he adduces, but before framing hypotheses it is as well to make sure of the premises, and it has been a surprise to the present writer to find upon what inaccurate data—one can scarcely term them "facts"—the superstructure is in many cases reared.

When dealing with primitive man we find various astonishing statements, thus: "If one were to connect the discovery of this primitive man with any single name, the honour would belong to a German traveller and investigator, George Schweinfurth. He was the first to discover a really primitive tribe." "When the Veddah enters into marriage, he binds a cord about the loins of his prospective wife. Obviously this is nothing else than a form of the widely current 'cord-magic' . . . to secure the faithfulness of the wife." As a matter of fact, "the bride gives her spouse a waist string of her own making" (Seligman), which may or may not have the significance Prof. Wundt attributes to it—we simply do not know. The Veddas do not use poisoned arrows, as he states they do. "Even marriage between brother and sister was originally not prohibited"; but, as Dr. and Mrs. Seligman point out, Hugh Neville said in 1886: "Much nonsense has been written by persons who ought to have known better, about marriage of Vædda with their sisters. Such incest was never allowed and never could be." He goes on to explain that "the mistake arose from crass ignorance of Vædda usages."

Further on we read that the Australian spear-thrower is a "grooved board," but of the numerous varieties of this implement in Australia not one has this construction. Again, "the shield of the Australians is long, and usually raised toward the centre. It covers the entire body." There are several kinds of shields in Australia, the most widely distributed being little more than a parrying stick. We are told that "the Papuans are the first to change the digging stick into the hoe . . . it is the man who makes the furrows with the hoe . . . and the woman follows with the seeds, which she scatters in the furrows." But the hoe as derived from the digging stick was unknown, and seeds were never sown in New Guinea until the arrival of civilised people. Another misleading statement is that "to the bow and the lance they [the Polynesians] have added the knife and sword; to the long shield, the small round shield." If Prof. Wundt had stepped across from his laboratory to the excellent Museum für Völkerkunde he need not have made these blunders. The statement that the Malays came from "the mainland of India" is incorrect; if he meant Further India he should have said so—but that, in any case, is a foolish term. There is no evidence that "the Malayans were the first to create a perfected form of boat."

It is unnecessary to give further examples of misstatements. There are also a considerable number of statements of the origin or evolution of customs and objects of material culture which are given with all the assurance of ascertained facts, though they are merely the unsupported statements of the professor. On the other hand, there are many valuable suggestions and inferences which are worthy of the attention of students.

A. C. HADDON.

MATHEMATICAL TEXT-BOOKS.

(1) *A Shilling Arithmetic.* By J. W. Robertson. Pp. viii+191. (London: G. Bell and Sons, Ltd.)

(2) *Revision Papers in Arithmetic.* By C. Pendlebury. Pp. xv+68+xviii. (London: G. Bell and Sons, Ltd., 1916.) Price 1s.

(3) *Preliminary Geometry.* By F. Rosenberg. Pp. vi+220. (London: University Tutorial Press, Ltd., 1916.) Price 2s.

(4) *Statics: a First Course.* By C. O. Tuckey and W. A. Nayler. Pp. 299. (Oxford: At the Clarendon Press, 1916.) Price 3s. 6d.

(5) *Exercices Numériques et Graphiques de Mathématiques.* By Prof. L. Zoretti. Pp. xv+124. (Paris: Gauthier-Villars et Cie, 1914.) Price 7 francs.

(6) *Ruler and Compasses.* By Hilda P. Hudson. Pp. 148. (London: Longmans, Green and Co., 1916.) Price 6s. net.

(1) MR. ROBERTSON'S "Shilling Arithmetic" deserves the attention of the teacher if only for the collection of carefully devised and arranged original examples. It is not overloaded with text, nor is undue space given to illustrative examples. Stress is laid upon the use of rough checks. No use is made in H.C.F. of the principle $ma \pm nb$. In finding prime factors the child is told to begin by removing the lowest factors first, a practice which does not make for speed, especially as the tests for divisibility by 11, 9, etc., are supposed to be at the service of the student. In the sections on fractions the figures are too small, and in the copy that has reached us they are often of varying degrees of distinctness. It is nothing short of criminal for any publishing firm in these days to issue books for the young upon which any reproach of the kind can be cast. Numbers 24 and 25 (p. 47) are instances of wickedly small type, and the strain to young eyes is greater still when the space between the lines is inadequate, *e.g.* compare numbers 26–40 on this page with numbers 41–43 on the next, and the relief is instantaneous.

In the treatment of stocks we are glad to see that the author banishes the mischievous "100*l.* stock" and uses "voucher" in its place. It is curious that in such questions as "Which is the better investment, 5½ per cent. stock at 89, or 4 per cent. stock at 97?" few, if any, text-books suggest the investment in each stock of the *product of the prices*—*i.e.* in the present case, 89*l.* × 97. This buys 97 bonds giving 5½*l.* each per annum or 89 bonds giving 4*l.* each per annum. The difference is rapidly found with a minimum of fractional work. There is a useful set of forty test papers. As an instance of the practical tone pervading the book, we may take the warning that the percentage profit in actual commerce is reckoned as often on the cost as on the selling price.

(2) Mr. Pendlebury's "Revision Papers in Arithmetic" provide "a well-graduated and comprehensive examination course up to the standard of the Oxford and Cambridge Locals." They seem excellently adapted for such a purpose. The Answer pages are perforated for removal if deemed necessary, and our only grumble is with the publisher as to the strain caused here and there by small faint figures to young eyes.

(3) Mr. Rosenberg's "Preliminary Geometry" claims to be a judicious blend of the theoretical and practical. Where possible, "each important proposition . . . is preceded by introductory analytical practical work, enabling the learner to discover for himself the law formally proved in the proposition." Parallels follow the work on the angle and triangle, but otherwise the order followed is that of the Oxford and Cambridge syllabus. Where the book is not used by the private student the answers, which contain hints for the solution of many riders, should be detachable. Boys and girls are mortal. The explanations are clear and precise. Such pages as 67–70, "Hints on the Solution of Riders," are invaluable to the private student, and throughout the book there is ample evidence that the author is familiar with every trap into which the unwary beginner may fall. The book enjoys all the devices of type, etc., that are common to works issued by the University Tutorial Press.

(4) The "Statics" of Messrs. Tuckey and Nayler must be carefully examined by all who are not so satisfied as to scorn ingenious "tips" on points in the presentation of a subject which is always difficult to a certain type of youthful mind. The figures are large and clear. It would have cost very little more trouble to add the date to the sources—Army, Previous, etc.—from which the questions have been taken. The point is not immaterial, as considerable trouble to examiners might thereby be saved, as a recent trial in the courts may suggest to those who have to set papers. The young teacher will welcome chap. viii., on "The Connections between the Principles"; such pages as 242–243 will be a revelation to many who are inclined to take "laws" for granted, and whose historical instinct requires a gentle titillation. The manner in which couples are introduced is worthy of notice, as is also the chapter on geometrical methods, since it is "beginning to be recognised that the relations between three actual forces in equilibrium can be more readily grasped by the beginner than those between two actual forces and their hypothetical resultant." The book will be a great disappointment to those who share with Sir Peter Teazle a horror of principles.

(5) Prof. Zoretti's "Exercices Numériques" represents the revolt in French educational circles against a system of teaching which leaves the student unable to use the tools at his disposal. The author's experience as examiner has brought him face to face with "bacheliers" in the land of the metric system who do not know the meaning of a decimal or a significant figure; who are checked by a change of units; to whom the real

nature of a vector is a mystery, although they could write out a complete theory of the central axis; and to whom numerical calculations of any description are as the abomination of desolation. In his *Leçons* the author has provided the student with an ample supply of algebraical exercises, and to these the volume before us provides a supplement, the scope of which is indicated by the warning: "Bien entendu, il n'aura jamais de recul devant les calculs numériques, sans quoi il vaudrait mieux fermer le livre pour toujours et changer de carrière." The chapters are arranged to be worked through, *pari passu*, with corresponding sections in the *Leçons*, so that a wide extent of ground is covered in these 120 odd pages. Close attention is paid throughout to relative and absolute errors. Many of the exercises deal with problems occurring in railway management, and may be novel on this side of the Channel. The book will be a useful addition to the library of the teacher or examiner.

(6) Miss Hudson's monograph on "Ruler and Compasses," which has somehow strayed into this group of elementary text-books, takes us on to a higher plane. Class-book in its entirety it can scarcely be in the schools of to-day, but none the less will it find a place on the shelves of the teacher who is in search of leading ideas, of the folk who in other days would have exhibited their taste for geometrical study in the "Palladium," the "Apollonius," or the "Ladies'" and "Gentlemen's" Diaries of their time. There must be a considerable proportion of those possessed of general culture who see something repellent in analysis, who find generalities too great a burden for their powers of assimilation, and who nevertheless have a native talent for the elementary investigations of pure geometry. Among them is, for instance, that small coterie who feel a never-failing charm in the elusive mysteries of cyclometry. To these it will appeal as well as to the mathematical elect, beginning with the cream of the schools—who will find Miss Hudson's book uncommonly useful, for example, in preparing for their "essay paper," quite apart from its intrinsic interest and value—and passing on to the trained mathematicians, whose interests have been mainly analytical, and who will be glad to find within two covers a host of material such as that due to Messrs. Richmond, Gérard, Hobson, etc. How many of the old stagers have heard of an *Einheitsdreher*, or can state the meaning of geometrography? We cannot better describe the author's scheme than in her own words: "The connecting link through the book is the idea of the whole set of ruler and compass constructions, its extent, its limitations, and its divisions." In completeness and in clarity of exposition it ranks with a companion volume in the same series, the "Projective Geometry" by Prof. Mathews, and, though not comparable in scale, we do not think that "masterpiece" is too strong a word to apply to each. Some day, but not yet, we may forgive Miss Hudson for the omission of an index.

W. J. G.

OUR BOOKSHELF.

First Course in General Science. By Prof. F. D. Barber, M. L. Fuller, Prof. J. L. Pricer, and Prof. H. W. Adams. Pp. vii+607. (New York: Henry Holt and Co., 1916.)

THIS book is written for the American school child. It opens with the statement that "the *primary function* of first-year general science is to give, as far as possible, a rational, orderly, scientific understanding of the pupil's environment to the end that he may, to some extent, correctly interpret that environment and be master of it. *It must be justified by its own intrinsic value as a training for life's work.*" Setting out with this idea, the authors take the various phenomena with which the child is likely to be confronted, and deal with them in a manner calculated to arouse his interest. The opening chapter deals with lighting: with candles, lamps, and kerosene; these subjects lead up to evaporation, boiling temperature, etc., then to petroleum, gasolene, coal gas, and finally to electric lighting. In the second chapter the authors pass on to heating: fires, stoves, combustion and energy, chemical compounds, coal, the measurement of heat, house-heating and cooking. A third chapter is devoted to the refrigerator, which plays a large part in the domestic economy of the States; this leads on to ammonia, the freezing of water, and cold storage. The weather is next discussed. The child by this time has gathered some general physical ideas and he can the more easily grasp the somewhat complex problems now presented to him. Meteorological instruments, weather charts, the seasons, climate and its relation to health, are all described. The principles of ventilation are then treated at length, followed by an account of dust, the vacuum cleaner, and the dangerous, because dusty, hangings of rooms.

The authors then deal with a wholly different subject: food. They are concerned more particularly with its preparation on both the large and the small scale. The next chapter is devoted to micro-organisms, and later chapters to soil physics, sewage, and machinery.

Thus the whole range of a child's experience is fairly well covered. It is difficult to form an opinion as to the general suitability of a book of this sort: usually one tells children about these things, and adapts one's methods to the audience, developing a theme when it seems desirable, but never treating two different audiences in the same way. Probably the best use of the book is as a teacher's guide to give him "copy" which he can work up and adapt to his own class.

The Mechanical Star-bearing Finder: A Simple Guide to Night Marching in Southern England and North France. By E. T. Goldsmith. (London: George Philip and Son, Ltd.) Price 5s. net.

THIS is a convenient pocket arrangement by means of which one can solve several of the problems which are capable of solution by the celestial globe. It is intended primarily for the determination of bearings by observations of stars, for use in night marching. Briefly, it is a planisphere in which the principal stars which are not too far from the equator are represented in a cylindrical projection; the star-chart is adjustable for different dates, and there is a movable celluloid protractor on which are marked the projection of the horizon and the projections of vertical circles at intervals of 10°. Following the simple instructions given, the magnetic bearing of a star, even if its name be unknown, can readily be ascertained. The operations are entirely mechanical, and anyone of ordinary intelligence should be able to determine directions with considerable accuracy. The form of projection adopted, however, has the defect of failing to give bearings of stars towards the north, and it is not very clear why the results are expressed in magnetic instead of in true bearings. A protractor adapted for southern Scotland and northern England is obtainable alternatively or separately.

LETTERS TO THE EDITOR.

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

The Temperature Coefficient of Gravity.

In *Phil. Trans.*, May 17, 1916, Dr. P. E. Shaw published an account of a research from which he deduced that the gravitational constant is increased by one part in eighty thousand when the temperature of the larger mass is raised one degree. According to Dr. Shaw's interpretation of the experiments, it is the mean temperature of the system which affects the coefficient of attraction, so that in the case of extremely unequal masses it is the temperature of the larger mass only which counts. The evidence does not seem strong enough to support so revolutionary a conclusion in view of the almost insuperable theoretical objections.

One or two of the more obvious difficulties may be formulated in a few words.

Take as an example the earth and a mass of 1 kg. Divide up the earth (ideally) into "terrestrial particles" of, say, 1 mgrm. each. When the temperature of the kilogram mass alone is raised one degree its attraction for each "terrestrial particle" should be increased proportionally by $1{\cdot}2 \times 10^{-5}$. But by the same reasoning the attraction between the kilogram mass and the earth as a whole should remain sensibly unaltered. In like manner, if we keep the kilogram mass at constant temperature and alter the temperature of the earth, the attraction between the kilogram and each "terrestrial particle" will be sensibly unaltered, while the attraction between the kilogram and the earth as a whole will have changed. This seems so essentially paradoxical that it is difficult to conceive of any supplementary hypothesis elastic enough to reconcile the contradiction involved.

The only way of avoiding this inconsistency is to admit that it is the product of the two values of a temperature-function which counts—*i.e.* that the temperature of the smaller mass is just as important as the temperature of the larger mass. Once this is admitted the experiments of Poynting and Phillips prove that no variation exists greater than 10^{-9} per degree Centigrade.

It may be argued that the temperature of the *attracting* body determines the attraction—*i.e.* that action is not necessarily equal to reaction. In addition to violating the principle of momentum, this involves the possibility of constructing a *perpetuum mobile*. An elongated body, kept hotter at one end than at the other by means of ideal thermal insulation, would experience a resultant force in the direction of its length, and could be made to do work indefinitely by harnessing it like a horse to a mill. Is anybody prepared to believe this on any but the most conclusive experimental evidence?

Again, it has been suggested by Prof. Barton that the temperature of the intervening radiation may determine the attraction. But the temperature of radiation is independent of the intensity, so that indefinitely feeble radiation would produce a finite effect.

If the intensity of the radiation is substituted as the determining factor, it implies that the attraction of two bodies is increased if a beam of light passes between them. If energy is to be conserved, this would imply that two bodies moving relatively to one another could increase or diminish the energy of a beam of light passing between them, and such a result would certainly be rather startling. Still more extraordinary would it be to find that a variation of 0·01 of a stellar magnitude on the part of the sun would change the length of the year by several minutes; yet this is what would be implied. There is no record of an appreciable change in the earth's orbit caused by sun-spots.

When one comes to examine the evidence out of which all these paradoxes arise, it can scarcely be said to be sufficient. Thus, for instance, as "indirect experimental evidence," Dr. Shaw cites Cornu, who found 5·50 for the earth's mean density from winter work, and 5·56 from summer work, a difference of 1·1 per cent. To reconcile the sign of this variation with his own temperature coefficient, Dr. Shaw suggests that the apparatus in a laboratory may have a higher temperature in winter than in summer. He can scarcely have noticed that the excess of temperature in winter would have to be some 900 degrees. Again, from Prof. Boys's work on the gravitation constant, Dr. Shaw deduces a temperature coefficient of 10^{-3}, of which, according to his own results, 98·7 per cent. must be ascribed to error. Can we have much confidence in the remaining 1·3 per cent.?

While we must all admire the experimental skill which enabled Dr. Shaw to observe a change of 0·2 mm. at either end in a range of 200 mm., using a telescope and scale (especially when we know the difficulties he had to contend with), we can scarcely be expected to make these radical changes in our theories on the strength of such a very small effect. Though his reasons for rejecting experiments which gave a negative value for the temperature coefficient were no doubt excellent, the fact that such readings occurred is a little disquieting. Again, the readings vary amongst themselves by as much as the whole effect, and one knows how misleading a mean value of, say, 176·2, 175·9, 175·75 may be when the whole residual effect is only 0·4 mm.

In conclusion we should like to express our admiration for Dr. Shaw's experimental work. We feel that as the result of such an elaborate research a null result is quite as important as, if less sensational than, a positive one. To have reduced the apparent temperature coefficient of gravity from the 10^{-3} deduced from Prof. Boys's measurements to one-eightieth of that value is certainly no mean achievement.

F. A. Lindemann.
C. V. Burton.
South Farnborough, Hants, December 4.

THE general view held by philosophers seems to be that when temperature rises the gravitative attraction changes (if at all) by a function of temperature only. This leads to the results stated in the beginning of their letter by Dr. Lindemann and Mr. Burton. But it is commonly conceded that at present there is no trustworthy theory of gravitation, so that one seems entitled to suggest that any increment in the force may be a function of both mass and temperature. The simplest formula, that of the weighted mean temperature, brings the facts as at present known into line. It seems that we must await further data; for, of course, a fact, however slight, may shatter a theory lying in its course.

If M, m, μ are the masses of earth, kilogram, and milligram, we have the cases cited thus. When m alone rises in temperature the increment of its force on μ is $Gm\mu\alpha T/d^2$, and on M is $Gmm\alpha T/d^2$. The first is sensible, the second insensible, compared with the forces when cold. Again, when μ alone rises in temperature the increment of its force on m is $G\mu\mu\alpha T/d^2$, but the increment of the force of M (considered as an aggregate of μ particles) on m is $G\mu\mu\alpha T/d^2$, multiplied by

$$\frac{M}{\mu} \cdot \frac{M}{M+m} \cdot \frac{\mu+m}{\mu} = GMm\alpha T/d^2.$$

This is identical with the increment of force on m due to M (considered as a whole), and is sensible compared with the force when cold. The series forms a consistent whole.

If the increments are due to radiation and resonance (see NATURE for July 13 last), there is an acoustical parallel. A medium fork will set up resonance to a slight degree in a large fork, to a greater degree in a small fork, all the forks having one frequency.

I cannot understand how the idea arises that action and reaction would ever, on this theory, be unequal. Let the force of m on M, both cold, be F. When m only rises in temperature the force is $(F+f_1)$, and when M only rises it is $(F+f_2)$, f_2 being of a higher order than f_1. But in each of the three cases the attraction is mutual and equal between M and m.

As regards Cornu's results, I stated that we could "deduce nothing" from them, so there is a misapprehension. I made no attempt to reconcile his results with mine.

I do not consider that the indirect results obtained from Prof. Boys's research can be laid by the side of mine for comparison. In his experiment any rise of temperature would involve *both* masses. Supposing the increment is due to molecular or other agitation of m due to radiation in my case, in his case there would be an enormously greater agitation in m due to direct rise in temperature. I see no reason why this should not be one hundred times as great as the effect due to radiation. The weighted mean formula was used to account for the effects observed when *either* mass is heated. The case when *both* masses are heated is different, and has not been at present considered, the data at hand being indirect and inconclusive.

The probable result from my experiments is $\alpha=+(1\cdot2\pm0\cdot05)\times10^{-5}$, or, as amended recently at Newcastle, $\alpha=+(1\cdot3\pm0\cdot05)\times10^{-5}$. Thus, while individual results differ among themselves, in some cases, by as much as the whole effect, yet the collective result is not weak.

I wish to express my appreciation of the generous terms used regarding my experiments by the authors.

P. E. SHAW.

University College, Nottingham, December 13.

THE USE OF METEORITIC IRON BY PRIMITIVE MAN.

METEORITES, as they reach our planet, are of three different kinds, namely, *siderites,* composed chiefly of nickel-iron; *aerolites,* composed chiefly of stony matter; and *siderolites,* composed of a mixture of iron and stone. The first and third only are of interest to us in this inquiry.

Great diversity of opinion has always prevailed among archæologists concerning the source of iron used in antiquity before it was intelligently produced from the ore. On the whole these opinions are about equally divided, though perhaps the majority are inclined to the verdict that meteoritic iron was *not* used by primitive man, for the following reasons:—First, because nearly all iron implements of antiquity extant, at least from the Old World (including the piece found in the Great Pyramid of Cheops), are of terrestrial origin; secondly, because it was believed to be non-malleable; thirdly, because it was said to be too scarce; and fourthly, because it was argued that small fragments could not have been detached from meteoritic masses by the means available to primitive man.

There is, to the casual observer, a great deal of truth in these four arguments, and they prove that there were several sporadic sources from which the early iron was drawn; perhaps in one locality they were chiefly terrestrial, while the use of extra-terrestrial or meteoritic iron predominated in other localities.

The fact that iron, in the earliest ages and from whatever source, was extremely rare is beyond all doubt. One might say that it was at least as rare as, and perhaps more valuable than, gold. It might therefore be asked: If meteoric iron was so rare and valuable, why was it not more carefully preserved by the people of antiquity? For, whereas we have plenty of gold objects of ancient workmanship in our museums, those of meteoritic iron are conspicuous by their absence. To this we may safely reply that the value of the meteoritic iron lay in its actual employment in the form of tools, implements, and weapons, and to have hidden such objects in treasure stores would have nullified their value, and that is one reason at least why so few were preserved. This disposes of argument number one.

We must bear in mind also that in the New World this argument does not apply with the same force, as we shall see that objects of meteoritic iron are not so rare there as in the Old World. The reason for this is that, whereas iron was produced in the Old World from the ore more than three thousand years ago, it was not introduced into the New World until the discovery of that continent about four hundred years ago, and it is obvious that objects more than three thousand years old have become rarer in our day than those comparatively new ones of only four hundred years ago.

A paper on this subject was contributed by the present writer at the autumn meeting of the Iron and Steel Institute. One of the principal features of this paper is a table including practically all known falls of meteoritic iron, their original

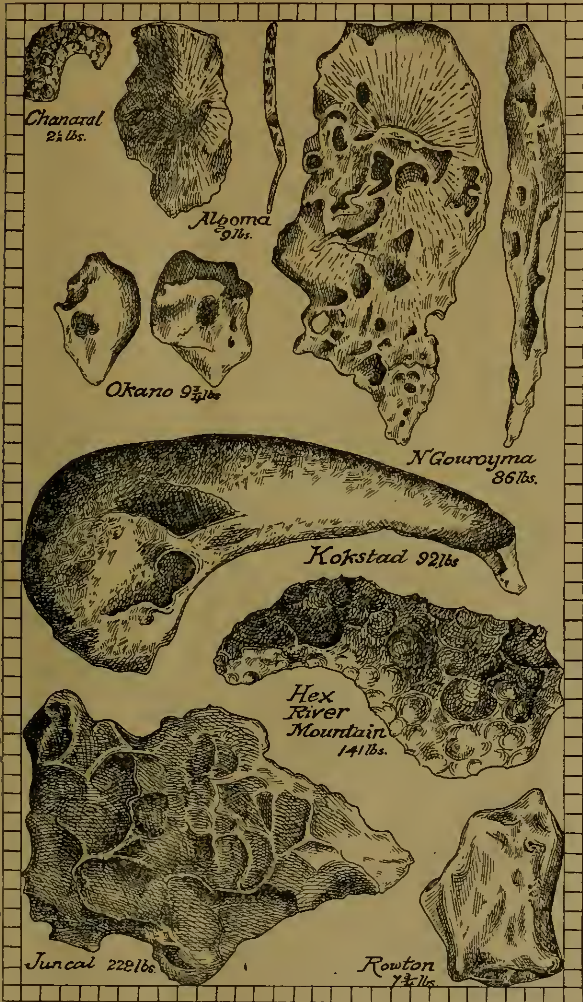


FIG. 1.—A number of iron meteorites showing their fragmentary form, from which it will be seen that some might be used entirely to form weapons and implements, whilst the protuberances of others might be cut off by primitive implements in order to form other weapons. Algoma, N'Gouroyma, and Okano are shown in two views each. Rowton is the only British specimen known; it fell near Wellington, Shropshire, on April 20, 1876. These meteorites are all drawn to the same scale, each square surrounding the illustration representing 1 in.

weight, whether malleable (that is, suitable for being wrought into objects of utility) or non-malleable (not suitable for such purposes). This table was compiled with the object of removing all doubt concerning argument number two. The *résumé* of this table gives us the amount of meteoritic iron known at the present day—about 250 tons. Of this total the very considerable amount of more than 99 per cent. is malleable. Since this considerable mass of approximately 250 tons has been accumulated practically within the last century, we might dispose of argument number three, concerning the scarcity of meteoritic iron.

This *résume* cannot be surprising, as meteoritic iron is, generally speaking, pure iron-nickel alloy, such as we are now producing artificially; and the latter is certainly ductile and malleable.

The general appearance of the majority of meteorites gives one the impression that they were fragmentary, and suggests that they formed portions of larger masses. A single fall might spread over a considerable area, and it is obvious that many masses of known falls must thus be difficult to find, or be lost, particularly such smaller pieces as might be wrought into useful objects.

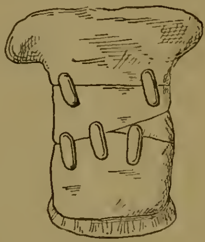
The accompanying illustration (Fig. 1) shows the fragmentary form of a few masses of meteoritic iron, from which we see that it is not like a cannon-ball, as is frequently supposed, and that it should not be so very difficult to sever such fragments. This disposes of argument number four.

Meteoritic iron was cut by the ancients in the same way as they cut pieces off the large masses of native copper found on the banks of Lake Superior, though it is not of course suggested that iron can be cut as readily as copper. When Cortez completed the conquest of Mexico the Spaniards noticed that the Aztecs possessed knives, daggers, etc., made of iron, and the question as to whence they had procured this iron became a perplexing problem to the Spaniards, which they were never able to solve. When asked, the natives mysteriously pointed to the sky, and indicated that they obtained their iron from the regions above. It was left to science to unravel the mystery. The

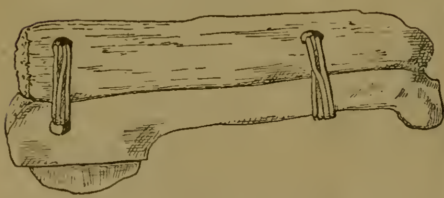
Aztecs were quite correct; the iron of which they had made their implements had come to them from the unknown regions of space, and was, in fact, of meteoritic origin.

Others, including Eskimos, certain Indian tribes, and the inhabitants of Yakutsk, in Eastern Siberia, used weapons and implements of meteoritic iron.

It would be impossible to mention here, even briefly, all the numerous meteorites of note which have fallen from time to time since the very earliest days. We may mention, however, in passing, the large meteorite which fell in the time of Pindar, 403 B.C., at Ægos Potamos, which is recorded in the Parian Chronicle, engraved in marble; and the stone at Orchomenos, of which Pausanias says that it fell from heaven before the siege of Troy, and during the reign of King Eteocles. Many falls are also mentioned by Pliny. Livy alone mentions twenty-one falls



"Oodoo" or woman's knife; the handle is of ivory.



"Savik" or man's knife (actual length, 4 in.); the handle is of wood and bone.

FIG. 2.—Ancient Eskimo knives made from the Melville Bay meteorite found by Rear-Admiral R. E. Peary.

in fifty-one years which fell during his lifetime. Another meteorite of note is the stone in the Kaaba, the most sacred jewel of Islam, called "The right hand of God on earth," which was probably worshipped formerly at the temple sacred to the Moon that used to stand in Mecca. These few examples will show how well it was understood in antiquity that meteorites came from an extra-terrestrial source; this is also the reason why, in practically all the languages of antiquity, iron is called "metal of heaven." The author believes that the very word *metal*, from the Greek verb *metallao*—"to search diligently for other things"—has reference to the diligent search which had to be made by the people of antiquity for meteoritic iron, being the "other things" more coveted by them than their usual raw material, namely, stones.

If we compare the mention of meteorites in ancient and modern literature, it would almost seem that meteorites were more plentiful in olden times; for we must bear in mind that when primitive man used iron first, he used it most probably in the same way in which he used copper 8000 B.C.—that is, for pins and needles, and such other objects in which, for instance, small flakes of iron could be inserted in bone handles, like the knives and other implements of the Eskimos (Fig. 2). Where larger masses were used they were probably employed in the same way and form as stone axes and adzes with the haft tied on. Better chisels and knives were probably not made until experience had been gained in the making of needles and pins, and after the use of the smith's fire was understood.

In conclusion we may say that primitive man before 1200 B.C. used iron more or less sparingly, which iron was obtained from the following sporadic sources:—

(*a*) Iron meteorites.

(*b*) Chance productions by a camp fire, a flash of lightning, a forest fire, or through volcanic agency.

(*c*) Telluric or native iron.

We thus see that in using the nickelliferous meteoritic iron primitive man had the advantage of a metal that was not available to modern man until 1809, which is the approximate date at which nickel steel was first manufactured in the modern steel industry. G. F. ZIMMER.

SURVEY WORK IN THE SINAI PENINSULA.[1]

IN the latest volume of the Egyptian Survey Dr. John Ball describes the geology and geography of an oblong district about 380 square miles in extent, the south-west angle of which rests on the Gulf of Suez, the northern part of it including some of the Gebel el Tih. This is an intensely dissected limestone plateau of about Cretaceous age, rising to nearly 4000 ft., with northward-facing scarps. South of this comes an undulating sandy upland, about 1600 ft. above the sea, and then (forming about half the district) a highly eroded mountain tract, the highest point of which, Serabit el Khâdim, reaches 3596 ft.

This tract consists mainly of crystalline rocks—gneisses, granites, diorites, and porphyries—probably Archæan, capped in places with sedimentaries. Of these the oldest are two sandstones, parted by a limestone, which represent the Carboniferous system, and the latter is shown by its fossils to be homotaxial with the Mountain Limestone in the North of England. The Nubian Sandstone, some 2000 ft. in thickness, which is, roughly speaking, Cenomanian in age, succeeds the upper of these sandstones without any marked break, and its lower part, as it is almost unfossiliferous, may represent something older. In one district, however, it includes carbonaceous

[1] "Survey Department, Egypt. The Geography and Geology of West-Central Sinai." By John Ball, Ph.D., D.Sc., etc. Pp. xi+219+xxiv plates and 54 illustrations in the text. (Cairo: Government Press.) Price P.T. 30.

shale and a thin seam of coal, neither being of any value. The remainder of the Cenomanian, above the Nubian Sandstone, contains many fossils, and includes some beds of oil-bearing marls, not, however, valuable. The limestones above these represent the Turonian and Santonian, but are not nearly so rich in fossils as the underlying beds. Eocene strata succeed, chiefly clays, and to them sandy clays and grits representing the Miocene, both being fossiliferous; the coastal deposits are Pleistocene and Recent. The rather frequent dykes and sheets of basalt are probably Miocene, to a later part of which belong the numerous faults. In the neighbourhood of these the strata are often much tilted, but otherwise are not far from horizontal. In one district occur associated ores of iron and manganese, which are now being worked.

The climate is temperate, dry, and very healthy.

FIG. 1.—View of the "Seil" in Wadi Abu Qâda, February 14, 1913. From "The Geography and Geology of West-Central Sinai."

In winter the frequent north winds cause sharp frosts in the higher districts, but on the coastal lowlands it is often warm and misty. The rainfall is very slight, generally not more than an inch in a year. But a heavy rainstorm may occur every four or five years, when the water, running rapidly off the steeply sloping sides of the valley, gives rise to a sudden flood which sweeps everything before it. Dr. Ball was fortunate enough to secure a photograph showing the front of one of these torrents, of which Fig. 1 is a reproduction. One such flood in 1867 swept away an Arab encampment in Wady Soláf, drowning forty persons, with many camels, sheep, and cattle. But at other times the only sculpturing agents are wind-blown sand and strains set up in rock surfaces by changes of temperature, both, as Dr. Ball describes, of considerable importance. But it is scarcely possible that the deeply carved valleys can be the result of existing conditions; probably they were produced when the rainfall was much greater, its later part corresponding with an age of ice in our own islands, when a great lake occupied the Jordan valley.

There is, as a rule, little vegetation or animal life. Of what is found Dr. Ball gives particulars. In short, we are indebted to him for a very full and clearly written account of the geology, geography, and natural history of this part of the Sinai Peninsula, the value of which is enhanced by many illustrations—photographs of scenery, drawings of fossils, and a coloured geological map. Both he and the Survey may well be congratulated, especially in existing circumstances, on the publication of so excellent a memoir.

T. G. BONNEY.

THE PHYSIOLOGY OF FATIGUE.

ONE effect of the war has been to increase the strain thrown upon industrial workers as a result of longer working hours and insufficient holidays, and efforts are being made not only to counteract the ill-effects of extreme physical fatigue, but also to devise means for the recognition of fatigue and to study the conditions under which it occurs. The latter aspect of the question is dealt with by Prof. Kent in a report on industrial fatigue recently issued by the Home Office.[1] For this purpose Prof. Kent employed as tests of the occurrence of fatigue, in the first place, alterations in the length of the reaction time and in the visual and auditory acuity of the worker, and, in the second place, the influence of overtime upon the actual output of the worker. A number of workers were examined, the observations in some cases extending over several weeks.

The general conclusion drawn from the inquiry is that overtime—that is to say, a longer working day—leads to increased fatigue, this being manifested both by the physiological tests employed and by its effect upon the efficiency and output of the worker. The evidence furnished by the physiological tests is, however, quite unconvincing; not only do the figures obtained by these tests vary enormously from day to day, but in some instances the tests indicate that the workers are less fatigued in the evening than in the morning, and less tired after a long working day than after a short day. Further, the purely subjective character of these tests renders them liable to be influenced by many causes other than fatigue, and they appear to have little or no value as an index of general fatigue.

The observations on the effect of overtime upon the daily output of work are of interest because, in some instances, the output of the same workers was noted during weeks when overtime was worked and during weeks when no overtime was worked; the total output was unaffected

[1] Second Interim Report on an Investigation of Industrial Fatigue. By Prof. A. F. Stanley Kent. [Cd. 8335.] (Issued by the Home Office.) price 1s. 6d.

or even lessened by lengthening the working day. The author does not take into consideration, however, the view, now becoming recognised, that a worker with a long day before him tends, consciously or unconsciously, to conserve his energy and to distribute it uniformly throughout the day. It is not improbable, indeed, that the ill-effects of unduly long working hours may be not so much the direct result of a greater expenditure of energy as the indirect result of shortening of the time available for leisure and recreation.

NOTES.

LONG lists of New Year honours—mostly conferred for services rendered in connection with military or naval operations—were published on Monday. We notice in these lists the following names and distinctions:—*K.C.S.I.:* Sir Francis E. Younghusband, the distinguished traveller and geographer; Maj.-Gen. R. C. O. Stuart, Director-General of Ordnance in India. *C.I.E.:* S. M. Burrows, secretary to the Oxford Delegacy for Oriental Students; P. J. Hartog, lately secretary to departmental committees on the organisation of Oriental Studies in London. *Kaisar-i-Hind Medal for Public Services in India, First Class:* Sir F. A. Nicholson, Honorary Director of Fisheries, Madras; and Dr. H. H. Mann, principal, Agricultural College, Poona, and agricultural chemist, Bombay. The following medical men are among those on whom honours are conferred for services in the field:—*K.C.B.:* Surgeon-General H. R. Whitehead. *C.B.:* Col. J. M. Irwin, Col. R. L. R. Macleod, Col. G. Cree, Col. A. A. Sutton, Col. G. H. Barefoot, Temp.-Col. T. Sinclair, Lieut.-Col. E. T. F. Birrell. *K.C.M.G.:* Col. M. P. C. Holt. *C.M.G.:* Col. T. Daly, Col. W. L. Gray, Col. F. R. Newland, Col. H. T. Knaggs, Col. H. I. Pocock, Col. B. H. Scott, Col. R. W. Wright, Col. T. Du Bedal Whaite, Col. F. J. Morgan, Temp.-Col. T. C. English, Lieut.-Col. A. R. Aldridge, Lieut.-Col. J. D. Ferguson, Lieut.-Col. F. H. Withers, Lieut.-Col. F. R. Buswell, Lieut.-Col. L. F. Smith, Lieut.-Col. F. A. Symons, Temp.-Lieut.-Col. G. M. Holmes, Temp.-Lieut.-Col. H. L. Eason.

WHEN the Germans introduced the use of poisonous gases into warfare, immediate steps were taken by our military authorities to provide the troops with means of protection from them, and action was taken later to organise offensive as well as defensive measures. The matter was put into the hands of leading chemists, physicists, and physiologists, with the result that our gas attacks are now more effective than those of our enemies. Field-Marshal Sir Douglas Haig, Commanding-in-Chief the British Forces in France, makes the following reference to this subject in his despatch dated December 23, 1916:—"The employment by the enemy of gas and of liquid flame as weapons of offence compelled us not only to discover ways to protect our troops from their effects, but also to devise means to make use of the same instruments of destruction. Great fertility of invention has been shown, and very great credit is due to the special *personnel* employed for the rapidity and success with which these new arms have been developed and perfected, and for the very great devotion to duty they have displayed in a difficult and dangerous service. The Army owes its thanks to the chemists, physiologists, and physicists of the highest rank who devoted their energies to enabling us to surpass the enemy in the use of a means of warfare which took the civilised world by surprise. Our own experience of the numerous experiments and trials necessary before gas and flame could be used, of the great preparations which had to be made for their manufacture, and of the special training required for the *personnel* employed, shows that the employment of such methods by the Germans was not the result of a desperate decision, but had been prepared for deliberately. Since we have been compelled, in self-defence, to use similar methods, it is satisfactory to be able to record, on the evidence of prisoners, of documents captured, and of our own observation, that the enemy has suffered heavy casualties from our gas attacks, while the means of protection adopted by us have proved thoroughly effective."

THE Canadian Government has appointed an honorary advisory council on scientific and industrial research to advise a committee of the Cabinet on all matters relating to scientific and industrial research, with the view of securing the united efforts of scientific workers and industrial concerns, and of selecting the most pressing problems indicated by industrial necessities to be submitted to research institutions and individuals for solution. We learn from *Science* that the members of this advisory council are:—Dr. A. S. Mackenzie, president of Dalhousie University, Halifax, N.S.; Dr. F. D. Adams, dean of the faculty of applied science, McGill University; Dr. R. F. Ruttan, professor of chemistry, McGill University; Dr. J. C. McLennan, director of the Physical Laboratories, University of Toronto; Dr. A. B. Macallum, president of the Royal Society of Canada, University of Toronto; Dr. W. Murray, president of the University of Saskatchewan, Saskatoon; Mr. R. Hobson, president of the Steel Company of Canada, Hamilton, Ont.; Mr. R. G. Ross, consulting electrical engineer, Montreal; and M. Tancrède Bienvenu, manager of La Banque Provinciale, Montreal. The question of co-operation between the scientific men of the country and industrial concerns with the view of solving the problems raised by the war and of placing the industrial resources of the country in a position to meet the conditions that will arise after the war has been under consideration by the Government and by representatives of science and industry for some time, as it was felt to be desirable to follow the example of the British Government in this matter. In a memorandum Sir George E. Foster, Minister of Trade and Commerce, has pointed out "the urgent need of organising, mobilising, and economising the existing resources of scientific and industrial research in Canada with the purpose of utilising waste products, discovering new processes—mechanical, chemical, and metallurgical—and developing into useful adjuncts to industry and commerce the unused natural resources of Canada."

METEOROLOGY has lost one of its most ardent supporters by the sudden death of Mr. William Marriott at Dulwich on December 28. He was sixty-eight years of age, and throughout his life had been remarkably free from illness, but latterly heart trouble had developed. Mr. Marriott commenced his meteorological work at Greenwich Observatory in January, 1869, and he left the observatory at the end of 1871. Whilst at the Royal Observatory he was in the magnetic and meteorological department under Mr. James Glaisher, F.R.S., who was very actively associated with the Meteorological Society. Mr. Marriott became assistant-secretary to the Meteorological Society in 1872, and he maintained the position until his retirement in September, 1915, after forty-three years' service. He had become a member of the society whilst serving at Greenwich, in 1870. The science of meteorology has steadily developed during the last half-century, and Mr. Marriott, in his official capacity, took the keenest interest in furthering its advancement. From 1881 to 1911 he edited the *Meteorological Record*, which contained the monthly results of meteorological observations over England and Wales. For climatological questions the *Meteorological Record* has afforded material of great value. Since 1911 this work has been taken over by the Meteorological Office. Mr. Marriott was the author of "Hints to Meteorological Observers," a work which constitutes instructions for taking observations, also "Some Facts about the Weather." He was a frequent writer for the Quarterly Journal of the Royal Meteorological Society, his contributions dealing with many and very varied subjects.

LIEUT.-COL. SIR FREDERIC S. EVE, who died on December 15, in his sixty-third year, was at one time senior surgeon to the London Hospital. In the earlier part of his career, while acting as curator of the museum of St. Bartholomew's Hospital and pathological curator to the museum of the Royal College of Surgeons of England, he investigated certain obscure forms of tumour which are apt to occur in the jaws, and cleared up their nature. He published several investigations on tuberculosis and other diseases of bones and joints. In 1915 he gave the Bradshaw lecture at the Royal College of Surgeons on "Hæmorrhagic and Chronic Inflammation of the Pancreas."

ON November 27 the Finnish entomologist, Dr. B. R. Poppius, died at Copenhagen, where he was acting upon the Norvego-Swedish Committee on the Grazing-grounds of Reindeer. He was only forty years old.

THE death is announced, in his eightieth year, of Dr. J. Little, Regius Professor of physic, Dublin University, and a past-president of the Royal College of Physicians, Ireland, and of the Royal Academy of Medicine, Ireland.

THE Royal Swedish Academy of Science has elected as foreign members Sir William Crookes, O.M., Dr. C. A. Angot, director of the Bureau Central Météorologique de France, and Prof. August Gärtner, professor of hygiene, University of Jena.

IT is announced that the Welsh National Museum Committee has received a gift of 20,000*l.* from anonymous donors, and that this will enable the committee to complete the building contract.

CAPT. CHARLES BATHURST, M.P., has, on becoming Parliamentary Secretary to the Ministry of Food, relinquished the post of organiser of the Land Settlement Scheme for ex-Service Men which he has held under the Board of Agriculture and Fisheries in an honorary capacity for the last eight months. The duties have been taken over by Sir Richard Winfrey, M.P., Parliamentary Secretary to the Board of Agriculture and Fisheries.

THE Massachusetts Horticultural Society has awarded its George Robert White medal to Mr. W. Robinson, of Gravetye Manor, Sussex, for his eminent services in the advancement of horticulture.

IT is announced in the issue of *Science* for December 15 last that a bequest of more than 20,000*l.* has been left to the American Museum of Natural History by the late Mr. James Gaunt, American representative of Messrs. A. and F. Pears, of London. The bequests are to be paid upon the death of Mr. Gaunt's brother.

THE Optical Society has arranged an exhibition of workshop methods of optical testing to be held at King's College, Strand, on Thursday, January 11, from 5 to 9.30 p.m.

THE Alvarenga prize of the College of Physicians of Philadelphia will be next awarded on July 14 of this year. It will be of the value of about 50*l.* Competing papers may deal with any medical subject, but they must not have been already published. They must reach the secretary of the college on or before May 1. Further particulars are obtainable from Dr. F. R. Packard, 19 South 22nd Street, Philadelphia, Pa., U.S.A.

A METEOR of unusual brilliance is reported to have been seen at Churchstoke, in Montgomeryshire, about 5.30 p.m. on December 19 last. It crossed the sky from south to north, and is said to have been "accompanied by a slight explosion." Many people were alarmed by the brilliance of the object, which lighted up the whole countryside.

THE report of the council of the Scottish Meteorological Society, read at the general meeting of the society on December 15, states that the encouragement of rainfall observation in Scotland has been kept steadily in view, and that there are now available in the journal monthly and annual returns for fully 750 stations. There are still, however, large areas in the North of Scotland for which information is either extremely scanty or entirely wanting. The officers and members of the council for the ensuing twelve months will be as follows:—*President*, Prof. R. A. Sampson; *Vice-Presidents*, Dr. A. Crichton Mitchell and Mr. M. M'Callum Fairgrieve; *Council*, Mr. J. Watt, Sir R. P. Wright, Prof. T. Hudson Beare, Dr. J. D. Falconer, Mr. J. Mackay Bernard, Mr. D. A. Stevenson, Mr. R. Cross, Mr. S. B. Hog, and Mr. G. Thomson; *Hon. Secretary*, Dr. E. M. Wedderburn; *Hon. Treasurer*, Mr. W. B. Wilson.

THE American Forestry Association has called a conference, to be held at Washington on January 18–19, to discuss measures for saving the white pine forests of North America from being destroyed by the blister rust. The Governors of all the States in the white pine belt, and the Government of Canada, are invited to appoint delegates. The disease came from Germany in 1907, when the Forestry Bureaux of several States imported thousands of seedlings and transplants from the nurseries of that country. That they were thus affected was not discovered until many of the trees had been set out, and only during the last year did the disease attain dangerous proportions. The blister rust is described as a fungous growth, which lives one year in the white pine and the next in currant and gooseberry plants. It cannot spread from pine to pine, but travels from pine to ribes and from ribes to pine. In the ribes it appears in the form of raised reddish-brown patches on the under-side of the leaves. In the pine it is more difficult to recognise, and can only be discovered by a scientific expert during the "fruiting period" in the spring, when the base of small trees just above the ground shows a yellowish growth of fungus and is often itself swollen. At present the only effective method of saving the pines that has been suggested is to root out all ribes in the neighbourhood of the forests—a costly remedy in some parts of New York State, where the farmers raise large crops of currants and gooseberries. Mr. G. D. Pratt, the New York State Conservation Commissioner, has announced that no more white pines will be seeded until it has been found what can be done.

IN the *American Museum Journal* for November Mr. M. D. C. Crawford discusses the value of design and colour in ancient fabrics to the manufacturer of our day. The Philadelphia Museum has recently obtained a collection of textiles from Peruvian graves which are believed to antedate the Spanish Conquest by some 2000 years. They are said to contain some of the most wonderful colour combinations in any fabrics hitherto known. Compared with them, we are told, "the Coptic fabrics represent a very limited development, and even the interesting cloths recently excavated in Turkestan by Sir Aurel Stein are but a fragmentary record of the art they represent. In Peru every process of decoration of which we know is found, every trick of the weaver's art, every skilful blending of colours. Nor is this a record of scattered fragments. Even the rarer techniques are well represented, and there is enough material to furnish inspiration for a century of design." The article contains good photographic reproductions of these interesting fabrics.

DR. W. E. ROTH contributes to the thirtieth annual report of the Bureau of American Ethnology a comprehensive paper on the animism and folklore of the Guiana Indians, of which the best hitherto known accounts are those of Brett, im Thurn, and Wallace. He finds no evidence of a belief in a Supreme Being, but the Spirits of the Bush are held in great respect. He describes a remarkable Carib String Puzzle, designed to deceive these Bush Spirits, the object being to remove, without cutting or breaking, an endless string from two sticks upon which it has been placed. If an Indian loses his way in the forest, the Spirit is the cause. So he leaves this puzzle on a pathway, and the Spirit, passing by, sees it, starts examining it, and tries to get the string off. So engrossed does he become that he forgets all about the wanderer, who is now free to find the road again. Brett describes an analogous case of a boy on the Lower Amazon, who, in order to protect himself from the Curupari, took a young palm-leaf, plaited it, and formed it into a ring, which he hung on a branch in the track of the party.

THE American Museum of Natural History, New York, continues to make good progress with the preparation and study of the remarkable Dinosaurians discovered in the Upper Cretaceous fresh-water deposits of Alberta, Canada. In the latest *Bulletin* (vol. xxxv., art. 38) Mr. Barnum Brown describes perhaps the strangest of the Trachodonts, *Corythosaurus casuarius*, which is a reptile about 20 ft. long, shaped much like the familiar Wealden Iguanodon, but with a high, rounded, bony crest along the top of its head. One well-preserved skeleton is covered with remains of the skin, proving that it did not bear any bony armour. The whole body must have been invested with small epidermal tubercles, which are without any definite pattern over the sides, back, and tail, but are partly modified into rows of larger limpet-shaped tubercles over the ventral surface. If these herbivorous Dinosaurs had any marked external features, it is now clear that they must have been due to colour rather than to special developments of the skin itself.

PROF. S. W. WILLISTON, of the University of Chicago, continues his important researches on the osteology of American Permian reptiles, and has just published a useful synopsis of all the American Permo-Carboniferous Tetrapoda (Contributions from the Walker Museum, vol. i., No. 9). The various families are defined, and the diagnosis of each genus is accompanied by a statement as to the parts of the skeleton by which it is known. There is still much difficulty in defining and naming the higher groups, owing to the discovery of intermediate forms and the imperfection of the fossils on which the nomenclature was originally based. It becomes, indeed, continually more evident that the Permo-Carboniferous Tetrapoda are the generalised forerunners of several later groups which soon became very distinct. Prof. Williston's work is illustrated by numerous excellent figures, from which it is possible to realise how many of these strange ancestral land animals are now known by nearly complete skeletons.

THE Carnegie Institution of Washington has just published an important monograph of the Coal Measures Amphibia of North America, by Dr. Roy Lee Moodie (Publication No. 238). It is a most exhaustive work, sumptuously illustrated, and not only adds much to our knowledge, but also provides a synopsis which will form a useful basis for future researches on the rare fossils with which it deals. The technical and descriptive part of the monograph is preceded by a historical sketch, notes on the localities whence the fossils were obtained, and a general chapter on the anatomy of the group. Many forms were discovered by the late Sir J. William Dawson in decayed tree-stumps in the South Joggins coalfield, Nova Scotia, but the author remarks that no geologist appears to have collected in this locality during recent years. Other specimens in ironstone nodules from Mazon Creek, Illinois, are so beautifully preserved that the black pigment of the choroid can be seen in the orbit, and the course of the alimentary canal may be traced in the trunk, arranged almost exactly as in a modern salamander. The whole of the ossified skeleton is well known in many families, and dermal scales occur in several genera of the Branchiosauria and Microsauria. There is remarkable uniformity in the structure of all these early four-footed animals, notwithstanding the numerous variations in general outward shape and the relative proportions of parts. Some are even so much specialised as to have lost their limbs and become snake-like.

WHILE some animals exhibit wide powers of accommodation to their environment, and hence are numerically abundant, others display very limited responses in this regard, and hence are restricted in numbers. This is well illustrated by Miss Maud Haviland in *British Birds* for December, in the course of a brief but illuminating account of her observations on Temminck's stint, made during her stay at Golchika, on the estuary of the Yenisei. For miles along the river bank not a specimen would be seen, but it was abundant wherever running water and dwarf willow were found in association. Similarly, she found the little stint, *Tringa minuta*, breeding near running water only when this occurred in association with a sphagnum swamp. During the pairing season Temminck's stint gives utterance to a long-sustained trilling, which "is musical enough to deserve the name of song." It is "louder and less mechanical than the note of the grasshopper warbler, more musical than the whir of the fisherman's reel, and may be likened more truly to the croaking of many natterjack toads in chorus." This song is heard at its best when the bird hangs suspended some 40 ft. in the air, but it is also uttered while it is perched on a tree-trunk or on a block of ice. But on such occasions the trill is less perfect.

THE new part of the Proceedings of the Prehistoric Society of East Anglia (vol. ii., part ii.) contains several papers on flint implements illustrated in the usual effective manner, besides two important discussions of the wider problems of British late Tertiary geology. Mr. A. E. Peake, in a presidential address, returns to the subject of Grime's Graves, and after describing and figuring a considerable number of newly discovered implements from these old flint mines, reiterates his opinion that they are all of Palæolithic type. He thinks their date would never have been doubted had they not been associated with a mine and a recent fauna. Mr. W. J. Lewis Abbott, in a rather discursive paper, claims that both marine and fresh-water deposits of Pliocene age are much more widely distributed in south-east England than is commonly supposed to be the case. The late Mr. Charles Dawson's discovery of rolled remains of Pliocene mammals at Piltdown makes it especially desirable to re-examine all the superficial deposits in the Wealden area. Mr. A. S. Kennard contributes an important summary of the results of his long-continued researches in English Pleistocene geology. He concludes that there is no evidence of more than one glacial period, which occurred towards the close of the Pleistocene, and is represented near London by the Ponders End arctic bed. He is also of opinion that before the end of Pliocene times man was already in the Palæolithic stage of culture in this country.

THE recently published Bulletin of the Imperial Institute (vol. xiv., No. 3) contains a brief but highly interesting description of the new Udi-Okwogu coalfield of Southern Nigeria, which is now being energetically developed. It lies immediately to the east of the River Niger, and has been opened by means of a railway line running northwards from Port Harcourt, which has already reached the coalfield and is being continued. The coal is of Cretaceous age, and a number of seams, up to six in the Udi district, have been proved; four of these are considered workable, with thicknesses ranging from 2 ft. to 5 ft. 8 in. The coal is semi-bituminous, and contains a high proportion of volatile matter, averaging about 40 per cent. on the ash-free coal. The percentage of ash varies within very wide limits; in many of the samples it is between 4 and 8 per cent., but is very much higher in some of the others; the coal is everywhere of a non-coking character. The calorific power is, of course, variable, but not very high as a rule, most of the samples giving 6000 to 7000 calories. A certain amount of development work has already been done, the quantity produced up to the end of 1915 having been 7812 tons. It is unnecessary to point out that this discovery is of the highest economic importance, and will necessarily prove to be a factor of the utmost value in the industrial development of our West African Colonies.

AN informing lecture on the subject of "The British Coal-Tar Colour Industry and its Difficulties in Time of War" was delivered at the Society of Arts on December 8 by Mr. C. M. Whittaker, head of the experimental dye-house of British Dyes, Limited. The lecturer replied to the criticism directed at British dye-producers for not assisting dye-users with pattern cards and expert advice in dye practice by referring to the manual of dyeing issued in five languages so far back as 1906 by Messrs. Read Holliday and Sons, Ltd. He also pointed out the difficulty of producing dyes of well-known constitution owing to the circumstance that the primary coal-tar products essential in this manufacture are required for the production of high explosives. In war-time the first duty of the coal-tar industry is to furnish the munitions of war, after which the next important task is the production of colours needed for the military and naval equipments of the British, Colonial, and Allied Governments. That these requirements have been satisfied is a great achievement, which should be remembered by the private dye-users, whose demands necessarily take a third place. The lecture deals with other shortages of raw materials, and shows how very promising has been the progress of the British dye industry in spite of these numerous handicaps. Notwithstanding all these adverse circumstances, the shares of leading colour-consuming companies in this country have appreciated considerably during the war, and the dyeing trade has never been so prosperous. Continued progress depends on the highly trained chemist, and research is now being organised on a scale never before attempted in Great Britain. One of the first-fruits of this endeavour is the production of chloranthrene-blue, made by British Dyes, Limited. In the discussion, the chairman, Sir William Tilden, referred to the encouraging outlook to be derived from the lecture. In replying to various questions the lecturer stated that bromine was the only product for which we should have to depend on Germany. The dye-makers had now mended their ways in regard to teaching institutions, and the grant of 5000*l.* for dye research by British Dyes, Limited, to the Huddersfield Technical College was a practical proof of this. As regards khaki dyes, the British productions were equal in fastness to any dyes made abroad.

IN 1913 the Rubber Research Committee in Ceylon, in co-operation with the Department of Agriculture in the Colony, started a scheme of research work, to be carried out partly on plantations in the island and partly at the Imperial Institute in London. The work in Ceylon includes the preparation of rubber in various ways and under different conditions, with the view of ascertaining the effect of the several factors on the quality of the rubber. The samples so prepared are sent to the Imperial Institute, where they are chemically examined, vulcanised, and their mechanical properties determined. Some results of this work are described in Bulletins 23 and 24, issued recently by the Department of Agriculture in Ceylon, which contains a number of interim reports from the Imperial Institute. It appears from these reports that as regards tensile stress required to rupture and elongation at the point of rupture, well-prepared Ceylon plantation rubber is in no way inferior to "fine hard Para" rubber from Brazil. The variability in properties of plantation rubber of which manufacturers have complained appears to be limited to the "time of vulcanisation," which, according to these reports, may vary within wide enough limits to cause trouble in the smooth working of a factory. The cause of this variation is being systematically sought by a careful study of the effects of various coagulants, "improvers," mechanical treatment, etc., employed in the process of preparation, on the working quality of the rubber, and especially on its "time of vulcanisation." Attention is also being given in Ceylon to the experimental tapping of Hevea trees. In Bulletin No. 25 Mr. Petch gives a further instalment of the results of this work, which has been in progress since 1912, and is designed to ascertain the difference in yield and the final effect on the trees of methods of tapping, which differ in the time interval allowed for resting the trees and in the spacing adopted between the tapping cuts. The results already obtained are of considerable interest, but do not permit of final conclusions being drawn.

THE practical value of the storm warnings issued by the Meteorological Department at Calcutta has twice been illustrated within the past two months, says the *Pioneer Mail* of December 2 last. Madras had due notice of the approach of the gale which visited it on November 29, the "Great Danger" signal having been hoisted a considerable time before the arrival of the storm. Similarly the hoisting of the "Great Danger" signal warned Calcutta of the approach of the storm of September 21, and the Committee of the Bengal Chamber of Commerce has publicly expressed its appreciation of the "usefulness and efficiency" of the work of the Meteorological Department on that occasion. "The warnings," it states, "were communicated to the public in good time before the storm actually broke, and proper precautions were consequently taken. The result was that the casualties to shipping were confined to a few launches and boats, no large vessels being sunk or damaged."

OUR ASTRONOMICAL COLUMN.

COMET 1915*a* (MELLISH).—A postcard from the Copenhagen Observatory gives the following ephemeris for comet 1915*a*. for Greenwich mean midnight:—

	R.A. h. m. s.	Decl. ° ′	Log Δ
Jan. 1	5 17 31	+43 4·1	0·7406
9	11 34	42 59·8	0·7502
17	6 28	42 51·8	0·7610
25	2 16	42 41·2	0·7726
Feb. 2	4 59 5	42 29·0	0·7848
10	56 53	42 16·2	0·7975
18	55 40	42 3·7	0·8103
26	55 23	41 52·0	0·8231
Mar. 6	4 55 59	+41 41·3	0·8357

The estimated brightness of the comet is from the 14th to the 15th magnitude. At the time of discovery, on February 10, 1915, the comet was of the 9th magnitude, and became visible to the naked eye during the following summer.

ROTATION AND RADIAL VELOCITY OF N.G.C. 4594.—At the Mount Wilson Observatory an ingenious device has been employed by Mr. F. G. Pease to facilitate spectroscopic investigations of motion in faint nebulæ (Proc. Nat. Acad. Sciences, vol. ii., p. 517). In this arrangement a silvered glass plate replaces the ordinary slit, and a slit is cut in the silver film at a place corresponding to each bright spot shown in a direct photograph of the nebula to be investigated, taken with the telescope to which the spectroscope is to be attached. The slits, of course, are chosen so as to prevent overlapping. For the comparison spectra another silvered plate is prepared, but with interrupted cuts, so that the central portions cover the parts previously exposed to the nebula when the comparison spectra are impressed. In view of the long exposures required, great economy of time is thus secured. Mr. Pease has successfully employed this arrangement on the spiral nebula N.G.C. 4594, for which a total exposure of eighty hours was given. It was found possible to determine the velocity at five places in the nebula, and the values are represented by the equation $y=-2{\cdot}78x+1180$, where y is velocity in km./sec. and x the distance from the nucleus in seconds of arcs. The radial velocity of the nebula is +1180 km./sec., while the rotational velocity at a point two minutes of arc from the nucleus is more than 330 km. Within the limits of error the rotational velocity increases linearly in passing from the nucleus, indicating that the nebula is rotating as a solid body, or, as seems more probable, that the material is moving in accordance with a law which will give a linear velocity curve. On certain suppositions the parallax would be 0·00013″. In observations of such exceptional difficulty it is satisfactory to find a close accordance with the velocity +1100 km. given by Slipher for this nebula.

THE COOKEVILLE METEORITE.—A recently found iron meteorite, from Cookeville, Putnam County, Tennessee, is described by G. P. Merrill in the Proceedings of the U.S. National Museum (vol. li., p. 325). The meteorite is obviously very old, and so much oxidised that its original form is greatly obscured. The weight before cutting was 2132 grams. A cut surface shows an unusual feature in its very regular octahedral coarse crystallisation. Practically the entire mass is made up of broad kamacite bands 2 to 6 mm. in width, between which lie very thin plates of taenite. The total iron, of which nearly 20 per cent. occurs as oxides, is 81 per cent., while nickel amounts to 6 per cent. in the metallic form and 1 per cent. as oxide. Cobalt, phosphorus, sulphur, and carbon are present in small quantities.

THE PYROGENESIS OF HYDROCARBONS.

THE growing demand for low-boiling paraffins for use as fuel, and aromatic hydrocarbons for the manufacture of dyes and other materials, is directing increased attention to the possibilities of their synthetic production from natural sources, namely, the higher-boiling paraffins, coal and shale. It is well known that the superheating of the higher-boiling paraffins causes them to break up, or "crack," into lower-boiling liquids, and the effect of temperature on the nature of the distillation products of coal has long been recognised.

In a paper read before the Institution of Petroleum Technologists on November 21 the authors, Messrs. E. L. Lomax, A. E. Dunstan, and F. B. Thole, brought together not only a valuable bibliography of the literature on the subject (part i.), but, in the latter section (part ii.), also discussed in a comprehensive way the scientific aspects of this obviously complex process, and the various theories advanced by different workers in this field of inquiry.

The earliest systematic study of "pyrogenic decomposition" (*i.e.* decomposition at high temperatures) of hydrocarbons was initiated by Berthelot, who regarded the change as due either to simple polymerisation or condensation with loss of hydrogen. Moreover, each change being reversible, at a given temperature an equilibrium was established between a complex series of decompositions, polymerisations, and condensations. Among the decomposition products acetylene was assumed to play an important *rôle* and to be the source more especially of aromatic hydrocarbons. Berthelot, in fact, obtained the latter by heating acetylene to a dull-red heat. Later observers have opposed this view on the ground that the presence of acetylene could not be demonstrated, and as an alternative suggested that hydrogen was first eliminated with the production of olefine and that the carbon chain was broken down atom by atom as methane.

From a careful series of experiments on the thermal decomposition of methane, ethane, ethylene, and acetylene by Bone and Coward, it appeared that acetylene was the source of aromatic hydrocarbons, and was derived from the decomposition of ethylene. This polymerisation of acetylene takes place at 600°–700°. At these high temperatures the "nascent radicals," $CH\equiv$, $CH_2=$, and CH_3-, are assumed to be formed, and either unite or, if hydrogen is present, undergo reduction.

The authors of the present paper proceed to discuss the possible changes which may occur based on thermochemical data, and point out that the reactions which proceed by absorption of hydrogen are in the main exothermic, and the products, therefore, relatively stable, whereas cracking or decomposition is mainly the result of endothermic change Now, according to the law of Le Chatelier, an exothermic synthesis will, at a high temperature, tend to be reversed, and the same is true of increased pressure, the tendency here being to bring about, under increased pressure, that change which diminishes the total volume of gaseous products.

That the process of cracking is necessarily complex is easily realised when the nature of the material, and especially the temperature conditions, are considered; for an exothermic reaction which may occur at low temperatures may very well be replaced by an endothermic one at a higher temperature with a complete change in the nature of the products. Thus, at moderate temperatures up to 500° the tendency is for the formation of a mixture of paraffins and olefines, whilst at about 700° the effect is the generation of aromatic hydrocarbons. The effect of temperature has been well illustrated in the experiments made on ethane, coal, and isoprene.

According to the authors "the thermal decomposition of petroleum into aromatic compounds occurs at temperatures considerably in excess of those needed for simple cracking, and in consequence much more serious losses occur in the shape of carbon and fixed gases. Paraffin hydrocarbons at these temperatures are almost completely decomposed. The desired products are not the primary results of cracking; they are obtained from them by further decompositions and synthesis. Accompanying them are other characteristic bodies, usually classed under the heading of unsaturated hydrocarbons, but which are far more reactive than the simple olefines. . . . Summing up, therefore, the effects of temperature on petroleum may be said to be: (1) temperatures up to 500°–600° yield in the main mixtures of olefines and paraffins; (2) temperatures about 700° yield a mixture of olefines, diolefines (*e.g.* butadiene), and aromatic hydrocarbons, with little paraffins: (3) temperatures about 1000° yield mainly permanent gases and a tar similar to coal-tar, in that they both contain aromatic hydrocarbons."

The effect of pressure on cracking appears in general terms to be that increased pressure favours synthesis, whilst diminished pressure promotes dissociation.

A very interesting development in the thermal decomposition of hydrocarbons is the effect of catalysts. Moissan first observed the production of liquid hydrocarbons (among them being benzene) by the contact of acetylene with metals, and in the well-known method of reduction of Sabatier and Senderens finely divided nickel, cobalt, iron, and other metals have been employed with and without hydrogen with very noteworthy results. Acetylene on reduction in presence of nickel yields both paraffins and cycloparaffins in proportion resembling Baku, Galician, and Pennsylvanian petroleum. Coke also behaves as a catalyst.

At the end of this very informing paper the authors give a summary of the mechanism of pyrogenesis, which does not admit of abbreviation, and is too long for reproduction. Those who are interested in the subject will feel that the authors have accomplished an important service to the coal-tar and petroleum industry in presenting to the public at such an opportune moment this valuable and exhaustive memoir.

J. B. C.

METALLIC TUNGSTEN POWDER AND HIGH-SPEED STEEL.

ONE of the most successful of the manufactures which have been established in this country by reason of the war is that of metallic tungsten. This metal occurs naturally in the form of oxide, together with the oxides of iron, manganese, and calcium. Pure tungsten powder is obtained by first isolating the tungstic oxide and then reducing it, whilst ferro-tungsten is obtained by reducing the mixed oxides. For the production of the best high-speed steel metallic tungsten powder is necessary, because ferro-tungsten contains impurities which are eliminated only when the process of separating the tungstic oxide from the ore is employed. Before the war almost all the pure tungsten powder was supplied by Germany, whilst ferro-tungsten was manufactured in France and, on a small scale, in this country. On the declaration of war only a limited stock of tungsten existed in this country, whilst the necessity for a large output of high-speed steel was urgent. The way in which it was supplied is described in an article in the *Chemical Trade Journal* for December 9.

An inquiry instituted by the Government showed that a factory for the production of metallic tungsten powder was essential. The Committee of High-Speed Steel-Makers, which took the matter in hand, recommended the engagement of the services of Mr. J. L. F. Vogel, and a company (High-Speed Steel Alloys, Ltd.) was formed, in which thirty firms manufacturing high-speed steel became shareholders. A site chosen at Widnes was taken over in November, 1914, and building was sufficiently advanced in July, 1915, for the commencement of production. The factory, which occupies a site of about six acres, is divided into eight departments. The first department comprises a warehouse for the storage of the ore, grinding and mixing plant, and the magnetic separator. The second department contains furnaces for roasting the mixed ore with soda, whereby all the tungsten is converted into sodium tungstate. In the third department the furnace product is broken up and conveyed automatically into the next department, where it is extracted with boiling water. The solution of sodium tungstate passes to the fifth department, where it is treated with acid. The resulting yellow tungstic oxide is dried in the next department, and prepared for reduction. The seventh department contains the furnaces for heating the crucibles to reduce the tungsten. The metal is washed and dried in the last department. The product has contained on an average 98·5 per cent. pure tungsten, which is one per cent. better than the German product.

The Government took control of all wolfram ore in the British Empire on September 1, 1915, but the amount being insufficient to meet the full demand, the High-Speed Steel Alloys Co., to improve the output, has purchased mines in Burma, and has sent out Dr. W. R. Jones, formerly of the Indian Survey, to take charge of operations.

EDUCATIONAL CONFERENCES.

AT the opening meeting of the Conference of Educational Associations, the chairman, Sir Henry Miers, directed attention to the wide interest aroused of late in educational questions, and laid down three lines of general agreement: continued education beyond fourteen, an improvement in the position and prospects of teachers, and a reorganisation of the scholarship system. We need to promote in young people a desire for further education and the power to carry it on, and to provide facilities for the exercise of that power. Mr. A. L. Smith, the Master of Balliol, in his inaugural lecture, struck a similar note. That all recently published programmes of reform should be working in the same direction, that so many suggestive experiments in the psychology and practice of education should be in progress, and that so wide an interest should have been aroused among workers, employers, and business men he regarded as very hopeful signs. As head of a great Oxford college he welcomed the controversy between classics and science, and expressed the opinion that much of the old curriculum should be discarded, that no one could be considered fully educated who was ignorant of the processes, standards, and history of natural science, and that it was possible to give a general scientific training which should provide useful equipment and valuable mental exercise for all. It would be both feasible and beneficial for science to enter into all early education, with specialisation later where aptitude was shown. Public opinion has not yet put the teacher in his right place, or rewarded him sufficiently, yet only so can we foster the power for development and heroism latent in the ordinary man. Educational methods have great influence on the efficiency and contentment of workers, and a great modern commonwealth needs at its centre a democracy which shall be intellectually, socially, and morally educated.

The Headmasters' Conference, which is held annually at some school or college, met at Rugby School on December 21–22. About 110 schools—including all the great public schools—are represented by the Conference. Among the conditions under which a school may be represented are that it contains 100 boys, counts at least ten among the undergraduates of Oxford and Cambridge, and sends to these universities an average of five or six boys each year. Particulars of the schools admitted to representation are given in the "Public Schools Year Book." At the recent meeting of the Conference held at Rugby the following resolutions were passed, among others:—

1. That this Conference welcomes the letter with regard to war memorials sent to headmasters in the early autumn by H.R.H. the Prince of Wales, as the chairman of the Statutory Committee, and endorses the suggestion that provision of scholarships and exhibitions should form part of the measures taken at public schools to commemorate the fallen.

2. (*a*) That it is essential to a boy's general education that he should have some knowledge of the natural laws underlying the phenomena of daily life, and some training in their experimental investigation. (*b*) That, in the opinion of this Conference, this can best be ensured by giving to all boys adequate courses of generalised science work which would normally be completed for the ordinary boy at the age of sixteen. (*c*) That, after this stage, boys who require it should take up science work of a more specialised type, while the others should for some time continue to do some science work of a more general character.

3. That, while desirous of improving the teaching of science and making it a reality in all public schools, this Conference deprecates the present proposals of the Oxford Hebdomadal Council for making the passing of an examination in science an essential qualification for an Oxford degree.

4. Board of Education Circulars 849, 933, and 956. That this Conference approves the general educational policy indicated by these circulars, and in particular the principles:—(*a*) That all boys in secondary schools should pursue a normal course of education up to the age of about sixteen, unimpaired by premature specialisation and unimpeded by the varying demands of external examinations. (*b*) That the universities should continue to be the responsible examining authorities in secondary schools, but holds that no further compulsion or restriction of any kind can be usefully applied to schools until a general acceptance of an approved "first examination" by universities and professional bodies has been secured. If in any case acceptance is only conditional, the conditions must be of the simplest kind, and a clean sweep must be made of the present absurd complexities. In the details of the proposed first and second examinations there are many points calling for further discussion, and two only will be mentioned in the present resolution:—(i) The Conference holds that natural science and mathematics should count as two "groups," not as one only; (ii) it adheres to the view expressed in Circular 849, section VI., regarding such subjects as music, drawing, manual work, and housecraft, to which may be added physical exercises. It is as far as possible from undervaluing such subjects as essential parts of a good education, but believes that their adequate inclusion can be better secured in other ways than by formal examination at the age of sixteen.

5. That this Conference reaffirms its conviction that Greek ought no longer to be retained as a compulsory subject in the Entrance Examinations to the Universities of Oxford and Cambridge. In urging this, the Conference in no way wishes to deny that for those boys who are fit for it there is no finer educational instrument than Greek, nor that there are other compulsory subjects which are open to grave objections.

THE U.S. NATIONAL RESEARCH COUNCIL.

IN the Proceedings of the National Academy of Sciences for October a report is given of the first meeting of the National Research Council, held in New York City on September 20 last. Dr. G. E. Hale was unanimously elected permanent chairman.

Dr. Hale, as chairman of the organising committee of the council, announced an agreement between the National Academy of Sciences and the Engineering Foundation by which the foundation has placed its funds at the disposal of the council for a period of one year, and has given the services of its secretary, Dr. Cary T. Hutchinson, to the National Research Council, to serve as its secretary. Dr. Hale announced that in accordance with this agreement the National Academy of Sciences has appointed Dr. Hutchinson secretary of the National Research Council.

Later in the meeting Dr. Pupin emphasised the great value of co-operation in industrial research, as evidenced by the work of the Research Laboratory of the General Electric Company, and spoke of the difficulty in securing men adequately trained. Dr. Noyes urged the need that universities and colleges should interest more men in research work and train them more effectively. Dr. Carty pointed out that industrial research has as its objective commercial development, and that scientific research has no such immediate purpose. Dr. Vaughan believed that much good could be done by the council in stimulating the Congress of the United States to make larger grants to help pure science. Mr. Manning explained the assistance given to the U.S. Bureau of Mines by the great chemical and smelting companies, and suggested similar assistance for pure scientific research.

After an adjournment for dinner, Mr. Rand dwelt upon the essential need of co-operation with the great industrial research organisations, instanced the assistance that the research laboratories of the U.S. Steel Corporation had rendered to the Institute of Mining Engineers, and expressed the belief that the co-operation of the U.S. Steel Corporation with the Research Council could be secured. Mr. Herschel pledged the support of the American Society of Civil Engineers, and Mr. Dunn explained the relations of the Engineering Foundation with the council.

Two meetings of the Executive Committee were held in New York on September 21 and 29. At the first meeting it was resolved that the efforts of the Research Council shall be uniformly directed to the encouragement of individual initiative in research work, and that co-operation and organisation, as understood by the Research Council, shall not be deemed to involve restrictions or limitations of any kind to be placed upon research workers.

The following resolution was adopted, inviting the American Association for the Advancement of Science to co-operate with the Research Council:—"That the American Association for the Advancement of Science be informed that the National Research Council has been organised by the National Academy of Sciences at the request of the President of the United States for the purpose of bringing into co-operation existing governmental, educational, industrial, and other research organisations, with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defence, and such other applications of science as will promote the national security and welfare, and that the association, which has itself established the Committee of One Hundred on Research, be invited to co-operate with the Research Council in the promotion of research, and that to this end it be asked to appoint a committee of three to meet with a similar committee of the Research Council to consider how such co-operation can be made most effective."

Among the committees appointed by the Executive Committee may be mentioned those on Research in Educational Institutions, on Promotion of Industrial Research, and on a National Census of Research.

It was agreed that joint committees on research in various branches of science be formed in co-operation with the corresponding national scientific societies.

In addition to the officers mentioned, Dr. C. D. Walcott and Dr. Gano Dunn have been appointed vice-chairmen of the council.

MINERAL RESOURCES OF THE BRITISH EMPIRE.

A PAPER on "The Mineral Resources of the British Empire with regard to the Production of the Non-Ferrous Industrial Metals," by Dr. C. Gilbert Cullis, professor of economic mineralogy in the Imperial College of Science and Technology, was read before the Society of Engineers on December 11.

The particular metals dealt with were copper, lead, zinc, tin, and aluminium. The object was to demonstrate the Imperial position with regard to each of these, and to show in respect of which of them the Empire was, on one hand, self-sufficing, or, on the other, dependent upon foreign countries. In the latter case the extent of the dependence was indicated, and methods suggested by which it might be diminished.

The situation with regard to four out of the five metals was shown to be wanting in independence and security, and the necessity for a full investigation of the British mine- and smelter-production was insisted upon.

With regard to copper, not only were the ore resources, as at present exploited, deficient, but the smelting facilities also were seriously inadequate for the Empire's metal requirements. The production both of ores and metal could be substantially increased by suitable organisation and administration.

Lead and zinc ores, raised in British territory, had in the past been exported on a large scale to foreign countries, notably Germany and Belgium, for metal recovery, with the result that the Empire had been placed in an anomalous position of dependence which ought never to have arisen. The shortage of zinc, in the early days of the war, and the consequent jeopardising of supplies of cartridge-brass were referred to. The mine-production of lead and zinc was more than sufficient for the Empire's requirements, but the smelting facilities were lamentably deficient, especially in the case of zinc. It was urged that all the lead and zinc concentrates of Broken Hill should in future be smelted within the Empire.

In the case of aluminium, while the actual bauxite resources of the Empire were so small that dependence had to be placed upon the French or American deposits —which were being more and more utilised in their countries of origin—large potential supplies, in the form of laterite, had a very wide distribution in the tropical colonies, but were almost untouched and untried. The systematic examination of these and other potential sources of aluminium, with a view to their utilisation, was seriously needed.

The only metal with regard to which our position was really strong was tin. The British mine-production of tin in 1912 was 66,000 metric tons out of a world's total of 125,000, and the smelter-production 85,500. Estimating the consumption at 32,500 tons, there remained 53,000 tons available for export. Now that the German market for Bolivian tin ore was closed, an opportunity had arisen of securing the whole of the Bolivian output for British smelting.

In a series of general conclusions, a plea was put forward for the elimination of wasteful methods in ore and metal recovery, for the fuller utilisation of by-products from ores, and for the adoption of large-scale operations of high engineering efficiency by which capital and labour might be advantageously used. The widespread export of raw or partially smelted materials, produced within the Empire, to foreign countries for the recovery of the finished products was condemned, and the promotion of industries making for independence as regards essential products advocated.

The expediting of geological and mineral surveys of all British territory, and the organisation of advance investigations with the object of improving current processes, or of discovering new ones by which geological materials hitherto unexploitable might be made productive, were urged.

The development of the mineral resources of the Empire had taken place in the past without any constructive Imperial policy; it had lacked co-ordination and control, and was in need of scientific and business-like administration, and the suggestion that a Government Department of Minerals and Metals should be established to foster and safeguard British mineral resources and to promote the welfare of related industries was strongly supported. If formed and properly conducted, such a department should do much to give security and order to what was now full of danger and disorder.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. A. SHEPARD CHURCHILL, who died on October 18, leaving estate of the value of 109,495*l*., bequeathed 50,000*l*. to Harrow School for two scholarships, one on the classical and one on the modern side, of the clear yearly value of 150*l*. each, to be known as the "Shepard Churchill" scholarships, tenable at any college at Oxford for four years. In the election regard is to be had to literary and scholastic attainments, fondness and success in manly outdoor sports, such as cricket and football, qualities of manliness, courage, truthfulness, devotion to duty, sympathy with and readiness to protect the weak, kindness, unselfishness, and love of comrades; exhibition during school days of force of character and of instincts leading to the exercise of good and kindly influence over school-fellows. There are also to be founded four entrance scholarships of 120*l*. each for two modern and two classical students. The residue of the property is also left for the benefit of Harrow School in such manner as the governors, with the approval of the headmaster, shall direct. The total bequest is expected to amount to 100,000*l*.

IN an important letter published in the *Electrician* for December 15, 1916, Mr. A. Gray, of Cornell University, points out that the American electrical engineering firms are in much closer touch with the teachers of electrical engineering than British firms desire to be according to Mr. J. Swinburne. The Westinghouse Electric Company takes in a large number of university graduates each year, and the officials of the company, in order to improve the graduates they receive, have instituted summer schools for teachers, of whom thirty are selected and assigned to special departments in which they work from 8 a.m. to 5 p.m. They are paid about 12*l*. for five weeks' service, and are allowed to visit any part of the works. In his department the teacher is generally given some problem to solve which has had to be put aside owing to the limited time at the disposal of the regular staff. The evenings are occupied in discussions on points connected with the work of some department to which a visit has been previously paid by the whole body of teachers under the guidance of the engineers of the company. The arrangement appears to have benefited both teachers and company, and seems worthy of a trial in this country.

PROF. ARNOLD WALL, of Canterbury College, has published "A Plea for a System of Internal Examination in the New Zealand University" (Christchurch: Whitcombe and Tombs, Ltd.; price 1s.). The University at present possesses the unique disability that its examination papers are set and the answers marked in exactly the opposite part of the globe in London—a plan originally introduced in order to enable the University to maintain a standard identical with that prevailing in Great Britain. The system has the disadvantage as at present worked that the professors and teachers have no voice in the setting of the papers, nor are their opinions from personal knowledge of the candidates available for the guidance of those who mark the scripts. We hope Prof. Wall will succeed in introducing some reform which will bring teachers and examiners into closer touch with each other. At the same time the system which he proposes has proved to be a failure in at least one university in this country, and it cannot be said that it is altogether satisfactory to have examinations conducted by a board in which both the external and internal examiners are in a minority, and the majority are teachers interested in other colleges or in other subjects than the one under examination.

A COPY of the calendar of the University of Sheffield for the session 1916–17 has been received. The arrangement of the contents follows the plan of previous years, and detailed particulars are given of the courses of work arranged for students who desire to graduate in the various faculties of the University. It will be remembered that, as in the case of other of our more modern universities, there is at Sheffield a very comprehensive faculty of applied science, and the degrees of bachelor, master, and doctor may be gained both in the various branches of engineering and in metallurgy. There is a department of glass technology which provides facilities for systematic study and research in the manufacture and general technology of glass, and students who attend and qualify in a full-time course may obtain a diploma in the subject. The mining department of the University, under arrangement with the West Riding County Council, provides courses of extension lectures in mining science, and inspects and examines local mining classes in the southern portion of the West Riding. Similar instances could be multiplied of the successful efforts being made by the University authorities of Sheffield to keep in touch with the industries of the area served by the University, and to give local manufacturers the benefit of the assistance of expert advice on scientific matters.

READERS who have copies, which they may be willing to spare, of advanced text-books, models, specimens, and apparatus for the study of geology are invited to communicate with the British Prisoners of War Book Scheme (Educational) at the Board of Education, Whitehall, S.W. A request has just reached the committee of that war charity from Ruhleben for about fifty books, etc., to enable the camp school there to establish a general course in dynamic geology and crystallography. The class will be conducted by two of the prisoners, who are (to quote the letter) "professionally engaged in geology"; and more than a dozen students, mostly engineers, have already given in their names. The following books are specially asked for, and they may serve as an indication of the scope of the classes at this camp and of the type of book desired:—Haug, "Traité de Géologie"; Launay, "Traité de Métallogénie"; Hobbs, "Earthquakes"; Murray and Hjort, "The Depths of the Ocean"; Dana, "System of Mineralogy"; Groth, "Physikalische Krystallographie" (or any other good English book of the kind); Braune, "Chemische Mineralogie"; Rosenbusch, "Microscopische Physiographie der Mineralien und Gesteine"; Harker, "Petrology for Students." Among the requirements for the equipment of the classes are a microscope, slides for crystal, mineral, and rock specimens, crystal models, mineral powders and apparatus for blow-pipe analysis, and goniometers. A detailed list of the requirements may be obtained from the chairman of the Book Scheme, Mr. A. T. Davies, at the Board of Education, Whitehall, S.W., to whom all offers (accompanied by a detailed list) should be addressed. Books in almost every subject are urgently needed to meet the steadily increasing demands which are daily being received from British prisoners interned in enemy or neutral countries.

THE report on the work of the Department of Technology of the City and Guilds of London Institute for the session 1915–16 has been published by Mr. John Murray. The work of the department has been carried on with some difficulty during the year. Half of the office staff has joined the Army, and the secretary of the department himself is serving in the Army in France. Whereas the number of classes registered in technological subjects in the session 1913–14 was 5049, in 1915–16 the number had fallen to 3961. The students in attendance in these two years numbered 55,996 and 35,203 respectively. The report points out that recognition is due to the authorities and teachers of technical schools for the successful efforts which they have made to carry on the work of their classes uninterruptedly, notwithstanding the absence of members of their staffs on active service, and many other difficulties due to the war. Valuable help has been given to the Ministry of Munitions by the technical schools in general, either by directly manufacturing articles and gauges for munitions of war, or by undertaking special work and training men in it. In connection with the examiners' reports on the results of the examinations, it is again put on record that candidates frequently enter upon their technical instruction very poorly equipped in the matter of general elementary education, ability to do simple calculations, or even to write simple English correctly. The institute goes so far as to endorse the opinion of one examiner that "the standard of general education of the candidates is not improving." The report concludes by insisting that, speaking generally, employers must change their attitude towards technical training, so that those who foster the education of their younger employees should become the great majority instead of the minority, and so that attendance at continuation schools and day schools, or, if this be too much to expect, at least at evening technical classes, should become the rule. Nothing short of a strong national movement in this direction can prove adequate to meet the requirements of the case.

SOCIETIES AND ACADEMIES.

LONDON.

Aristotelian Society, December 18, 1916.—Dr. H. Wildon Carr, president, in the chair.—A. N. **Whitehead**: The organisation of thought. Science is a thought organisation of experience. The most obvious aspect of the field of actual experience is its disorderly character. It is for each person a *continuum*, fragmentary, and with elements not clearly differentiated. The fields of experience from which science starts are of a radically untidy and ill-adjusted character, whereas the neat, trim, tidy, exact world which is the goal of scientific thought is a world of ideas. The first great steps in the organisation of thought were due exclusively to the practical source of scientific activity, without any admixture of theoretical impulse. The whole apparatus of common-sense thought arose in this way: concepts of definite material objects, of the determinate lapse of time, of simultaneity, of recurrence, of definite relative position, etc. Science is rooted in the apparatus of common-sense thought. Science is essentially logical; the nexus between its concepts is a logical nexus, and the grounds for its detailed assertions are logical grounds. Four departments of logical theory may be discriminated, which by analogy may be called the arithmetic section, the algebraic section, the section of general-function theory, and the analytic section. The last, which is concerned with the investigation of the properties of special logical constructions—that is, of classes and correlations of special sorts—includes the whole of mathematics.

Paris.

Academy of Sciences, December 11, 1916.—M. Camille Jordan in the chair.—M. P. Painlevé was elected vice-president for the year 1917.—A. **Lacroix**: The phenomena of exomorph and endomorph contact phenomena of the ægyrine and riebeckite granites of North-West Madagascar.—G. **Bigourdan**: The position and co-ordinates of the observatories of Boulliau, of Gassendi, and of P. Petit.—E. **Ariès**: The determination of free energy by the equation of Clausius.—C. E. **Guillaume**: Wire-drawing and the expansion of invar.—G. **Charpy** and M. **Godchot**: The oxidation of coal. Fourteen samples of coals from St. Eloy, Ferrières, and Noyant were heated at 100° for periods of from two to three months. After this heating there was a gain in weight due to oxidation of from 3 to 5 per cent. Comparisons were made of the ash, volatile matter, and calorific value before and after heating. The loss of calorific power varied from 3 to 13 per cent. The ash and volatile matter were practically unaltered, and hence it follows that the deduction of the calorific value of a coal from its ash and volatile matter must be liable to grave error, since a similar oxidation process is often found to have occurred in stored coal, and sometimes even in the coal in the mine.—M. **Mesnager**: Formulæ of the thin plate fixed on a plane rectangular contour.—C. **Benedicks**: A new effect relative to thermo-electricity and to the thermal conductivity of metals. From theoretical considerations the author has arrived at the conclusion that the well-known deduction from the Wiedemann-Franz law made by Drude is inadmissible, and experimental evidence in support of this is given in the present communication.—R. **Ledoux-Lebard** and A. **Dauvillier**: The K series of tungsten and the production of the X-rays from the point of view of the quanta theory. The relation between the frequency and the voltage according to the quanta theory should be linear; for voltages between 24 and 140 kilovolts the experimental data give a curve, the deviation from the theoretical straight line increasing with the voltage. The K series appears at about 80 kilovolts instead of the 95 indicated by Whiddington's formula.—G. A. **Hemsalech**: The grouping of the lines of the iron spectrum under the selective influence of thermal and chemical actions. The lines in the iron flame spectrum can be arranged in three groups: lines emitted by the external flame of a Bunsen burner and reinforced in flames of higher temperature, lines produced under the influence of chemical actions, very marked in the cone but feeble in the flame, and the third group, the lines of the "supplementary" spectrum. Examination of the normal spectra has shown the existence of curious groups of lines in each of the three classes, distributed according to a law as yet unknown.—A. de **Gramont**: Remarks on the preceding communication, emphasising the importance of the results obtained by G. A. Hemsalech and pointing out the desirability of the study of a more extended portion of the iron spectrum by the same method.—J. **Deprat**: The discovery of numerous fossil-bearing horizons in the Middle and Upper Cambrian of South Yunnan, and on the succession of the fauna in these strata.—Ph. **Glangeaud**: The first volcanic eruptions (Oligocene) in the lacustral geosynclinal of Limagne (Côtes de Clermont, Chanturgue).—J. **Amar**: An instrument for measuring and re-educating the movements of pronation and supination, the gyrograph.—A. **Lardennois**, P. **Pech**, and J. **Baumel**: Study of the gangrenous infections of wounds by means of radiography. The information which can be obtained by the radiographic examination of gas gangrene is useful not only for the study of the process of destruction and its localisation in the muscle, but also it is useful for the diagnosis of the focus of a gangrene, and especially for determining its extent.—J. **Beauverie**: New experiments on the influence of osmotic pressure on bacteria. Studies of the effects of increasing proportions of common salt on the growth of bacteria.—A. **Paillot**: New parasitic micro-organisms of the cockchafer.

New South Wales.

Linnean Society, October 25, 1916.—Mr. A. G. Hamilton, president, in the chair.—E. F. **Hallmann**: Revision of the genera with microscleres, included, or provisionally included, in the family Axinellidæ (Porifera). Part iii. The genera Thrinacophora, Dragmatyle, Holoxea, and Higginsia are revised; five genera and one species are described as new.—A. H. S. **Lucas**: An efflorescence on some New Zealand kelps.—C. **Hedley**: Studies on Australian Mollusca. Part xiii. Six species referable to the genera Arca, Loripes, Solecardia, Tellina, and Tugalia are described as new, and figured; additional particulars and illustrations of a number of imperfectly known species are supplied.—F. H. **Taylor**: Australian Tabanidæ. Part ii. One genus and twelve species are proposed as new; a change in the names of two is made, and notes on, and additional localities for, known forms are recorded.—A. M. **Lea**: Descriptions of new species of Australian Coleoptera. Part xii. Twelve species of the family Curculionidæ and eight of the Cerambycidæ are described as new.—G. F. **Hill**: Notes on the bionomics of *Lyperosia exigua*, de Meijere. The buffalo-fly, a formidable pest to cattle and horses in the Northern Territory, is believed to have been introduced with early shipments of buffaloes, cattle, or ponies from the East Indies, so far back as 1824. The local distribution, habits, oviposition and life-history, natural enemies, and methods of control are discussed.

Victoria.

Royal Society, November 9, 1916.—Mr. W. A. Osborne, president, in the chair.—F. **Chapman**: The probable environment of the Palæozoic genus Hercynella in Victoria. The complete fauna of the Yeringian beds containing this supposed pulmonate mollusc in Victoria was recorded, and, from the presence of corals and many gasteropods, it was shown that these sediments must have been laid down under fairly deep water marine conditions, as in Bohemia. The thin-shelled fauna of the Yeringian sea was probably due to the marked terrigenous element in the deposits produced by fluviatile action. This evidence was compared with that given by Miss O'Connell, of Buffalo, U.S.A., who has described the Hercynellas of the Waterlime group as being associated with a brackish or estuarine fauna containing eurypterids and pod-shrimps, and therefore differing considerably from the Victorian occurrence.—R. **Etheridge**, jun.: Reptilian notes. (1) The identity of *Megalania* (vel *Varanus*) *prisca*, Owen, with *Notiosaurus dentatus*, Owen. Some vertebræ, limb-bones, dentary, and tooth from King Creek, Condamine River, in the Australian Museum, confirm Lydekker's conjecture of the identity of these two forms. (2) *Megalania prisca*. A cave fossil from the Wellington Caves Reserve. Remains of this lizard have now been recorded from fluviatile, spring, and cave deposits. (3) An opalised reptilian dentary from Lightning Ridge, Walgett, of Cretaceous age, described as *Crocodilus* (? *Bottosaurus*) *selaslophensis*.

PETROGRAD.

Imperial Academy of Sciences, September 28, 1916.—E. S. **Fedorov**: The determination of the density of the atoms in the surfaces of crystals.—V. P. **Amalickij**: Geological and palæontological explorations on the northern Dvina and the Suchona. Palæontological results. Reptilia. Part i., Anomodonta, Owen; Dicynodontidæ, Broom; Dvinosauridæ, n.f. Part ii., Seymouridæ.—G. N. **Frederiks**: The genera Reteporina, d'Orbigny; Phyllopora, King; and the allied forms of the Fenestellidæ.—R. **Abels**: Magnetic observations in W. Siberia, 1914–15.—S. V. **Orlov**: Simplified formulæ applied to investigating the curve in the tail of comet 1908c (Morehouse).—S. **Kostinskij**: The new variable 1916 Cassiopeiæ.—A. A. **Bělopolskij**: A new method of determining the radial velocities of stars with the spectro-comparator.—B. **Gorodkov**: A journey to the southern limit of the conifer forests of the Tobolsk Government.—D. **Smirnov**: Observations on the life of *Ellobius talpinus*, Pall., in the Merv oasis (Mammalia, Rodentia).—A. R. **Prendel**: The Hirudinea of the ancient beds of the Dniester.—A. V. **Martynov**: A new species of the tribe of the Apataniini and other forms from the Minussinsk district.—V. and E. **Martino**: Materials for the classification and geographical distribution of the Mammifera of the Kirgise Steppe. Part ii.—A. **Birulia**: Miscellanea scorpiologica, xi. The scorpiofauna of Lower Mesopotamia, Kurdistan, and N. Persia.—A. A. **Borisiak**: Tertiary mammals of Russia. No. 1, Indricotherium, n.g.—V. I. **Palladin** and V. V. **Levčenko**: Glycuronic acid in plants.

SECTION FOR HISTORICAL SCIENCE AND PHILOLOGY, October 12.—A. N. **Samojlovič**: The adages of the Crimean Tatars.—Vl. **Kotvič**: Mongolian inscriptions of Erdenidzu.—E. D. **Polivanov**: A note on Japanese riddles.—V. M. **Alekseev**: The immortal doubles and the tao-sse with the golden toad in the suite of the god of riches.—N. J. **Marr**: The migration of the Japhetic peoples from the southern to the northern Caucasus.—V. V. **Bartold**: The folk-tale of Dido's ruse.

BOOKS RECEIVED.

The Towns of Roman Britain. By the Rev. J. O. Bevan. Pp. viii+65. (London: Chapman and Hall, Ltd.) 2s. 6d. net.

Stars at a Glance. Pp. 48. (London: G. Philip and Son, Ltd.) 1s. net.

Genetics and Eugenics. By Prof. W. E. Castle. Pp. vi+353. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press.)

Joseph Pennell's Pictures of War Work in England. Pp. xii+plates li. (London: W. Heinemann.) 6s. net.

Cosmical Evolution: Critical and Constructive. By E. McLennan. Second edition. Pp. xxi+490. (Corvallis, Oregon: The Author.)

God's Progressive Revelation of Himself to Men. By the Rev. Canon J. M. Wilson. Pp. 62. (London: S.P.C.K.) 1s. net.

DIARY OF SOCIETIES.

SATURDAY, JANUARY 6.

GEOLOGISTS' ASSOCIATION, at 3.—The Age of the Chief Intrusions of the Lake District: J. F. N. Green.—The Ibex-zone at Charmouth: W. D. Lang.

MONDAY, JANUARY 8.

ARISTOTELIAN SOCIETY, at 8.—Hume's Theory of the Credibility of Miracles: C. D. Broad.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geography of South American Railways: W. S. Barclay.

TUESDAY, JANUARY 9.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Recent Progress in Dredging Machinery: W. Brown.

WEDNESDAY, JANUARY 10.

GEOLOGICAL SOCIETY, at 5.30.—Notes on the J. A. Douglas Collection of Graptolites from Peru: Dr. C. Lapworth.—The Palæozoic Platform beneath the London Basin and Adjoining Areas, and the Disposition of the Mesozoic Strata upon it: H. A. Baker. With an Appendix by Dr. A. M. Davies.

THURSDAY, JANUARY 11.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—The Amazon River and Unexplored South America: J. Campbell Besley.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Principles Involved in Computing the Depreciation of Plant: F. Gill and W. W. Cook.

FRIDAY, JANUARY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—*Patella vulgata*, L., and its so-called Variety, *P. depressa*, Penn.: Rev. Dr. A. H. Cooke.—The Occurrence of Manganese in Mollusca: Dr. A. E. Boycott.—Note on the Holotype of *Crioceratites bowerbanki*: J. de C. Sowerby and G. C. Crick.

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THURSDAY, JANUARY 11, 1917.

CIVIL ENGINEERING CONSTRUCTIONAL WORK.

(1) *Elementary Strength of Materials.* By Ewart S. Andrews. Pp. viii+216. (London: Chapman and Hall, Ltd., 1916.) Price 4s. 6d. net.

(2) *Costruzioni di Strade e Gallerie.* By Prof. Salvatore Rotigliano. Pp. xxiii+808. (Milano: Ulrico Hoepli, 1916.) Price 18 lire.

(1) THIS book is an abridged edition of the author's larger work on the subject, and has been specially arranged for the practical man as well as for students in engineering colleges. It is one of the best arranged and most complete of the smaller treatises which have appeared on this subject, and as the author has made use of the latest published results of research on the strength of materials, the book is thoroughly up to date. The book deals very successfully not only with the various problems involved in the calculations of the stresses and strains produced by different kinds of loads, but also with the methods now adopted for carrying out tests of all kinds on the materials used by engineers and architects. The author gives valuable advice as to the precautions which must be taken in order to secure trustworthy results when tests are made, and as to the most suitable types of machines for different classes of tests. Mr. Andrews is to be congratulated on having produced an excellent text-book, which will be of considerable use to both engineers and architects.

(2) The author of this work, Prof. Rotigliano, is engineer-in-chief to the city of Palermo, and the book is based on the lectures delivered by him as professor of road construction at the Royal School for Engineers at Palermo. The book is divided into four sections, the first section dealing with the laying out of roads and railways, the second with the necessary earthworks, the third with the construction and maintenance of roads, and the fourth with the construction of tunnels.

In the first section, after a general introduction, the author deals with the subject of traction on roads and railways and the frictional and other resistances which have to be overcome, giving a number of useful formulæ which enable the tractive force to be determined under known conditions for animal and mechanical traction; the limiting values for gradients and curves are also fully discussed. The third chapter deals with the setting out of curves, both circular and parabolic, and there are a number of practical rules as well as a full theoretical treatment of the subject. The remaining chapters of this section deal with topographical surveys, the laying out of roads and railways in various classes of country, and the general considerations which decide the best route to adopt in a given case. In dealing with the laying out of railways in mountainous districts, as was to be expected in the case of a book written by an Italian engineer, much attention has been paid to the subject of spiral curves, reverse curves, and zigzags.

The first chapter of the second section is devoted to the necessary mensuration for determining cross-sectional areas and volumes of excavation; a number of formulæ are given for the various calculations which have to be made. Chap. viii. deals with the problem of equalisation of cuttings and banks, and the factors which determine the distances through which it is economically possible to transport excavated material. The next chapter deals with the various hand tools which are employed in the work of excavation in ordinary soft ground, and the methods adopted for preparing the shot-holes when explosives have to be employed. The tenth chapter is devoted to an account of the methods usually adopted for transporting the excavated material by wagons running on temporary lines of rails. Chap. xi. deals fully with mechanical excavators and steam navvies, with the employment of aerial lines for the transport of material, and with the utilisation of machinery in modern constructional work. In the final chapter of this section the author discusses the numerous practical problems which the engineer has to solve, more especially when roads have to be constructed in mountainous districts.

The third section is devoted to a description of the various materials employed in constructing the road surfaces of main and district roads and of urban and suburban streets, of the modern methods of testing and preparing these materials, and of the work of laying them on the prepared road-bed. The questions of road maintenance and of the influence of the various classes of traffic on the wear of the road surface are fully discussed.

The fourth and concluding section of the book is devoted to the laying out and construction of tunnels; the author gives a complete treatment of the whole problem. After a brief explanation of the various systems adopted for the setting out of the centre lines, the methods of carrying out the work of driving the tunnels are fully described, and the latest types of compressed-air and hydraulic machinery for operating rock-drills are explained and discussed. One chapter is devoted to a careful account of the timbering which is needed when tunnels are driven in soft ground, and the work concludes with a description of the construction of subaqueous tunnels, with an account of the special difficulties which have to be overcome in such work, and with details as to the various systems adopted for the ventilation of long tunnels.

The book is extremely well illustrated, and is one of the most comprehensive text-books which have been published on the subject of earthwork construction. As probably few British engineers are able to read Italian, it is to be hoped that some British publishing firm will undertake the work of producing a translation of this book for the benefit of British engineers. T. H. B.

ORGANIC CHEMISTRY FOR AGRICULTURAL STUDENTS.

Organic Agricultural Chemistry (The Chemistry of Plants and Animals). By Prof. J. S. Chamberlain. Pp. xvii+319. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 7s. net.

THIS volume is intended to solve the difficult problem of providing a course in chemistry for students at agricultural colleges. By common consent the ideal plan is for the would-be agricultural chemist to go through the pure chemical course and take an honours degree. But many cannot do this; their training has to be carried out at the agricultural college, where chemistry as such is strictly subordinated to the matter in hand.

Prof. Chamberlain deals with the problems by picking out those substances that the student will come across in his agricultural studies, and then connecting them together by building up the course round them. Necessarily this prevents discussion of many problems of chemical interest; constitutions have to be taken on trust without even an indication of the way in which they have been established. The course, too, is necessarily altered, and many old friends disappear: the ketones are not mentioned; even acetone is not described.

But the book has to be judged by its suitability for the people for whom it was written, and from this point of view it is satisfactory. The ordinary simple substances are dealt with in sufficient detail, and the experiments are numerous enough to ensure that the student shall familiarise himself with them. Fats, sugars, starches, and proteins are discussed in a simple manner, and various interesting illustrations are given that show the bearing of chemistry on the problems of everyday experience.

The first section of the book having dealt with organic substances, the second is devoted to physiology, both of plants and of animals. It is unfortunate that the lecturer in agricultural chemistry is almost always called upon to teach these subjects, for it is obvious that no man can do justice to physiology when he has to bring it in simply as an "extra." Prof. Chamberlain has courageously introduced the chapters, and no doubt they will supply the teacher's needs. But throughout one has the feeling that agricultural chemistry ought not to be extended to include physiology.

The third section treats of crops, which undoubtedly belong to the subject. An account is given of the proximate and ultimate constituents of the ordinary crops, and of their value to both man and animals. The author classifies them on p. 150 as volatile and non-volatile, using "volatile" to include starch, cellulose, protein, etc., and "non-volatile" for the ash constituents. It would have been better to retain the old terms "organic" and "mineral," or something that does not involve calling cellulose a "volatile" substance.

Several omissions call for remedy. In a book of this kind the student may reasonably expect to find the answers to the questions that arise in everyday practice. What, for instance, is the constituent in cotton-seed cake that has such a "binding" effect on cattle? or the substance in young grass that makes them scour? Why is May grass better than October grass? Why have mangolds to be stored some months before they can safely be used? These are the kind of questions about crops that are perpetually before the agricultural instructor in this country, and a similar variety of questions must be put by inquisitive farmers in the States; they represent the kind of problem that the text-book writer ought to face.

The book has several new features which seem decidedly useful. No space is lost in giving details of analytical methods which, as the author truly observes, can be got out of the analytical text-books. The detailed study of animal nutrition is taken before that of plants—a course which, in the author's experience, gives the student a clearer conception of the biochemical changes involved, and at the same time emphasises both the differences between plants and animals and their fundamental similarity.

No references to original papers are given, but there are references to larger text-books, so that the student seeking further information will know where to find it.

The book is, we believe, the only one of its kind. The well-known volume by Haas and Hill was written from the general biochemical point of view. Prof. Chamberlain is, so far as we know, the only recent chemist who has written organic chemistry for agricultural students. E. J. R.

COLOUR.

Color and its Applications. By M. Luckiesh. Pp. xii+357. (London: Constable and Co., Ltd., 1915.) Price 16s. net.

IT is always difficult, if not impossible, to separate the principles of a science from the applications of them, and the author has, perhaps wisely, not attempted to do so. On the other hand, while a student may be able to master the principles so far as they have been made clear, he can never hope to become practically acquainted with the innumerable applications of such a subject as colour. Therefore, we have here a very good account of the fundamentals, and a similarly good account of some of the applications, while other of the latter are treated in so limited a manner that it can scarcely be claimed that they are fairly presented. With these few exceptions, which indeed the author from his preface evidently appreciates, we have a very useful general treatise on colour which includes 130 well-selected diagrams, curves, and tables, so that for very many purposes the book will be found sufficient in itself. But at the end of every section references are given to other text-books and to original papers to facilitate a more extended study.

About three-fifths of the volume is devoted to fundamental matters: the nature of light, the production of colour, colour mixture, colour terminology, the analysis of colour, colour and vision, the effect of environment on colour, theories of colour-vision, and colour photometry. In connection with colour mixture we have the subtractive and additive methods dealt with, and also the "juxtaposition method" as if it were a third method, though it is this only from a practical point of view, being really a form of the additive method. The mixture of both the subtractive and additive methods which exists in three-colour typographic half-tones is not referred to, but in omitting this the author only follows in the footsteps of those who have preceded him. It seems to be generally taken for granted, perhaps because "subtractive" colours are used, that this is simply a modification of that method, but the most cursory examination of a print will show that the dots of colour, while often more or less superposed, are also often juxtaposed.

A few pages that should be of much interest to those who need to make critical observations of minute detail, as in some microscopical work, deal with acuteness (or "acuity") of vision. For the same brightness in all cases vision is more acute with monochromatic than with white light, and for this purpose yellowish-green is superior to any other colour. The reviewer would observe that microscopists generally prefer this colour, which is also that for which the eye is most sensitive and for which objectives are generally best corrected. But the superior resolving power of light of shorter wave-length has led to the occasional use of bluish-green light, in spite of its obvious disadvantages. It seems from the figures given that the microscopist may lose more by the reduction of his acuteness of vision, even assuming equal brightness, than he can possibly gain by the increase in resolution, unless he can command a higher magnification without introducing other troubles.

With regard to the applications, colour photography is briefly dealt with in eleven pages, but the next group of chapters, "Colour in Lighting," "Colour Effects for the Stage and Displays," and "Colour Phenomena in Painting" (which deals chiefly with questions of illumination), occupies more than a quarter of the whole volume. This is evidently the subject that most interests the author, as, indeed, one would expect from the position that he occupies. Colour-matching as a special art, an account of various attempts to make "colour-music," borrowing more or less the notation of sound-music, and a few notes on coloured media, complete the volume.

C. J.

QUARTIC SURFACES.

Quartic Surfaces with Singular Points. By Prof. C. M. Jessop. Pp. xxxv+198. (Cambridge: At the University Press, 1916.) Price 12*s*. net.

WE have in analytical geometry a great contrast between the general and the particular. For algebraical curves and surfaces of the nth order or class we have a comparatively large number of results, such as those given by Cayley, Cremona, and others half a century ago; but when we take a particular value of n and try to investigate, say, the distinct types of surfaces of that order, the task is a very formidable one if n exceeds 3. The present work deals with the case when $n=4$, and that only so far as relates to surfaces that have nodes or nodal curves, or both.

Chap. i. shows us very simply the forms of equation corresponding to quartics which have from four to sixteen (ordinary) nodes; this gives twenty-four types of surface, some types having further varieties. As we might expect, the sixteen-nodal surface is the easiest one to discuss in detail; practically we have Kummer's surface and particular cases of it, and by introducing theta-functions we can obtain many elegant properties with ease (this is shown in chap. ii.). Among the six-nodal quartics we have Weddle's surface (discussed pp. 173–188); here double theta-functions are useful auxiliaries.

Chap. iii. gives an account of quartics with a nodal conic; when this conic is the imaginary circle at infinity, the surface becomes a cyclide. Prof. Jessop might have remarked that since any two conics in space are projectively equivalent, the theory of cyclides includes that of all quartics with a nodal conic. Hence we may, if we like, read chap. v. (on cyclides) and translate all its theorems into properties of every quartic with a nodal conic, and thus deduce the theorems of chaps. iii. and iv. However, the author's sequence has the advantage of introducing us at an early stage to Segre's wonderful projection of quartics from four-dimensional space (p. 55), and to Geiser's one-one relation between points on a plane and those on a general cubic surface (p. 46). The value of Segre's method becomes still more obvious in chap. iv., which ends with his table of types of quartics with a double conic, arranged according to indices of elementary factors; this is one of the most valuable tables in the book.

Chap. vi. deals with surfaces with a double line, among which Plücker's surface appears; chap. vii. with quartics that contain an infinite number of conics (here Steiner's surface comes in); chap. viii. with rational quartics in general; and chap. ix. with determinant surfaces (Weddle's surface being the symmetric case). All are well worth reading; and, in fact, the treatise has the great merit of introducing us to the main methods which have, in this inquiry, replaced tiresome algebra by a combination of abridged notation, pure geometry, and function-theory suited to the particular problem in hand. Without making any invidious distinctions, we may fairly assert that, in this particular domain, Segre and Humbert have, each in his own way, immensely simplified the discussion of the theory.

Prof. Jessop's book has, of course, the defects of its qualities. Among these we may note that he never points out that in writing a treatise on algebraic loci with certain singularities he is at the same time writing on algebraic envelopes with corresponding singularities. A mathematical student will find it an excellent exercise to dualise all the theorems contained in this volume. Again, in discussing cyclides, the author has missed the chance of referring to Lie's one-one correspondence of lines and spheres in space. A real cyclide is the envelope of a real sequence of spheres; Lie's transformation leads to a sequence of complex lines, and it would be interesting to see what the cyclide corresponds to.

Prof. Jessop duly appreciates the late R. W. H. T. Hudson's book on Kummer's surface; he has himself composed a work of the same kind, in the sense that it is a valuable introduction to some of the latest results obtained by geometricians. G. B. M.

OUR BOOKSHELF.

A Manual of Fire Prevention and Fire Protection for Hospitals. By Dr. O. R. Eichel. Pp. v+69. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 4*s.* 6*d.* net.

THE British Fire Prevention Committee, whose fire surveyors have been undertaking the fire precautionary arrangements in innumerable hospitals throughout the country, recently indicated in one of its reports that medical men who are prone to forethought are particularly ready to take precautions in such establishments as hospitals. We therefore specially welcome the little book before us, from the pen of a medical man connected with the New York State Department of Health. As it is largely based on American practice, much of the detail does not hold good in this country, yet the principles enunciated are sound.

Taking up a question of detail and having regard to the unfortunate tendency of some hospitals in this country to purchase dry-powder extinguishers, we observe that the author deals with them as follows:—

DRY-POWDER EXTINGUISHERS.—"These are the least reliable and most inefficient extinguishers known. Unfortunately, they are also very widely used, and can be found in many hospitals. . . ." Again, referring to another unfortunate type of fire appliance (*sic*), the glass hand grenade, which will be found in many hospitals, the author says:—

GRENADE TYPE.—"These types usually consist of bottles containing fluids, a large percentage of which is water, and are of so little value as to be practically worthless. The false sense of security which may result from their presence, and the time lost in attempting to quench the fire with them, may be very dangerous. They are hardly equivalent in value to a pitcher full of water. . . ."

Whilst we have mentioned specific examples of the author's comments on appliances, we should like to emphasise that he wisely gives fire prevention precedence to fire extinction. He deals with lighting hazards, heating hazards, etc. He also has some words to say on the organisation of the staff from the fire point of view, *i.e.* what he describes as the "Hospital Fire Department."

The Portland Cement Industry. By W. A. Brown. Pp. x+158. (London: Crosby Lockwood and Son, 1916.) Price 7*s.* 6*d.* net.

THE cement industry presents striking resemblances to the aniline dyes industry. The first aniline dye was discovered and manufactured in England. Afterwards the sustained attention devoted to the subject by trained minds in Germany so changed the conditions through the introduction of new colours and cheaper methods of production that eventually a monopoly was acquired. Similarly, Great Britain first produced cement—Parker's (afterwards called Roman) cement in 1796 and Portland cement in 1824, to which may be added reinforced concrete (covered by Elkinson's patent) in 1854. So, too, though partly from different causes, the cement industry has developed far more rapidly in Germany and the United States than here. The remarkable progress in America is attributed to the close co-operation during the past fourteen years of Associations of Cement Manufacturers and Cement Users. Fortunately, British cement machinery is now equal to any made in Germany, though it cannot compare favourably with American machinery. The improvement of cement has been facilitated by the general adoption of the "British Standard Specification," but ample scope remains for research with a view to increased economy and efficiency in the manufacturing processes.

The book before us is eminently practical, and deserves serious consideration because the author has had important American experience, and is now managing a large modern cement works in South Wales. Special attention is bestowed on the vital question of costs, particularly working costs for economical production, and the book may be profitably consulted by those interested in the industry. There are numerous illustrations, including thirty-six full-page plates, and some notes on physical testing constitute a valuable feature. J. A. A.

Actualités Scientifiques. Le Principe de Relativité. By E.-M. Lémeray. Pp. 155. (Paris: Gauthier-Villars et Cie, 1916.) Price 3 fr. 75 c.

THE aim of this work is not to give a historical or critical survey of the development and significance of the principle of relativity, but rather to develop some of its consequences for dynamical theory so far as they are independent of all hypotheses as to the electrical constitution of matter. Three principles are assumed: the constancy of the velocity of light, the principle of virtual work, and the fundamental law of inertia, the last only for the most restricted case. From these the author develops conclusions as to the limitations to be placed upon the theorem of equality of action and reaction, upon the law of gravitation, and upon the meaning of mass. The extent to which the principle agrees with and requires experimental results is barely touched upon, but this is probably because the book is the record of a series of lectures aiming at a presentation of a particular point of view.

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.*]

Meteorology and Wheat Shortage.

IN looking through some old papers I came across one entitled "The Law of Sequence in the Yield of Wheat for Eastern England for 1885–1904," contributed by Sir Napier Shaw to the *Hann Band der meteorologischen Zeitschrift*, 1906, pp. 208–16 (Brunswick: Fried. Vieweg und Sohn, 1906). From a study of the rainfall and its connection with the amount of the harvest, Sir Napier Shaw applied the method of harmonic analysis to the quantity in question, and obtained a formula according to which its fluctuations are periodic, the period being eleven years. In Fig. 42 (p. 212) curves are shown in which the agreement between the calculated and observed results is very close. It now becomes interesting in the light of recent events to extend Sir Napier Shaw's predictions for a further period of eleven years, with the following results, the numbers representing average yield in bushels per acre:—The highest maximum of about 35·5 should have occurred in 1909–10, followed by a minimum of about 29·5 in 1911–12. The predicted yield next rises to about 32·5 in 1912–13, and then decreases, the lowest minimum being about 27·0 bushels per acre and occurring at the beginning of the war, in 1914–15. From now on the predicted yield should increase, but would not reach its former maximum of 35·5 until 1920–21. For the period 1915–17 the predicted yield is not much more than 29 bushels per acre. It will be seen, therefore, that, according to theory, it was to be expected, both here and abroad, that England's wheat supply, so far as it depends on the eastern counties, would be at its lowest at and about the present time. G. H. BRYAN.

PROF. BRYAN's reminder of my work of twelve years ago upon the yield of wheat in the eastern counties of England comes at an opportune moment. It may be of interest to recall how the "theory," to which he refers, arose. In considering the figures for the yield of wheat for England in the twenty-one years 1884 to 1904, I had noted that they were so closely related to the rainfall of the "principal wheat-producing districts" (approximately the part of Britain east of a line from Portland to Inverness) for the previous autumn that one might almost rely upon losing a bushel and a quarter per acre from the crop for every inch of rain recorded for the region in the previous autumn. There were some exceptional years, and in the hope of getting something still more amenable to rule I restricted the area to the counties of the meteorological district "England East," and took out the figures for wheat from the returns of the Board of Agriculture and for rainfall from the Weekly Weather Report. From these it appeared that every inch of rain in the autumn meant a loss of 2·2 bushels of wheat per acre for the eastern counties, but the occasional exceptions were not less pronounced than for the wider area, but more so.

Trying to circumvent these vexatious exceptions to an obviously useful general rule, I was working with a graph of the twenty yields 1885 to 1904, and discovered accidentally that it was reversible with reference to the epoch 1895–96. The individual values varied from 25·2 to 36·3, but the means for the pairs of years 1895–96, 1894–97, 1893–98, and so on, were nearly identical; the means of any other set of pairs not so. The only explanation of a reversibility of that kind that I could imagine was the combination (possibly fortuitous or occasional) of a series of periodic variations of any periods whatever which happened to be concurrent in a node in 1895–96. By a crude process of trial and error I was led to the conclusion that the best representation of the actual figures on that basis was to be got by combining a sine-curve of eleven years period with five of its harmonics of selected amplitude, each with a node at 1895–96; five of the nodes were ascending, one descending. This is a different matter from taking any graph between zero values eleven years apart and finding the harmonic components that will give the best fit, because the graph that I was working with crosses the zero line twelve times in twenty years. There is little or nothing suggestive of an interval of eleven years, but it followed from my analysis that the figures must repeat themselves after eleven years, a conclusion which I had not previously conjectured, but which turned out to be verified in an astonishing number of cases, and led to a most accurate prediction of the yield for 1905, which was then unknown.

There were thus two "theories" in the field, one that the yield of wheat depended (negatively) upon the rainfall of the previous autumn, the other that the figures repeated themselves after eleven years in consequence of the periodic changes with a fundamental interval of which "eleven years" was the nearest whole number. A curious point was that the years which were exceptional as regards the rainfall-rule did not appear as exceptions to the rule of reversal with regard to 1895–96. Thus the year 1903 is 6·2 bushels in defect of the rainfall-rule, but it compensates the yield for 1888 quite properly; on the other hand, 1904 gives a yield 4 bushels too small to compensate the yield of 1887, but it agrees quite well with the rainfall, while 1887 itself does not. In fact, if 1887 had agreed with the rainfall the repetition in 1898 and compensation in 1904 would have been quite good.

Thus there is a good deal of tantalising attraction about either "theory," and the relation of the one to the other. Mr. R. H. Hooker took the matter up, and discussed the yields of the various crops in relation to the weather conditions of different parts of the year in a well-known paper published by the Royal Statistical Society. He gave his opinion in favour of autumn rainfall as against "eleven years," in spite of the triumphant success of the latter's first prediction, that for 1905, which gave 32·8 bushels per acre to compare with an actual 32·0, whereas autumn rainfall would have given 37·6.

I have not looked into the matter critically since 1906, although the question is obviously one of immense practical importance, particularly at the present time, when the extension of the wheat area is being urged. To some of my friends the period of eleven years, which in this case could not be evaded or concealed, is anathema, and to others all such imagined periods and apparent relations are more likely to turn out will-o'-the-wisps than beacon-lights. So I thought it best to let the question rest until another eleven years had expired. That time has now arrived, and the question certainly deserves further investigation.

But there are certain pitfalls in the way of the continuance of the investigation. "Autumn rainfall" is a conventional expression, so is "eastern counties" in regard to the yield of wheat. One is apt to get off the line of continuity if one tries to deal with the matter amid the press of other things. And even with the additional figures properly computed we shall not necessarily secure the continuity which the investigation requires. The years that have elapsed have been memorable for the progress that has been made in the successful breeding of wheat, and success in breeding means improving the crop by choosing wheat that is immune from the effects of incidental causes which are part of the natural order and used to be instrumental in depressing the market yield. Moreover, when wheat was cheap there was a disposition only to sow it in the most favourable land, to withdraw the rest from wheat-cultivation, and thus to raise artificially the average yield per acre.

Considering all the circumstances, even as they were in 1906, it is surprising that any suggestion of law should come out of the figures at all. Improved knowledge among farmers may easily now have introduced variations which will form a systematic error in the comparison of facts with the calculations of either "theory"; consequently the investigation means rather more than comparing figures. The mere repetition of the process that was good enough for 1904 may be illusory in 1917, for causes which were not inherent in the original figures. NAPIER SHAW.

A Frost Thistle: A Beautiful Effect of Freezing.

THE frost flower here photographed was entirely the result of a chance experiment, but it was so beautiful that it would be well worth repetition and detailed study.

So far as I can see, the sole factors necessary for the production of such an effect are a small amount of garden mould left standing in a little water (about

an inch in depth) in a small glass jar, and frosty weather. In this particular case the vessel was left out of doors on a window-sill during a recent frosty night in a state of tranquillity save for the occasional shakings caused by vehicles passing over the bridge below.

In the morning the water was frozen solid; the glass was intact, the ice having expanded upwards, doming the surface. Within the ice cylinder was a wonderfully perfect representation of a thistle flower, most delicately fashioned in gleaming threads of silvery whiteness and of exquisite beauty, all emanating from a fluffy-looking, opaque, central, domed nucleus.

In reality the threads were fine curved threads of gas (? air) radiating through the clear ice. As shown in the figure, those below curved downwards, those above upwards, for all the world like lines of force round a magnetic pole, but demonstrated by capillary tubes in ice. On closer examination I was, I believe, able to discover another essential feature in the phenomenon in the form of tiny specks of mud, one at the peripheral end of each gas-tube.

I submit the following explanation of the frost thistle.

It must be assumed that as freezing proceeds from without inwards, the gas-tubes also grew centripetally. The tiny particles of earth we believe to have determined the points of origin of minute gas bubbles. When the first shell of ice was formed, these bubbles would naturally, by the expansion of the ice, tend to be squeezed and compelled to elongate, and then to move in the direction of least resistance—*i.e.* inwards and towards the centre of the vessel. In other words, these silvery threads, curving, as they do, upwards from the bottom and downwards from the top, are graphs which indicate the progress of the congelation.

When the congelation had reached to about one-third of the radial distance to the centre, some change appears to have occurred, for the central ice-mass was no longer clear, but of a milky opaqueness, within which the gas-tubes could be no longer followed by the eye. This we attribute to the sudden solidification of a confined residual volume of liquid of enhanced salinity, which, at the moment of its change of state, yielded up its dissolved gases in countless bubbles of the minutest size. These, probably uniformly distributed throughout the central ice, produced its cloudiness.

May I add that this example of natural magic grew within a few yards of the site of Roger Bacon's study on Folly Bridge at Oxford? R. T. GUNTHER.

NATIONAL RECONSTRUCTION.

IT is not too much to say that of all the subjects which claim careful consideration at the present time of discussion as to Imperial reconstruction, none is more important than education. It is true that the consequences of any change for the better or worse in educational matters will affect more directly the next generation than the present, but the clarification of men's minds and the settlement of a course of action in this direction are urgently desirable. For it is evident that opinion is still much divided as to the aims which ought to be kept in view, and until such divisions are practically healed the present wasteful conflict will go on.

The discussion which has been carried on during so many years by the partisans of classical studies on one hand, and the supporters of science on the other, is an indication that there is still much misunderstanding and exaggeration on both sides. The extremists on one side contend that Greek is an essential element in a liberal education, and talk of physical science as "gross materialism," while some of the extreme opponents of classical studies are not content with dropping Latin and Greek, but would turn schoolboys into technical chemists. It is to be hoped that the people with more moderate views, who fortunately seem to form the majority, will arrive before long at a generally acceptable compromise whereby the interests of a truly liberal education may be secured.

The advocates of the classical system have shown in recent utterances a moderation which may be taken as indicating a politic submission to the force of that part of public opinion which is against them. An example occurred at the meeting of the Hellenic Society on November 14, Dr. Walter Leaf, president, being in the chair. The president opened the proceedings with some remarks about compulsory Greek in the entrance examinations at Oxford and Cambridge for which he would receive the cordial thanks of any friends of physical science who may have listened to him. As he justly pointed out, the study of Greek must stand or fall on its own merits, and he denounced the retention of Greek as a compulsory subject in terms as vigorous as could be desired both by those who care nothing for classical learning and by those who have the interests of Hellenic studies at heart. For there can be no doubt that the number of young people who enjoy the gifts which enable them to push on beyond the difficulties of the language itself, so as to be in a position to imbibe and to enjoy something of the beauty of Greek poetry, drama, and philosophy, is, and must always remain, relatively small; while the forcing of hundreds of young men to undergo the drudgery of getting up an imperfect knowledge of Greek grammar and some small portion of a Greek author is deliberately to create a crowd of people who in after life hate and despise the system which has compelled them to waste so much time.

Dr. Leaf made a mistake in his reference to what he described as the present tendency to exalt materialistic science. Everyone knows that the circumstances of the time compel a concentration of attention on inventions which have arisen out of scientific discovery, and to the unthinking the production of dyes and explosives, of big guns and aeroplanes, may appear to be the chief aim and purpose of scientific research. But this is not all that science has to offer, nor is it the purpose towards which instruction in scientific principles, methods, and results as an element in a liberal education should be directed. Such products of scientific activity belong mainly to the technical school and the workshop, and though a good deal of illumination for the mind may be derived from a study of such things, the primary purpose in the use of physical science in education is in training the powers of observation, the application of the inductive method to the results and the acquisition of such a knowledge of the external world as is necessary to the intellectual life of the modern civilised man. Surely no man brought up under the classical system at school and university can pretend that he is indifferent to the discoveries in electricity, chemistry, and biology in the last half-century. Present knowledge about the constitution of the chemical elements and the application of the principles of evolution have so changed all ideas about the world in which we live and the nature of man himself that such changes can be ignored by no one who claims to be called an educated man.

It may be asked whether it would not be an advantage even to the classical scholar that he should be in a position not only to learn from the newspapers that discoveries have been made, but also to understand something of the nature of the evidence on which they are assumed to be established. It appears, however, that there are people who still think otherwise, and, as governors of schools and universities or Civil Service Commissioners, do not hesitate to place all kinds of obstacles in the way of the new learning and to draw or drive away from the fields of science many of the best brains in the country. Protests have already been raised over and over again at meetings of the British Association, at the British Science Guild, in addresses by presidents of the Royal Society, and at the gathering organised by the Neglect of Science Committee in May last. A fresh and vigorous denunciation of this kind of obstruction was uttered by Prof. Soddy in November last at a meeting of the University Scientific Society at Aberdeen. His subject was "The Future of Science and What Bars the Way," and he began by addressing himself to the consideration of the latter question because he believes that active opposition has still to be overcome before science can take its rightful place in the Scottish universities. He repeats with emphasis what has been asserted already often enough, namely, that some of the older institutions have lost whatever capacity they may once have had for intellectual leadership, and by the inherent qualities of their system they perpetuate a type of man who is out of harmony with the present age, who remains in a world of medieval obscurantism, and is an obstacle in the way of future national reconstruction. A claim is set up for the older studies to an elevating spiritual influence which the present state of the world shows to have failed. In the meantime science has put at the disposal of man physical powers which, in the hands of the barbarian uninfluenced by the humanist, threaten to wreck the world.

The conservatism and exclusiveness of which Prof. Soddy complains are not confined to the Scottish universities. They pervade the schools throughout the kingdom, dominated as most of them are by the classical stronghold of Oxford; and in the public service of the country the statesman, the headmaster, and the divine remain largely blind and deaf to the signs and warnings of the time. They claim not merely to preserve a sanctuary for the memory of departed glories, but their decadent humanism continues to monopolise the avenues to preferment, to positions of influence, opportunity, and honour.

But what will be likely in the address to attract most attention in Aberdeen, and perhaps elsewhere, is the charge which is brought against the University Court of financial jugglery to the disadvantage of science and medicine. Mr. Carnegie in 1901 gave two millions sterling to the Scottish universities for the purposes of scientific study and research as well as payment of the fees of deserving students. Prof. Soddy asserts that owing to the form in which the accounts are published, it becomes possible to divert the money to a large extent from the objects for which it was intended, and that this operation has been applied to the departments of chemistry and geology. Obviously these are matters which will have to be looked into.

In the conflict which is going on there can be no doubt that, assisted as it is by the prominence of the many practical problems, of which the dyes are the most notorious example, science will utimately win the day. The purely classical people will have to give way, and there is evidence that all over the country some progress has been made in the quality of the science teaching in the schools. It is to be hoped that in the triumph of the practical the interests of the liberal will be duly safeguarded. We can no more afford to let go ancient literature and history than modern physics and chemistry. All that the representatives of science ask for is that the new may be admitted to an equal place alongside the old, where both may stand in mutual honour and esteem.

The indifference to the value of science appears to be almost attributable to a natural conservatism inherent in the British character. It certainly has pervaded a large part of the business world up to quite recent times, when the pressure of war-work has served as a wholesome stimulant. The newspapers are full of discussions as to what is to happen when the war ceases, but for the most part they have rather a specialist character. A series of articles appeared in the *Times* of July and August last in which "The Elements of Reconstruction," in reference to the Empire, were discussed in an unusually broad and thoughtful spirit. They have been reprinted with an introduction by Lord Milner,[1] and both articles and introduction deserve to be read carefully and digested by all thoughtful men. The keynote of the whole may be said to be *co-operation*. This means that, in the view of the writers, the methods of business will have to be changed completely; there must be among manufacturers mutual support and confidence instead of suspicion and rivalry; and in the interests of the State many small businesses in competition with one another must be united. There must be national scientific education, and the men who control the industries must be fully qualified by education, liberal as well as special, not only to understand fully their own processes, but to deal in an enlightened spirit with all the problems connected with labour.

Whether the doctrine that food production, fuel, and transport are not to be left under the control of private ownership, but transferred to public administration, will within our time be put into practical operation is a question. The author's opinion is that such a development can be realised, not by the Socialist panacea of "expropriation," but "by amalgamation, by co-ordination and co-operation, by bringing the State into partnership, and an increasing partnership, in the big businesses that result from these amalgamations, by developing the crude beginnings of the 'controlled establishment,' by the *quid pro quo* of profit-sharing and control in the national interest in exchange for the national credit and a helpful tariff."

Labour and trade-unions provide another text which needs much careful thought. A temper must be cultivated free from class hostility and the use of aggressive phraseology. The war has doubtless done some little to clear away jealousy and suspicion between employer and employed, to so large an extent the fruit of traditional misunderstandings. "The efficacy of ignorance," to use an expression of Dr. Johnson's, has been tried long enough, and that is why at the outset the prime importance of education was assumed. It is interesting to notice that in the opinion of the authors of "Eclipse or Empire?" reviewed in NATURE of November 9, the falling-off which they claim to have observed in inventions is due to our defective system of education. Here there are evidently two distinct propositions, of which the former is open to question. If the former is established, there will not be much difficulty in accepting the latter.

The lack of clear thinking is one of the evil influences of the past, and as labour continues to make its voice heard, sometimes above other voices, it is imperatively necessary that the broadening of the higher education in school and university shall be accompanied by a lengthening and deepening of the course in the elementary schools.

[1] Nisbet and Co., Ltd. 1s. net.

ACCESSORY FACTORS, OR "VITAMINES," IN DIET.

It was known to Captain Cook that fresh food, especially green vegetables, contained something which was absent from the preserved food used by him in his voyages, but was necessary to maintain health. Stepp showed, a few years ago, that bread and milk, if extracted with alcohol, did not suffice for the growth of rats, but that addition of the residue from the alcohol extract restored the adequacy of the diet. Hopkins then found that rats are unable to grow on a diet, otherwise complete, composed only of pure protein, fat, carbohydrate and salts, although this diet can be rendered perfectly adequate by the addition of a minute amount of milk. Further research by Osborne and Mendel and others in the United States confirmed these results.

There are, therefore, certain necessary constituents of food the presence of which is not obvious to chemical examination, owing to the very small amount contained. For these substances the name "vitamines" was suggested by Funk, on the basis of chemical work which was afterwards found by him to be incorrect. Unfortunately the word has come into use. Since we are, as yet, ignorant of their chemical nature, which is probably of several kinds, it is preferable to use the longer name, "accessory factors."

An interesting account of some of the aspects of the problem, especially those of practical interest, was given in a lecture by Prof. Carl Voegtlin to the Washington Academy of Sciences, and published in the Journal of the Academy for October 4. After directing attention to such diseases as scurvy and beri-beri, due to deficiency in certain constituents of food, Prof. Voegtlin discussed the chemical nature of "vitamines." They are somewhat readily destroyed by temperatures above 100° C., especially in alkaline reaction. The acidity of lime-juice thus preserves the anti-scorbutic properties of the fresh fruit. They are removed from solution by adsorption on the surfaces of various inert powders, such as kaolin, charcoal, and mastic, a property which will probably be of value in obtaining them in a concentrated form. The lecturer makes a slip, however, when he states that it is necessary that a substance should be in the colloidal state in order that it may be adsorbed. It is merely necessary that its deposition shall reduce the surface energy of the adsorbent; amyl alcohol, for example, is largely adsorbed by powders. According to McCollum there are two kinds of accessory factors which it is necessary to add to polished rice in order to make it effective for growth, neither being sufficient alone. One of these is contained in butter, the other in wheat germ; this latter appears to be insoluble in fat, although soluble in alcohol and in water.

Vitamines are not manufactured by the animal organism, but they do not readily disappear from it when once supplied. It seems that they do not suffer loss by chemical change. This fact suggests that their action is of a catalytic nature, somewhat like that of traces of zinc in the growth of Aspergillus, shown by Raulin. Or they may be related to the hormones of internal secretion.

The remainder of the address is devoted to the consideration of the relative content of various foodstuffs in these substances. It is pointed out that ordinary mixed diets contain a liberal supply, but that tinned foods may be deficient. An exclusive diet of highly prepared cereals, such as polished rice, is dangerous. Owing to the value of fresh vegetables in this respect, we may note the importance of not restricting the import of such fruit as oranges, which are apt to be the only vegetable consumed in the poorer districts of London.

It appears that, although phosphorus is not known to be a constituent of vitamines, yet a fairly accurate index of the vitamine content of cereals may be given by their phosphorus content. With regard to bread, attention is directed to the use of sodium bicarbonate in its manufacture. This is converted on baking into the carbonate, and the resulting alkalinity tends to destroy the vitamines. If acid substances, such as butter-milk or cream of tartar, are also added, the effect is obviated.

Owing to the small quantities of these essential factors which are present in foods, the difficulty of investigation is great. But the problem is being attacked by many workers and valuable results are being obtained.

W. M. BAYLISS.

SIR E. B. TYLOR, F.R.S.

AFTER a period of twilight of seven or eight years and a few days' illness, Emeritus Prof. Sir E. B. Tylor peacefully passed away on the night of January 2, and with his death closes a memorable chapter in the history of anthropology in England.

Edward Burnett Tylor was born at Camberwell on October 2, 1832, and was educated at Grove House School, Tottenham, belonging to the Society of Friends. At an early age he entered his father's business, but his health soon broke down, and he travelled abroad for several years. In 1856 he visited Mexico in company with the ethnologist, Henry Christy, who doubtless stimulated his interest in ethnology. The observations made during this tour were published in his first book, "Anahuac; or, Mexico and the Mexicans" (1861). Thenceforth he led the strenuous, uneventful life of a student. In 1858 he married Miss Anna Fox, of Wellington, with which town he was closely associated until the day of his death.

Tylor never had a university training, but several universities honoured themselves by conferring on him an honorary degree. For many years he was keeper of the University Museum at Oxford, and he took great delight in and did much to improve the Pitt Rivers Museum. He was reader in anthropology in the University of Oxford from 1884 to 1895, when a professorship of anthropology was instituted for him; he became emeritus professor at the close of 1909. The Royal Society elected him to a fellowship in 1871. He had the distinction of being invited to be the first lecturer under the Gifford Trust at Aberdeen, but his lectures, given in 1889–91, have, unfortunately, never been published. The honour of knighthood was conferred on him in 1912. Many other distinctions by learned societies marked the high appreciation in which he was universally held. Tylor was a tall man of imposing appearance, and his friendly, modest courtesy will never be forgotten by those who had the privilege of knowing him.

The publication of his masterly work, "Researches into the Early History of Mankind and the Development of Civilization" (1865), at once brought Tylor to the forefront as an ethnologist. In some respects it was pioneer work, as in it he assembled multitudinous facts culled from a wide range of reading, and so grouped them as to bring out new conclusions. His reputation as a thinker and as an exponent of "ye beastlie devices of ye heathen" was further enhanced by the publication in 1871 of "Primitive Culture: Researches into the Development of Mythology, Philosophy, Religion, Language, Art, and Custom" (2 vols.). His great erudition was presented with such a charming literary style and flashes of quiet humour that the book was read with delight by people of very varied interests. It speedily became a "classic," and such it will always remain. As Andrew Lang said in the "Anthropological Essays presented to Edward Burnett Tylor in honour of his 75th Birthday, October 2, 1907": "The extent of his reading, his critical acumen, his accuracy, his power of exposition, his open mind, and his scientific caution make this book no passing essay, but a possession for ever."

Ten years later Tylor published a most excellent little book, "Anthropology: an Introduction to the Study of Man and Civilization" (1881), which still remains a valuable and suggestive guide for those who desire to know the significance of what Max Müller termed "Mr. Tylor's science."

On looking through the compendious bibliography of Tylor from 1861 to 1907 compiled by Miss Freire-Marreco for the above-mentioned Essays, it is obvious that, apart from his four books, his activity largely manifested itself in lectures, reviews, and addresses. His papers, even when descriptive, were always marked by a breadth of view and an endeavour to drive home the lessons to be garnered from the facts. The most important of these papers is that "On a Method of Investigating the Development of Institutions, applied to Laws of Marriage and Descent," in which it was his "aim to show that the development of institutions may be investigated on a basis of tabulation and classification." In order to indicate the wide range of his studies, the following are some of the subjects of his papers: Games, Australian marriage laws, the origin of the plough and wheel-carriage, the Asiatic relations of Polynesian culture, the winged figures of the Assyrian and other ancient monuments, charms and amulets, the Tasmanians as representatives of Palæolithic man, and totemism. Indeed, there were few aspects of anthropology which he had not investigated, and he enriched all those with which he dealt.

Although Tylor illustrated his theses with a wealth of references, he never permitted himself to be swamped by them. He will always be regarded as the first and foremost exponent of the comparative method in this country, and though, as was natural for a contemporary of Darwin and Huxley, he was imbued with the principle of development, yet he was fully alive to the borrowing of culture and to cultural drifts; thus, ever since 1874 he repeatedly drew attention to the direct cultural influence of Asia on the higher civilisations of the New World and the spread thence of certain elements of that culture among more barbarous tribes. Tylor was always interested in method, and it was mainly by his efforts in this direction that ethnology can now claim to be a science.

A. C. HADDON.

CAPT. F. C. SELOUS.

THE late Capt. Frederick Courteney Selous, whose death in action against the remaining German forces in East Africa has just come as a painful shock to his many friends in the two hemispheres, was born in London on the last day of 1851. His surname—pronounced in the French manner—indicated his French ancestry on the father's side, but his main composition was English and Scottish, and his appearance almost Scandinavian in his blondness and his Nordic violet eyes perhaps the most striking feature in a very charming face. As a young man he was exceedingly good-looking, and always reminded me—after I had been to South Africa—of a not uncommon type of Boer (which, indeed, is a very common type in Holland), similarly blond and with the like violet-grey eyes. I first met him in the early 'eighties at the house of his near relatives, the Garrods, of Harley Street. The great comparative anatomist, Alfred Garrod, was his cousin, and similarly of Huguenot-French origin.

Selous was educated first at Rugby and afterwards in French Switzerland and in Rhenish Germany, so that he entered on his African explorations with a well-filled mind and a trained power of observation. I rather fancy his decided bent for natural history and the pursuit of big game must have arisen from his Garrod connections and the consequent deep interest he took in the Zoological Gardens (Prof. Garrod was prosector there).

He was an African pioneer of the very best type. Always a total abstainer, there was never anything rowdy about him, yet he won the respect and frank liking of the roughest types of men of all races. He was greatly esteemed in the United States. Only three days before the announcement of his death I received a note from the secretary of the New York Zoological Society, recounting a talk with Prof. H. F. Osborn and Colonel Roosevelt about the war, winding up with the question: "*Have* you any news about Selous? We are all so anxious about him."

Selous was not a systematist in zoology, but he was a close and accurate observer of the life-habits of birds and beasts, and in his branch of natural history he contributed much valuable lore to science. If all his contributions were removed from the galleries and drawers of the British Museum, our examples of the African fauna—especially its spectacular fauna—would indeed be poor. Moreover, he added very greatly to our knowledge of birds' eggs, especially the eggs and nests of Palæarctic (and Mediterranean) birds.

His loss will be a source of grief to many, not only here and in the United States, but also in Africa. I should think he was one of those few notable and active men who never made an enemy, not even when he took a strong, almost vehement, line in the matter of the protection of birds from the ravages of the plumage trade, on which subject he made terse and most effective speeches.

H. H. JOHNSTON.

NOTES.

THE question of closer co-ordination between scientific research and practical design in aeronautics has been mentioned more than once in these columns, and it now appears that such co-ordination will be one of the good results following the reorganisation of the Air Board. The inclusion of two representatives of the Ministry of Munitions and of a technical director should ensure the full use of the available scientific data in the design of machines, especially as the name of Dr. T. E. Stanton has been mentioned in connection with the latter appointment. As is well known, Dr. Stanton has been superintendent of the engineering and aeronautical departments of the National Physical Laboratory for many years, and is therefore in possession of all the necessary scientific knowledge in both the aerodynamical and purely engineering branches of the subject. The proposed housing of the various departments of the Board under one roof, and consequent free exchange of ideas between technical experts of both Services, should do much to advance the scientific design of machines. Another excellent feature of the reorganisation is the possibility of standardising component parts of machines and engines for both Services, and thereby improving the rapidity of construction. If we are to maintain our air supremacy, it is necessary that we should have an ample supply of machines of existing proved types, as well as that we should proceed to new designs, and the centralisation of supply and design should assure both these necessities in the future.

IN a series of recommendations made by the Federation of British Industries for the development of Government service for the promotion of British trade in foreign countries, it is suggested that foreign trade should be under a single department operating under Foreign Affairs. The proposed department would undertake the promotion and protection of British trade in foreign countries and the collection and distribution of information relating thereto, support British efforts to secure contracts abroad, and, when possible, make it a condition that goods purchased by loans to foreign countries should be obtained mainly from British sources. Similar functions in regard to Home and Colonial trade should be discharged by the Board of Trade, a Ministry of Commerce, or other appropriate department. With respect to the Diplomatic Service, it is suggested that the staff should be increased with the view of enabling officials to pay more attention to commercial affairs, and that an officer of high rank designated Commercial Counsellor with appropriate assistance should be added. Suggestions are also made for the improved remuneration and training of the members of the Consular Service, promotion to be by merit under the supervision of a Promotions Board. Candidates for the service should be required to pass a general course in economics and commercial methods, and should be conversant with two or more foreign languages. Facilities for such training should be provided at the universities. Officers should also be granted facilities to visit the leading industrial centres at frequent intervals. A staff of experts is also needed to procure detailed information on particular trades, industries, and markets. Finally, the urgency of this reform is pointed out. Steps should be taken immediately in order to be prepared for conditions after the cessation of war.

"MICROBES and the War," with comments on the national neglect of natural science, is the title of a pamphlet by Prof. Ernest Glynn, of the University of Liverpool. The author first describes, in popular language, the various microbial diseases which attack armies in the field, and comments on the measures that have been taken to combat them, which are the outcome of scientific research as to their nature and prevention. Notable instances of these are typhoid fever and anti-typhoid inoculation, cholera and anti-cholera inoculation, Mediterranean fever and its spread by goats' milk, and, among animals, glanders and its recognition by the mallein test. By an appreciation of the vast importance of bacteriological science in the present war, our armies "have won great, though silent and bloodless, victories." Prof. Glynn then proceeds to discuss the general neglect of science by the nation and its disastrous consequences in the present war—our dependence upon the foreigner for dyes, chemicals and synthetic drugs, glassware and optical glass, for example. A Cabinet Minister excused the importation of fat into Germany by the statement that it had only *recently* been discovered that glycerin could be obtained from lard; Woolwich Arsenal advertised for university-trained research chemists at wages of *2l.* *os.* *6d.* per week! Prof. Glynn ascribes the national neglect of science as being largely due to the dominance of vested interests in classics. At Eton, of eighty assistant-masters but five teach science, and the same disproportion holds good for the majority of public schools. The argument is supported by quotations from numerous sources that have appeared during the last two years. The pamphlet is issued by Messrs. Tinling and Co. at the modest price of 3*d.*, and should be widely circulated.

THE death is announced, at eighty-nine years of age, of M. J. B. A. Chauveau, member of the section of rural economy of the Paris Academy of Sciences.

PROF. W. KOLLE, of the Institute of Hygiene and Bacteriology at Berne, has been appointed successor to Prof. Paul Ehrlich in the directorship of the Frankfort Institute for Experimental Therapy.

THE Order of the Nile, Second Class, has been conferred by the Sultan of Egypt upon Mr. S. H. Wells, Director-General of the Department of Technical, Industrial, and Commercial Education in Egypt, and formerly principal of the Battersea Polytechnic.

MR. F. A. STOCKDALE, Director of Agriculture, Mauritius, has been appointed by the Secretary of State for the Colonies Director of Agriculture, Ceylon, and Dr. H. A. Tempany, Government Chemist and Superintendent of Agriculture for the Leeward Islands, has been appointed to succeed Mr. F. A. Stockdale as Director of Agriculture, Mauritius.

CLOSE upon the news of the depredations of the blister rust in the American white-pine forests comes a report from the Department of Agriculture directing attention to the fact that the poplars of the United States are seriously threatened by an outbreak of the European poplar-canker. The States affected include New Hampshire, Massachusetts, Rhode Island, Connecticut, New Jersey, Pennsylvania, Delaware, Maryland, Ohio, and Nebraska. The disease attacks the twigs, limbs, and trunks of the black and Lombardy poplars, and of the Carolina poplars or cottonwoods.

DR. FRANK M. CHAPMAN, curator of ornithology at the American Museum of Natural History, New York, has recently returned from a journey taken largely in order to establish friendly relations with the museums of South America. He has arranged with the directors of several of these museums for regular exchanges of specimens. Many of the directors have also consented to act as local representatives of the New York institution, and to give assistance in the work of exploration. Dr. Ribero, for instance, at Rio de Janeiro, helped Dr. Chapman's party to find favourable spots for collecting in the mountains near that city. Dr. Chapman's report on Colombia is already in type, and reports are in preparation respecting the exploration of Ecuador, Peru, and Bolivia. It is hoped that there may eventually be completed—though not, perhaps, for several generations—a biological survey of the whole of South America, for which the American Museum of Natural History, with the co-operation of the local museums, will be responsible.

AT the annual general meeting of the Faraday Society held on December 18, 1916, the following officers and council were elected:—*President*, Sir Robert Hadfield; *Vice-Presidents*, Prof. K. Birkeland, W. R. Bousfield, Prof. F. G. Donnan, Dr. Eugene Haanel, Prof. A. K. Huntington, and Dr. T. Martin Lowry; *Treasurer*, Dr. F. Mollwo Perkin; *Council*, W. R. Cooper, Dr. C. H. Desch, Dr. J. A. Harker, Emil Hatschek, Cosmo Johns, Prof. A. W. Porter, E. H. Rayner, A. Gordon Salamon, Dr. George Senter, and Cav. Magg. E. Stassano. A general discussion, to be opened by Sir George Beilby, F.R.S., will shortly be held on "The Training and Work of the Chemical Engineer." Later in the session general discussions will probably be arranged to deal with "Osmotic Pressure" and "The Setting of Cements and Plasters."

DR. J. WALTER FEWKES has issued a pamphlet reporting the progress made in the excavation and repair of the Sun Temple at Mesa Verde National Park. The monument was discovered by Dr. Fewkes in 1909, and since then work has steadily gone on in order to excavate and repair this interesting building. The pamphlet issued by Dr. Fewkes contains a full account of the building, with a ground plan, measurements, and photographs, which make it now possible to understand the character and purpose of this remarkable structure.

UNDER the title, "Some Forest Insects in Aberdeenshire," Mr. Walter Ritchie, in the *Scottish Naturalist* for December, cites a remarkable case of a beetle which, in different areas of its range, selects different food-plants, though there is no apparent need for this change in diet. The species in question is *Cryptorhynchus Lapathi*, which, in Central Europe, is a destructive enemy of the alder, but on the Dee, near Aboyne, it feeds on the willow. Though alder trees of various ages were growing in abundance among the willows not a single alder was attacked.

"THE Evolution of Provincial Museums and the Obstacles They Have to Surmount" formed the subject of an admirable address by Mr. F. Woolnough at the Ipswich Conference of the Museums Association of 1916. He complains much, in the *Museum Journal* for December, wherein this address is printed, of the lack of interest taken by the State in the work of museums, hence the want of funds and the restricted usefulness of such institutions. Every museum, he contends, should be provided with a well-equipped lecture-room, wherein the various aspects of this or that section of the collections can be enlarged upon before or after a visit to the actual specimens in the galleries. This provision is not likely to be made in the immediate future, having regard to our depleted exchequer, but nevertheless it is sadly needed.

WE note with regret that the Bill for the introduction of protective measures designed to save some of the more interesting birds of Malta from extermination has been shelved, at least temporarily, as the result of an opposition which depended for success on ability to distort facts, in the supposed interests of local sportsmen and those who gain an easy living by exploiting the bird-life of the island. From the report of the debate in the *Daily Malta Chronicle*, which has been sent us, we learn that the Lieutenant-Governor and the Crown Advocate paid a just tribute to the efforts of Dr. Giuseppe Despott to place this Bill upon the Statute-book. Though the Crown Advocate, in the course of an able and learned speech, showed that the leader of the Opposition was himself but recently urging the very measures he now so strongly opposed, and though he directed a running fire of scathing criticism against the manifold absurdities of the arguments advanced, the Bill was suspended for six months in order that further evidence might be obtained. In the interests of the islanders themselves and of economic ornithology beyond the sphere of operations of this Bill, it is to be hoped that it will presently find a place on the Statute-book.

WITH the November number of the *Quarterly Journal of Microscopical Science* (vol. lxii., part 1) is issued an Index to vols. xxix.–lxi. (inclusive). The preface is signed by Mrs. H. L. M. Pixell-Goodrich, who is presumably responsible for its compilation on the plan adopted by Dr. G. H. Fowler for the index to vols. i.–xxviii. It is an index of both authors and subjects, and will be an invaluable aid to zoologists, who have so frequently to consult this important periodical. Incidentally, also, it constitutes a very interesting record of contributions made, chiefly by British zoologists, to what we may perhaps be allowed to term the more academic branches of zoological science during the past twenty-eight years, a record with which the editor of the journal, Sir E. Ray Lankester, has every reason to be satisfied.

THE caterpillars of that destructive insect, the large larch saw-fly, *Nematus erichsonii*, have been found, and for the first time, in Aberdeenshire. They were met with in considerable numbers during the months of August and September by Mr. Walter Ritchie, who gives a brief account of his discovery in the *Scottish Naturalist* for December, 1916. He found that the area over which these caterpillars were dispersed measured about eight square miles, and this being so, it is well that the discovery has been made now, in order that immediate steps may be taken to check or suppress its extension. The damage, he remarks, caused by this species in England led to its being placed among the insects scheduled under the Destructive Insect Pests Order. By this Order the presence of the insect in any plantation must be reported at once to the Board of Agriculture.

A FURTHER important contribution to the science of animal nutrition in its application to farm animals is furnished by Armsby, Fries, and Braman in their determinations of the net energy values for cattle of red clover hay and maize meal, which are recorded in vol. vii., No. 9, of the *Journal of Agricultural Research*. Results in close agreement with previous determinations were obtained, the general average indicating a net energy value per kilogram of dry matter consumed of 981 Cal. in the case of clover hay, and 1913 Cal. for maize, the total metabolisable energy being 3522 Cal. and 3755 Cal. respectively.

FOR the guidance of farmers the Board of Agriculture has issued a leaflet (Special Leaflet No. 64) on ground-nut cake, a feeding-stuff to which much attention has been given since the outbreak of war. As an important product of British tropical possessions the ground-nut (*Arachis hypogaea*) has an obvious interest, and in view of the high value of its oil for edible purposes and the richness in protein (45 to 50 per cent.) of the press residue, or cake, all efforts to secure its wider use in this country are warmly to be commended. As in the case of palm kernels, the successful development of the industry is largely dependent upon the creation and maintenance of a large and stable home market for the cake, and the Board's leaflet should contribute usefully towards this end.

THE general concern about rising food prices lends a wider interest than it would normally claim to the recently issued Report on Prices and Supplies of Corn, Live Stock, and other Agricultural Produce in England and Wales in 1915 (Agricultural Statistics, 1915, vol. l., part iii.), presented to the Board of Agriculture and

Fisheries by Sir R. H. Rew in October last. Basing his comparison upon the average for the three years 1906–8, he arrives at the general index number of 138 for the year 1915, as compared with 111 in 1914. As compared with the latter year, the greatest increases were in wool (190 as against 133), barley (166 as against 113), and hops (140 as against 92). As compared with the average prices of 1906–8, the highest levels were attained by wool (190), barley (166), and oats (163). A notable exception to the general high rate of increase was fruit, which was only 5 per cent. above the standard selected.

The cereal harvests of Argentina and Australia are now sufficiently advanced to enable the International Institute of Agriculture to issue from Rome its annual survey of the world's supply of cereals available until next year's harvest. From this survey the crops of enemy countries are necessarily excluded, but otherwise all significant grain-producing countries are included. In the case of wheat, the estimate shows a decline of no less than 25·3 per cent. from last year's figure, or 8·8 per cent. below the average for the period 1909–13. An important factor in this decline is the lamentable decrease in the Argentine crop, which is estimated at little more than one-half (52 per cent.) of the average for the above period. In marked contrast the Australian crop is estimated to be 4 per cent. higher than last year, and 64 per cent. above the five-year average. For sixteen countries in the northern hemisphere the crop harvested is 9·1 per cent. below the five-year average. Barley, oats, and rye show increases above the five-year average of 1·1, 2·3, and 12 per cent. respectively. For maize, data for the northern hemisphere only are yet available, and show a diminution of 5·3 per cent. below the five-year average. In every case the contrast with the excellent crops of 1915 is very marked.

At a recent meeting of the National Academy of Sciences, Washington, U.S.A., Prof. W. M. Davis brought forward a proposal for the exploration of the North Pacific Ocean. Some details of the scheme are given in *La Nature* for December 16. Prof. Davis's proposal entails a thorough exploration of vast areas of the ocean in which there are at present few, if any, soundings, not by a single ship, even on the scale of the *Challenger* Expedition, but by methodical, long-continued efforts, presumably by several vessels, and including work in oceanography, biology, geology, and meteorology, as well as in the anthropology of many little-known islands. He suggests that the United States should undertake the work and be responsible for its cost.

A memorial to Sir Francis Drake was erected last summer on the shores of Drake's Bay, on the coast of California. According to the *Geographical Review* for November, 1916 (vol. ii., No. 5), the memorial takes the form of a redwood post bearing a brass plate inscribed with the date of Drake's landing, June 17, 1579, and is, so far as practicable, a replica of the post set up by Drake himself before leaving the bay. The memorial was erected by the Sir Francis Drake Association, a body of persons interested in commemorating Drake's voyage as a milestone in the history of California. There seems to be little doubt that it was in the bay now named after him, and not in San Francisco Bay, that Drake landed in 1579 on his voyage from Panama.

An article on the climate of Salonica which appears in the *Bolletino* of the Royal Italian Geographical Society for December (vol. v., No. 12) is of particular importance at present. The article is based on the data obtained from the two observatories founded in 1891 and 1893 respectively, and published in Vienna and Sofia. From the numerous tables which are given it would appear that in January, the coldest month, the mean temperature is 5·4° C., with an absolute minimum of −7·2° C.; July, the warmest month, has a mean of 26·6° C. The mean annual rainfall is 546 mm., with a marked maximum in late autumn and again in May. July, with a mean of 25 mm., appears to be the driest month. Snow falls on an average of six days in winter. The prevailing winds are south-westerly in summer and northerly in winter.

The *Scientific American* for December 2, 1916, contains an illustrated article on the telescopic rifle-sight of the United States Army. The telescope is of the reflecting prism type, and magnifies six diameters. It is made as nearly as possible dust- and water-proof, and is furnished with a rubber eyepiece to protect the eye of the marksman from the recoil of the rifle. A dovetailed slot on the telescope slides on to a corresponding piece on the service rifle. When detached it is carried in a leather pouch. In sighting, the object is brought on to the point of intersection of the cross lines of the telescope, which is adjusted for ranges up to 3000 yards by means of a milled and graduated screw-head on the left-hand side, and for direction by a smaller screw-head. As in the case of the majority of soldiers the accuracy of sighting with the ordinary sight exceeds the ability to hold the rifle steady enough to secure a hit, it is not intended to issue a telescope sight to every soldier, but only to those who have shown by their skill as marksmen that they have the requisite steadiness of aim to profit by it.

Bulletin No. 147 of the Institution of Mining and Metallurgy contains an account of a discussion on standardisation and the metric system at a recent meeting of the institution. The desirability of employing discretion in the adoption of the principle of standardisation was insisted upon, and it was pointed out that the articles in which standardisation had been successfully achieved by the Engineering Standards Committee are, in general, parts common to all kinds of machinery, such as nuts, bolt-heads, and wires, and not of a complicated character. In the case of plant that cannot be standardised down to details it may be possible to lay down the broad outlines, such as leading dimensions, speeds, and powers. As examples of mining plant which can be standardised completely were instanced the Californian stamp, amalgamating plates, rock crushers, iron or steel trams for underground use, tramway gauges, skips and skip-ways. An important question is whether standardisation should be adopted in terms of our present system of weights and measures, or in terms of the metric system. As regards universality, the metric system has a particular claim to consideration, as it is a system which is continually obtaining official recognition in other countries, while our own system is not. In the immediate future competition in trade will be more strenuous than it has ever been before, and in adhering to our present weights and measures we shall be seriously handicapped; it is therefore necessary to decide at once whether the question of internal convenience shall continue to override all other considerations. There is no doubt that the adoption of the metric system in this country is inevitable sooner or later, and the present time appears to be exceptionally suitable for introducing the reform.

Mr. H. C. Brill is the author of two papers of considerable biochemical interest in the March number of the *Philippine Journal of Science* (*Section A.*). The first deals with the so-called "false" chaulmoogra oil, which is expressed from the seeds of *Hydnocarpus venenata*, Gaertner. Considerable uncertainty exists as to the origin of true chaulmoogra oil, but it is probably obtained from the seeds of *Taraktogenos kurzii*, King. Since the latter oil is admittedly the most promising remedy for the treatment of leprosy, it is highly important to determine whether oils from the seeds of other plants of the same family, such as *H. venenata*, can be substituted for it, thus largely increasing the quantity of the remedy available. The author finds that the oils from *T. kurzii*, *H. wightiana*, *H. anthelminticus*, and *H. venenata* are chemically similar, but differ from the oil of *Gynocardia odorata*. It is therefore to be expected that the physiological action of the former oils would be similar, and the outcome of the author's further work on their physiological properties will be awaited with interest. The second paper establishes the fact that certain edible beans, particularly varieties of the soy bean, contain a substance which, like the "maltol" discovered by Brand in caramel malt, gives a reaction with ferric chloride similar to that given by salicylic acid. Of thirty-two varieties of Japanese, Chinese, and American beans, eight breakfast foods, six coffee substitutes, and four flours, twenty-one of the bean samples, one breakfast food, and four of the coffee substitutes gave positive results when tested by the ferric chloride reaction; but only the four coffee substitutes gave positive results when tested by Jorissen's reaction. In testing for the presence of salicylic acid in beans, it is therefore advisable to use Jorissen's reagent.

MR. J. H. LAVENDER gives some interesting notes in *Engineering* for December 29 on the hardening of screw gauges. From a number of preliminary experiments on different brands of cast steel, one having a high percentage of manganese was selected. The reasons for this selection are as follows:—(*a*) The manganese content of the steel appeared to affect the volume changes in the steel; (*b*) this particular brand of steel could be quenched in oil, and a better surface finish obtained than from one quenched in water. The analysis of the steel gave the following percentages:—C, 0·96; Si, 0·19; Mn, 1·20; S, 0·03; P, 0·02. The furnace used for heating the gauges need not be of any particular kind, so long as the metal is not heated too rapidly and uniformity during heating is obtained. A small Richmond gas furnace is very suitable for the work. From the results given by the pyrometric curves, it was decided to harden gauges from a temperature of 749° C. Gauges quenched from this temperature are quite hard, and the temperature is sufficiently high to provide a fair margin for the hardener. Undue oxidation is prevented by providing a reducing atmosphere in the furnace by means of excess of gas, and by having the quenching tank as near as possible to the furnace. Gauges are tempered in oil at 260° C., sufficient time being given for obtaining uniform temperature throughout the metal. Whale oil is used for cooling purposes. The strain produced by sudden quenching is got rid of during the tempering process, and a trustworthy man, by following the procedure outlined, can produce work which comes within the National Physical Laboratory's requirements.

"THE Wellcome Photographic Exposure Record and Diary" for the new year is issued by Messrs. Burroughs Wellcome and Co., a little volume for the pocket that many photographers would be very sorry to be without. It includes, as in past years, not only what the title indicates, but many tables, formulæ, and other information that photographers need, and the well-known "Exposure Calculator" that has stood the test of many years. The formulæ are, of course, in terms of "tabloids," but as the content of each is given, the user of them knows what he is doing. The price of the diary is one shilling, and special editions are issued for the southern hemisphere and U.S.A.

AN early publication of the Cambridge University Press will be Dr. J. Y. Buchanan's "Comptes Rendus of Observation and Reasoning." It will contain, among others, the following papers:—Recent Antarctic exploration; chemical and physical notes; on ice and brines; on steam and brines; the size of the ice-grain in glaciers; ice and its natural history; Beobachtungen über die Einwirkung der Strahlung auf das Gletchereis; in and around the Morteratsch Glacier; a study in the natural history of ice; the use of the globe in the study of crystallography; on a solar calorimeter used in Egypt at the total solar eclipse in 1882; solar radiation; the total eclipse of August 30, 1905; eclipse predictions; the solar eclipse of April 17, 1912; the publication of scientific papers; the Royal Society; nomenclature and notation in calorimetry; thermometric scales for meteorological use; and the metrical system.

MESSRS. SOTHERAN'S new catalogue (No. 767) of second-hand books in zoology, including big-game hunting, and comprising many works relating to ornithology, should be seen by all in search of bargains in these branches of science, most of the works being priced at a great reduction. We note that the list directs attention to a complete set to 1912 of the Abstracts of the papers printed in the Philosophical Transactions and the Proceedings of the Royal Society; also of the Philosophical Transactions from 1665 to 1910. Messrs. Sotheran announce the continuation, by Mr. W. L. Sclater, of Shelley's "The Birds of Africa." It is hoped to complete the work by the publication of four or five additional volumes.

WE have received from Mr. Humphrey Milford a copy of the general catalogue of the Oxford University Press, issued in November last. It contains 574 pages describing the six sections—one of which is concerned with natural science and medicine—into which the catalogue is divided. An exhaustive alphabetical index of authors, editors, and some titles makes it easy to discover particulars of individual books. The section dealing with natural science runs to thirty-five pages, and describes works on the history and methods of the sciences and on the following, among other subjects:—Mathematics, physics and chemistry, astronomy, geology, biology, and medicine. The illustrations scattered throughout the different sections add to the attractiveness of the catalogue

THE spring announcements of Messrs. Macmillan and Co., Ltd., include:—"A Text-Book of Thermo-Chemistry and Thermo-Dynamics," Prof. O. Sackur, translated and revised by Dr. G. E. Gibson; "Human Physiology," Prof. L. Luciani, translated by Frances A. Welby, with a preface by Prof. J. N. Langley, illustrated, in five vols., vol. iv., edited by Dr. G. M. Holmes; "Community: A Sociological Study, being an attempt to set out the Nature and Fundamental Laws of Social Life," Dr. R. M. Maciver; "The Origin and Development of the Moral Ideas," Dr. E. Westermarck, vol. ii., second edition; "The Economic Annals of the Nineteenth Century," the late Prof. W. Smart, vol. ii., 1821–1830; "Higher Education and the War," Prof. J. Burnet; "Highways and Byways in Wiltshire," E. Hutton, illustrated by Nelly Erichsen.

OUR ASTRONOMICAL COLUMN.

Large Meteor on January 4.—This brilliant object was observed at about 10.20 p.m. at the Royal Observatory, Greenwich; by Mrs. F. Wilson, Totteridge; by the Rev. Canon Grensted, Liverpool; and by the Rev. H. C. Bender, Chelsea, S.W. As viewed from the metropolitan district the meteor traversed the region of Pisces, while, as seen from Liverpool, the path lay amongst the stars in the western part of Canis Major.

Mr. Denning writes us that the data already to hand indicate that the object was very low in the atmosphere, its height being approximately from forty-four to eighteen miles above the earth's surface from a point six miles E.N.E. of Salisbury to four miles S.E. of Tetbury. Had the meteor survived during another twenty-five miles of flight it would have fallen to the ground in the locality about ten miles S.E. of Ross, or twelve miles E. of Monmouth, and this may have actually occurred, though the descent was not observed. The fallen mass may, however, yet be discovered. In the case of the meteorite of October 13, 1914, though the light and detonation were noticed over a considerable area, the fall of the object was not witnessed, but it was accidentally discovered, embedded in the soil, on the following day.

Extra-focal Photometry.—Among the many methods employed in photographic photometry, the extra-focal method developed by Parkhurst has the great advantage that only a simple equipment is required. The plate being exposed in the camera beyond the focus, the resulting images have relative densities varying with the brightnesses of the stars, and, by means of a Hartmann microphotometer, these can be compared with artificial star discs of known relative magnitudes. At the Laws Observatory, University of Missouri, investigations of the method have lately been made by R. H. Baker and Edith E. Cummings, using a 5-in. photographic doublet, attached to a $7\frac{1}{2}$-in. refractor as guiding telescope (Bulletin No. 24). The greatest known source of error is sky-fog, the effect of which is greatest for the fainter stars. This and other possible sources of error have been fully investigated, and means of overcoming them have been found. Tests of the accuracy attainable were made on eight plates containing double exposures of selected circumpolar regions, on which 196 stars were suitable for measurement. The star images ranged from 0·3 to 0·5 mm. in diameter, and it is shown that the advantage of such small images in reducing overlapping and exposure time does not involve any loss of accuracy. The probable error of a single observation was about one-twentieth of a magnitude, so that the extra-focal method compares favourably with other methods. Twelve eclipsing variables are under investigation.

Hyderabad Observatory.—From the annual report of the director of the Nizamiah Observatory, Hyderabad, for the year ending October 5, 1916, we learn that, although serious inconveniences have been caused by the war, substantial progress has been made with the work for the Astrographic Catalogue. Besides the investigation of proper motions by measurement of plates taken at Oxford, Mr. Pocock reports that 134 plates were taken and measured during the year. In zone $-17°$, 143 plates, containing 56,302 stars, have now been completely reduced and the results partly printed, while in zone $-18°$ copy for press has been prepared for 102 plates, containing 42,545 stars. Much work has also been done in connection with the magnitude scales of the various catalogues used in connection with the astrographic work.

EDUCATIONAL POSITION AND OUTLOOK.

After-war problems dominated the various sectional meetings of the Conference of Educational Associations held last week, and the two schemes of reform suggested by the Education Reform Council and the Workers' Educational Association were frequently in evidence. Three main lines of thought could be noted. One took up the burden of the Master of Balliol's inaugural address in his insistence upon the need for an educated democracy. Thus Principal Maxwell Garnett, of the Manchester School of Technology, speaking on the vocational outlook before the Child Study Association, urged that primitively interest was aroused by things to be done; thus permanent neurographic records were formed, and from these neurograms interest systems were created which tended always to grow. Hence it was wise to develop a single wide interest and a power of concentrated attention, and such interest systems, developing in adolescence, if centred round one's vocation, would produce a body of workers who would be at once more effective and more contented. At the same time, there was need to reserve from all classes those who would become prophets and thinkers. This last was the note of Prof. Shelley's address before the Teachers' Guild; a healthy democracy must evolve an aristocracy whilst at the same time fostering the forces that would destroy it, and always there must be a selection of the most vigorous personalities who would express the ideals and aspirations of the age. This involved, as Principal Garnett also insisted, some other method than the crude intellectual test of selecting those who should proceed by scholarships to higher centres of learning. Prof. Gilbert Murray had pointed out at the previous meeting the corollary to this, that there should be secured to the youth of all classes the best education for which each was intellectually fitted.

A second main line of thought had to do with the classics-science controversy, with science in favour. Thus Sir Alfred Keogh, presiding at the Education Reform Council meeting, urged that the lack of knowledge of elementary facts of science and Nature shown by Ministers and administrators was a national misfortune, and that every boy destined for public life should have a very liberal education both in science and classics. The other side was given at the Association for the Reform of Latin Teaching, where, however, Dr. Rouse deplored the almost complete failure of the reformers to influence the teachers of classics. On the question of the teaching of science in secondary schools, an interesting point was raised by Prof. Nunn, in the discussion on women's work in boys' schools, before the Froebel Society. He thought that whilst the biological sciences were safe in their hands, the physical sciences were not. Such practical developments of mathematics and the physical sciences as engineering were nearer to men's interests, and if women were to treat these in any but an academic manner they must be brought into direct contact with such practical developments.

A third main line of thought was that of the position, prestige, and salaries of teachers. At no previous conference has this point been so frequently emphasised by chairmen and lecturers, and in reference to all grades and classes. Greater culture and efficiency and a wider training were constantly in demand, and to attract the right men and women to the profession a more generous recognition and remuneration were needed—and the teachers were not those who insisted; they only applauded.

The annual meeting of the Geographical Association was held at the London Day Training College on January 5–6, with Sir Thomas Holdich, president, in the chair. The position of geography as the bridge subject between the humanistic and the purely scientific studies was well brought out in the papers and discussions. Mr. H. J. Mackinder, M.P., in opening a discussion on the resolutions drawn up by the Five Associations, quoted a statement issued by the council of the Geographical Association with regard to the teaching of geography. In this document the object of teaching geography in schools is said to be to train future citizens to imagine accurately the interaction of human activities and their topographical conditions. It is pointed out that as these conditions have been established partly by natural forces and partly by human effort, any discussion of the correlation of the various conditions must be both scientific and humanistic. The case is summed up thus:—"The unity of geography, for school purposes at any rate, is essentially humanistic, and on one side related closely to history, but the assembling of the physical data is a very important part of geographical teaching and cannot be left to the teacher of other subjects."

Two other papers brought out the relationships of geography, and at the same time curiously emphasised the fact that geography is a subject in itself. Prof. Fleure read a paper on "Regions in Human Geography," which was saturated with humanism, and was marked by a strong historical flavour, and yet was in no sense history. "Correlation of various conditions" within a region is essentially geography, whatever is or is not. "Though essentially humanistic" and "related to history," geography has a unity of its own. Prof. Nunn read a paper to a joint meeting of the association and the Mathematical Association on "Map Projections." The relationship of geography to science was taken for granted in the meeting, just as the joint meeting last year with the Historical Association took the humanistic relation for granted. What was perhaps more striking with regard to the paper was the different point of view of the geographer from that of the mathematician, even a most sympathetic mathematician, in regard to this almost purely mathematical subject. It was quite evident that while both geography and mathematics gain immensely by correlation, yet there is very distinct work for each. The danger of leaving projections for geographical work entirely to the mathematical teacher, or, indeed, for mathematical training to be left to the geographical teacher, was unmistakable. Again, to quote the statement, "the assembling of the physical data . . . cannot be left to the teachers of other subjects." The last sentence of the statement stands true: "Experience has shown that the art of geographical correlation depends on specially trained habits of thought."

The Mathematical Association held its annual meeting on January 5, under the presidency of Prof. Whitehead. After the business meeting—at which Prof. T. P. Nunn was elected president for 1917–18—Prof. Nunn read an important paper on "The School Course in Geometry," illustrated by many interesting models and practical devices. He urged that geometry should be closely connected with the facts of life and that the pupils should approach it through practical work of various kinds; that many topics which have hitherto been postponed to a late stage or omitted altogether—*e.g.* certain facts of solid geometry and the simpler properties of the conic sections—should be introduced at a comparatively early stage; and that the reasoning, while of a nature suitable to the stage reached, should throughout be careful and rigid. In this connection he distinguished three stages: the first that of simple intuitional reasoning in connection with direct experience; the second that of deductions based upon the assumption of certain fundamental truths; and the third that of constructing a system of geometrical truths on the smallest possible basis of assumptions.

The afternoon session opened with an inspiring address from Prof. Whitehead on "Technical Education." His main thesis was that a liberal education should in all cases be in close touch with the activities of life; and it should include in varying proportions the literary, scientific, and technical elements. These should be closely connected; technical education needs the enlightenment of science, intellectual education lacking some relation to handwork is barren, while the literary element supplies that wider contact with other life and thought which is essential to healthy mental life. Only so can we reach the ideal in which "work is play and play is life," and nothing but harm can come of the assumption that the practical world is one in which high ideals can have no place.

Later in the afternoon Mr. P. Abbott opened a discussion on "The Place of Mathematics in Educational Reconstruction," dealing chiefly with the mathematics suitable for continuation schools. Other speakers dealt with other aspects of the subject.

The twenty-fifth annual general meeting of the Incorporated Association of Headmasters was held at the Guildhall, London, on January 8. The Rev. J. R. Wynne-Edwards (Leeds Grammar School), in his presidential address, said that in science teaching in schools two chief objects are in view—first, the acquisition of facts that "every educated man ought to know," the laws of Nature, the constitution of our planet and its atmosphere, the chief properties of light, heat, and electricity, and their bearing on daily life; and secondly, the investigator's respect for truth, his determination to observe phenomena irrespective of preconceived ideas, and to reason on observed facts without being hampered by preconceived theories. Of these two objects the second is by far the more important. It is agreed that the time has come to improve our system of science teaching and to bring science to bear more fully on the problems of our daily life; but difficulties present themselves the solution of which will tax all the ingenuity of the nation. At present there is not an adequate supply of teachers, and it is absolutely essential that a solution of this difficulty should be found. Another difficulty is to adapt science teaching to the need of industry without taking away its power as an intellectual stimulus, and to persuade the manufacturers of the country that it is to their interest to have the very best advice that science can give them and to pay for it accordingly. One still hears of graduates serving in Government munition works as science experts at 2*l.* a week, which they are prepared to accept in their anxiety "to do their bit" for their country, while workmen in the same works may be earning their 5*l.* or 6*l.* per week. There are, however, signs of a change, and the great demand and very limited supply of expert science men is giving rise to abnormal conditions.

The following resolution was carried by 70 votes to 15: "That it is of the highest importance to the welfare of this country that the decimal system of weights and measures be adopted, and that this association approves of the policy and aims of the Decimal Association, and invites its members to support the proposals."

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES FOR 1916.

MATHEMATICS.—The Grand Prize of the mathematical sciences. No memoir was received dealing with the question proposed, but a prize of 2000 francs was awarded to N. E. Nörlund, professor at the University of Lund, for his work on the linear equations in finite differences. The Bordin prize, Georges Darmois and Bertrand Gambier each an honourable mention (1000 francs); the Poncelet prize to Charles de la Vallée Poussin, for the whole of his contributions to mathematics; the Francœur prize to (the late) René Eugène Gateaux, for his work on the functional calculus.

Mechanics.—The Montyon prize to E. Mérigeault, for his work on the theory of ventilators and centrifugal pumps and on internal-combustion motors. No memoir was received on the subject proposed for the Fourneyron prize. The H. de Parville prize to Leonardo Torres y Quevedo, for his researches on calculating machines and other mechanical inventions.

Astronomy.—The Lalande prize (increased to 1000 francs) to Jérôme Eugène Coggia, for his astronomical work as a whole; the Valz prize to Giovanni Boccardi, for his researches on the variation of latitude; the Janssen prize to MM. Ch. Fabry, Henri Buisson, and Henry Bourget, for their researches on the determination of the temperature, and evaluation of the atomic weights of the unknown gases in the nebula of Orion; the Pierre Guzman prize was not awarded.

Geography.—The Delalande-Guérineau prize to Sir Ernest Shackleton, for his explorations in the Antarctic continent; the Gay prize to Henri Vallot, for his topographical studies in the French Alps; the Tchihatchef prize was not awarded; the Binoux prize to Eugène Prévot, for his work in geodesy and topography.

Navigation.—The prize of 6000 francs between M. Marbec (3000 francs), for his rapid adaptation of the vessel *Gharb* as a water-carrier to Gallipoli, P. Dumanois (2000 francs), for his work relating to the installation of Diesel motors on submarines, and M. Le Matelot (1000 francs), for his practical method of determination of position near the coast; the Plumey prize (2000 francs) to Louis Barbillion, for his researches on governing motors used in connection with dynamos.

Physics.—The La Caze prize is not awarded; the Kastner-Boursault prize to (the late) Eric Gerard; the Hébert prize to Jules Lemoine, for his work on the optical effects of electricity; the Hughes prize to (the late) L. Chaumont, for his memoir on Kerr's phenomenon.

Chemistry.—The Montyon prize (unhealthy trades) to (the late) Alexandre Hébert, for his researches relating to the hygiene of workshops; honourable mentions (1500 francs each) to Charles Samuel Banzet, for his work on respiratory masks for use against noxious gases either at the front or in works, and to Paul Langlais, for his apparatus designed to protect workpeople against fumes at shell works; the Jecker prize to (the late) Paul Lemoult, for the whole of his chemical work; the La Caze prize is not awarded; the Cohours foundation: the arrears to (the late) Jacques Bongrand; the Houzeau prize to (the late) Edouard Bauer.

Mineralogy and Geology.—The Victor Raulin prize to J. de Lapparent, for his work on eruptive rocks.

Botany.—The Desmazières prize to F. Renault and J. Cardot, for their work on the mosses of Madagascar; the de Coincy prize to R. Souèges, for his researches on the embryogeny of the Ranunculaceæ and Cruciferæ; the Montagne and de la Fons Mélicocq prizes are not awarded.

Anatomy and Zoology.—The Cuvier prize to Edouard Chevreux, for his work on the Amphipods; the Savigny prize to Ed. Lamy, for his malacological studies; the Thore prize is not awarded.

Medicine and Surgery.—Montyon prizes to Octave Laurent (2500 francs), for the whole of his work in surgery; Edmond Sergent and Henri Foley (2500 francs), for their works on recurring fever; Maurice Letulle (2500 francs), for his book on pleuro-pulmonary tuberculosis; mentions to Jules Glover (1500 francs), R. J. Weissenbach (1500 francs), and Henri Stassano (1500 francs); the Barbier prize to G. Moussu, for his researches on the local reactions to tuberculin in domestic animals; the Bréant prize (arrears of interest) to J. Havet (2000 francs), for his work on the nervous system of invertebrates; Mme. Marie Phisalix (2000 francs), for her researches on the poison apparatus and poisons of lizards and snakes; Frédéric Bordas and S. Bruère (1000 francs), for their work on the accelerating action of farm manure on the rapid destruction of dead bodies; the Godard and Mège prizes are not awarded; the Bellion prize to (the late) Richard Millant, for his work on opium poisoning; the Baron Larrey prize to Dr. Lasnet, for his essay on the organisation and working of the medical service in Colonial expeditions, A. Tournade receiving a very honourable mention for his work entitled "The Organisation and Working of No. 13 Temporary Hospital of Verdun."

Physiology.—The Montyon prize to M. Couvreur, for the whole of his work in experimental physiology; the Lallemand prize, divided equally between Aldo Massaglia, for his researches on glycosuria, and L. Launoy, for his work on the thyroid, parathyroid, and thymus glands; the La Caze prize is not awarded; the Pourat prize to MM. Mayer and Schaeffer, for their contributions to the physico-chemical properties of the cell and its tissues; the Martin-Damourette prize is not awarded; the Philipeaux prize to Antoine Magnan, for the whole of his work relating to the influences of the medium, movement, and feeding on organisms.

Statistics.—The Montyon prize to Charles Perrier, for his memoir on the criminal skull.

History and Philosophy of Science.—The Binoux prize between Joaquim Bensaude (1000 francs), for his book on nautical astronomy in Portugal at the period of the great discoveries, and (the late) Louis Couturat (1000 francs); a mention (500 francs) to E. Doublet, for his works relating to the history of astronomy and meteorology.

Medals.—The Berthelot medal to Paul Lemoult, Alexandre Hébert, and Edouard Bauer.

General Prizes.—The Bordin prize is not awarded; the Jean Reynaud prize to the late Henri Amagat, for the whole of his work; the Baron de Joest prize to Ernest Esclangon, for his researches on the sound phenomena produced by cannon and projectiles; the Houllevigue prize to Edmond Bordage, for his studies on the fauna and flora of Réunion; the Saintour prize is not awarded; the Henri de Parville prize to Auguste Barbey (1000 francs), Louis Raveneau (500 francs), Daniel Bellet (500 francs), and E. Montoriol (500 francs); the Lonchampt prize to Mlle. Thérèse Robert (2500 francs), for her researches on the function of calcium salts on the growth of plants, and H. Busquet (1500 francs), for his physiological and pharmacodynamical researches; the Wilde prize to M. Mansuy (2000 francs) and F. Garrigou (2000 francs), for the whole of their work; the Caméré prize to M. Freyssinet, for his novel applications of reinforced concrete; the Gustave Roux prize to (the late) Michel Longchambon (2000 francs), for his geological and petrographical work; the Thorlet prize to Adolphe Richard; the Lannelongue foundation between Mmes. Cusco and Rück; the Laplace and Rivot prize is not awarded; the Trémont foundation (1000 francs) to Charles Frément, for his work on the deformations of metals submitted to stresses; the Gegner foundation to A. Claude (2000 francs) and Mlle. I. Ioteyko (2000 francs); the Jérôme Ponti foundation to MM. Battandier and Trabut, for their botanical work in northern Africa; the Henri Becquerel foundation is not awarded.

BONAPARTE FOUNDATION.

The committee has had to examine thirteen requests for grants from the Bonaparte Fund. The following grants are recommended:—(1) Charles Alluard (4000 francs), for continuing the publication, in conjunction with R. Jeannel, of the scientific results of three expeditions in eastern Africa (1903 to 1912).

(2) M. Bondroit (2000 francs), for collecting the material in France necessary for the constitution of a fauna of French ants.

(3) Pierre Lesage (2500 francs), for the continuation of his experiments on the plants of the coast zone, and in particular his researches on the transmissibility of the characters acquired by plants watered with salt water.

(4) The Touring Club de France (3000 francs), to contribute to the establishment of the new botanic garden at Lautarel (Hautes-Alpes).

(5) Camille Sauvageau (3000 francs), for extending to the species of Laminaria of the Mediterranean and the Channel the remarkable discoveries of the author on the development of a single species which grows in the Bay of Biscay.

(6) Em. Vigouroux (2000 francs), to contribute to the purchase of apparatus useful for the continuation of his interesting researches on the state of silicon dissolved in metals.

(7) Raoul Bayeux (2000 francs), to aid him in continuing his researches on the physiological effects and the therapeutics of hypodermic injections of gaseous oxygen. The author proposes to study experimentally the action of hypodermic oxygenation on the defensive reactions of the organism against asphyxia and against infections.

(8) Joseph Laïs, as a contribution to the expense of photogravures relating to the photographic chart of the heavens, the copper-plates to become the property of the Paris Observatory.

The committee has in reserve, after payment of these grants, 55,000 francs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE fifth election to Beit Fellowships for Scientific Research will take place on or about July 15. Not more than three fellowships will be awarded. Applications must be received on or before April 16. Forms of application and all information may be obtained, by letter only, addressed to the Rector, Imperial College, South Kensington, London, S.W.

DR. W. H. HADOW, Principal of Armstrong College, Newcastle, and Vice-Chancellor of Durham University, has been appointed a member of the committee to consider and report on the scheme of examination for Class I. of the Home Civil Service in lieu of Mr. H. A. L. Fisher, who has found it necessary to resign membership of the committee on assuming the duties of the President of the Board of Education.

"EDUCATION in the Universities after the War" is the subject of a lecture to be delivered by the Master of Balliol next Tuesday evening, at 5 o'clock, at the meeting-room of the Society of Antiquaries, Burlington House, Piccadilly. Mr. Fisher, Minister of Education, will preside. The lecture will be one of a series on "Reconstruction," to be given every Tuesday during January and February. Applications for reserved seats may be made to the hon. secretary, United Workers, 175 Piccadilly, W.

ON December 15 last the degree of Doctor of Medicine *honoris causa* was conferred by Malta University on Col. Ch. A. Ballance, C.B., M.V.O., Col. Wm. Thorburn, C.B., Col. Arch. E. Garrod, C.M.G., F.R.S., and Col. Howard H. Tooth, C.M.G. Lord Methuen, the Governor of Malta, presided, and a Latin address was delivered by Prof. A. Bartoli, and a speech made by the rector, Prof. E. Magro. In his concluding remarks Lord Methuen said Col. Ballance had been in Malta from the time the hospitals were started, Col. Thorburn arrived shortly after, and, together with Col. Garrod and Col. Tooth, they had rendered services to the patients that could not be over-estimated.

THE shortage of colour sensitisers for photographic plates, and the difficulties thereby incurred in the colour-printing trade, are affording another example of the fact that when the requisite stimulus is applied the chemical resources of the country are quite able to meet industrial needs. The Leeds Education Committee, through its Technical School, having become aware of the situation in the colour-printing trade, approached the Leeds University, and the work of supplying the necessary sensitisers has been taken in hand under a joint scheme of research. A preliminary report gives a full description of the preparation of two dyes, formocyanine and tolucyanine, which are stated to be identical in their sensitising powers with those of the German products hitherto used. The work is being continued.

THE School of Oriental Studies at the London Institution is, we learn from the *Times*, to be formally opened by the King near the end of next month, but classes will begin on January 18. A preliminary announcement which has been circulated states that at the outset teaching will be provided in seven groups of languages, comprising twenty different tongues; but it is hoped at an early date to extend the scope of the school. Courses on the history, religion, and customs of Oriental and African countries will form a special feature in the teaching of the school. The Senate of the University of London has assented to the transfer to the school of the teachers in the Oriental departments at University and King's Colleges, excluding certain subjects, such as Egyptology, Assyriology, and Hebrew. The Oriental staffs have accordingly been transferred to the school, but since the teaching at the colleges has been on a restricted scale numerous additional appointments have been made. The school is intended to provide London with a centre for Oriental teaching adequate to the needs of the metropolis and of the Empire, and one that will remove the reproach that London has hitherto been without an Oriental School comparable with those of Paris, Petrograd, and Berlin.

UNDER the will of the late Miss A. F. Yule, the daughter of the late Sir Henry Yule, the house and grounds of Tarradale, or Taradale, in the county of Ross and Cromarty, where Sir Roderick Murchison was born in 1792, are left in trust "to be preserved for ever to the use and enjoyment of my countrymen under the style and title of the Murchison of Taradale Memorial." The executors are left a wide discretion in interpreting the objects of the testatrix, but the idea expressed is that the house, with all its contents, including a library extending to more than 20,000 volumes, should form "a place of rest and refreshment for poor scholars or other students, preferentially, but not exclusively, those no longer young," and preferably also of Scottish birth or descent. If funds do not permit otherwise, the house may only be kept open for three or four months in the year. The desire is also expressed that the grounds of Tarradale House should form a sanctuary or reserve for the preservation of the wild life of the Highlands, more especially for wild birds, and the trustees are given power to lend the house and grounds to any one or more of the Scottish universities, for a limited period, for purposes of scientific research, exclusive of experiments on living animals. The whole residue of the estate, apart from a few small legacies to servants and others, is left to the trustees for the purposes of the trust to form a maintenance fund for carrying out the objects named. Should there be any funds in excess of the requirements of the original scheme, the trustees are directed to utilise them for the establishment of "Murchison of Taradale Memorial Bursaries" at any of the Scottish universities or places of secondary education in Scotland or elsewhere, for the assistance of young natives of Ross-shire of either sex of any age between fourteen and twenty-four, preferably those able to speak and write the Gaelic language.

SOCIETIES AND ACADEMIES.

LONDON.

Faraday Society, December 18, 1916.—Sir Robert Hadfield, president, and later Prof. A. W. Porter, in the chair.—Ezer **Griffiths** and E. A. **Griffiths**: A carbon tube furnace for testing the softening points and compressive strengths of refractories. The paper describes a carbon tube furnace designed for the testing of refractory materials under definite load. The specimens are cut from the brick and ground up into the form of short cylinders. Pressure is applied by means of springs suitably connected to carbon rods which carry the specimen under test. Two simple forms of electrode construction are described. In one of them the current is carried by two copper tubes bent into a zigzag form, and cast into two blocks of white bearing metal. The faces of the blocks are cast to the form of the carbon tube to which they are clamped. The copper tubes also serve for water cooling. The temperature of the specimen is directly observed by means of a polarising type of optical pyrometer.—Prof. E. D. **Campbell**: Do equiatomic solutions in iron possess equal resistances? The conception of steel as a solid solution has long suggested a relationship between its chemical composition and resistance. Benedicks, in 1902, laid down the general law that equiatomic solid solutions in iron possess equal resistances. The experimental work of Arnold has shown the assumptions underlying Benedicks's law to be untenable, and the object of the author's experimental work was to seek a more satisfactory hypothesis. The experiments, which are fully described in the paper, were carried out on seven steels of varying composition, and their specific resistances were measured in both the hardened and annealed states. The deviations from the calculated values cannot be explained on Benedicks's assumption, but they suggest that it is the *molecular* concentration of the *carbides* in solid solution, and not the *atomic* concentration of the *carbon*, which determines the influence on the specific resistance exerted by such solutes.—R. H. **Sherry**: Grain-growth in deformed and annealed low-carbon steel. Coarse crystallisation or grain-growth in pure iron and low-carbon steels permanently deformed and annealed has from time to time caused no little difficulty to workers in sheet, wire, cold-drawn bar, and pressings of these materials. The present paper, based on an extended investigation, explains the conditions under which grain-growth occurs.—R. G. **Parker** and A. J. **Dalladay**: The union of glass in optical contact by heat treatment (see NATURE, December 21, 1916, p. 317).—Prof. W. C. McCullagh **Lewis**: The effect of pressure on the equilibrium constant of a reaction in a dilute solution: A simple proof of the expression. The paper indicates a simple mode of deducing the effect of external pressure on the equilibrium constant of a reaction in dilute solution. The method, which involves the simple concept of maximum work, may be found to be of use by teachers of physical chemistry, as students generally find the method of Planck somewhat difficult.

Geological Society, December 20, 1916.—Dr. Alfred Harker, president, in the chair.—Dr. Marie C. **Stopes**: Recent researches on Mesozoic "Cycads" (Bennettitales). The paper dealt particularly with recently discovered petrified remains which reveal their cellular tissues in microscopic preparations. The distribution of a few of the most interesting representatives of the Bennettitales (including the cohorts Bennettiteæ and Williamsoneæ) was shown in a table. The group is by far the most characteristic of all the plants of the Jurassic and Lower Cretaceous, during which periods its distribution was almost world-wide. It was locally, if not universally, dominant, and was the most highly evolved plant-group of the epoch of which we are cognisant. Three chief points of interest are noted in the geological distribution of these plants:—(*a*) That the most numerous highly specialised trunks reach their maximum in the Jurassic and Lower Cretaceous periods, when their distribution was practically world-wide; (*b*) that the oldest and therefore presumably the most primitive type, Wielandiella, is externally less like the living Cycads than the commoner later forms, while these latter are utterly unlike the living genera in their fructifications; (*c*) that the geologically youngest cone is the largest yet discovered, occurring in the Gault when the extinction of the group appears already to have set in. Contrary to what might have been anticipated from their external likeness to the living Cycads, coupled with their great geological age, the fossil "Cycads" are much more complex and on a higher level of evolution than the living group. It seems to the author to be extremely unlikely that the fossil and the living forms have any direct phylogenetic connection nearer than a remote, unknown, common ancestor. The mooted connection between the fossil "Cycads" and the Angiosperms is highly suggestive, but lacks data for its establishment.

Royal Microscopical Society, December 20, 1916.—Mr. E. Heron-Allen, president, in the chair.—A. **Bacot**: Note on the relation between the hatching and development of the larva of the yellow-fever mosquito (*Stegomyia fasciata*) and the presence of bacteria and yeasts. In sterile water or in "killed" cultures of various bacteria and yeasts, the author found that the proportion of mosquito eggs unhatched within a normal period was much larger than when a living culture or stagnant water teeming with organic life was employed. Of the "refractory" eggs first mentioned a large proportion hatched out at once on the addition of a small quantity of brewer's yeast, or other living micro-organisms, to the previously sterile fluid.—Prof. S. J. **Hickson**: Certain sessile forms of Foraminifera. After discussing the observations of Schultze and Carpenter, the author gave his reasons for regarding the foraminifer described by the former as identical with *Polytrema miniaceum*, but that studied by the latter as being a different organism, for which he now proposed the new generic name of Homotrema; and then detailed the differential diagnosis of the two forms. The author next dealt with the form known as *P. cylindricum*, Carter, which he regarded as the type of a new genus, Sporadotrema; all these forms he regarded as having secondarily acquired the sedentary habit after a previous free existence, in contrast with the genus Gypsina, which he considered had always been sedentary and encrusting in its habit.—E. J. **Sheppard**: Note on an exhibit showing migration of nuclear material into an adjacent cell. A slide of the "pollen mother-cells" of *Lilium candidum* was exhibited showing migration of nuclear material (chromatin) from one cell nucleus into the cytoplasm of an adjacent cell, the migration chromatin being preceded and almost surrounded by a liquefaction or absorption zone of the cytoplasm. So far no fusion of the chromatin with that of its "receptor cell" had been observed, and no explanation of the phenomenon was offered.

PETROGRAD.

Imperial Academy of Sciences, October 19, 1916.—M. D. **Zalésskij**: The carbon flora discovered by V. N. Robinson and J. I. Nikšić in the N. Caucasus.—A. A. **Čuprov**: The mathematical expectancy of the coefficient of dispersion.—V. V. **Zalenskij**: The fate of the spermatozoa and the segmentation of the ovum of *Salpa africana*.—I. A. **Balanovskij**: The new variable in Hercules.—L. S. **Kolovrat-Červinskij**: The disengagement of the emanation from solid or fused radium salts.—P. A. **Zemiatčenskij**: Deposits of fireproof clay in the neighbourhood of Latna, on the Kiev-Voronež Railway, Lepecka (Tambov Government), and Čirikov, on the Griaze-Orlov Railway (Voronež Government).—V. V. **Redikorcev**: New pseudo-scorpions.—V. A. **Lindholm**: Contributions to the malacological fauna of the Government of Nižnij Novgorod.—N. S. **Kurnakov**: The discovery in Russia of potassium chloride or sylvine.

November 2, 1916.—N. Ja. **Cinger**: The most useful species of conic projections.—S. I. **Metalnikov**: The problem of the immortality of unicellular protozoa.—N. A. **Bush**: Valuable trees of the Caucasus.—N. V. **Nasonov**: Supplementary notes on *Ovis orientalis*, Gmel.—A. **Martynov**: Supplementary note on the Trichoptera fauna of the Crimea.

SECTION OF HISTORICAL SCIENCE AND PHILOLOGY, October 26, 1916.—N. Ja. **Marr**: The date of the Mosoch migration from Armenia to Svania.

November 9, 1916.—K. A. **Inostrancev**: The Charput inscription (561 H.).

BOOKS RECEIVED.

The High Price of Sugar and How to Reduce It. By H. H. Smith. Pp. iv+54. (London: John Bale, Ltd.) 1*s.* net.

Atoms. By Prof. J. Perrin. Translated by D. Ll. Hammick. Pp. xiv+211. (London: Constable and Co., Ltd.) 6*s.* net.

Laboratory Manual of General Chemistry, with Exercises in the Preparation of Inorganic Substances. By A. B. Lamb. Pp. vi+160+pp. for Notes. (Cambridge, Mass.: Harvard University Press.)

Australia. By Prof. J. W. Gregory. Pp. 156. (Cambridge: At the University Press.) 1*s.* 3*d.* net.

The Classics of International Law:—Synopsis Juris Gentium. By Prof. J. Wolfgang Textor. Edited by Prof. L. von Bar. Vol. i., A Reproduction of the First Edition Vol. ii., A Translation of the Text. By J. P. Bate. (Washington: Carnegie Institution.)

The Interferometry of Reversed and Non-reversed Spectra. By Prof. C. Barus. Pp. 158. (Washington: Carnegie Institution.)

Sissano: Movements of Migrations Within and Through Melanesia. By W. Churchill. Pp. 181. (Washington: Carnegie Institution.)

A Naturalist in Borneo. By the late R. W. C. Shelford. Edited, with a biographical introduction, by Prof. E. B. Poulton. Pp. xxvii+331+plates xxxii. (London: T. Fisher Unwin, Ltd.) 15*s.* net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 11.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—The Amazon River and Unexplored South America: J. Campbell Besley.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Principles Involved in Computing the Depreciation of Plant: F. Gill and W. W. Cook.

FRIDAY, JANUARY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Probable Motions in the Spiral Nebula M 51 (Canes Venatici) found with the Stereo-Comparator.—S. Kostinsky.—A Determination of the Constant of Aberration: S. S. Hough.—(1) The Part played by Rotation in Cosmic Evolution: (2) Note on the Action of Viscosity on Gaseous and Nebular Masses: J. H. Jeans.—Observations made at Adelaide during the Annular Eclipse of the Sun, July 30, 1916: Adelaide Observatory.

MALACOLOGICAL SOCIETY, at 8.—*Patella vulgata*, L., and its so-called Variety, *P. depressa*, Penn.: Rev. Dr. A. H. Cooke.—The Occurrence of Manganese in Mollusca: Dr. A. E. Boycott.—Note on the Holotype of *Crioceratites bowerbanki*: J. de C. Sowerby and G. C. Crick.

MONDAY, JANUARY 15.

VICTORIA INSTITUTE, at 4.30.—Christian Mysticism: Very Rev. Dean Inge.

TUESDAY, JANUARY 16.

ROYAL INSTITUTION, at 3.—The Old Brain and the New Brain, and their Meaning: Prof. C. S. Sherrington.

ROYAL STATISTICAL SOCIETY, at 5.15.

MINERALOGICAL SOCIETY, at 5.30.—Tapiolite in the Pilbara Goldfield, Western Australia: E. S. Simpson.—Palæophysiology; the Organic Origin of some Minerals occurring in Sedimentary Rocks: J. V. Samojloff.—The Simondium Meteorite: Dr. G. T. Prior.

WEDNESDAY, JANUARY 17.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Presidential Address: Alcide d'Orbigny, his Life and his Work: E. Heron-Allen.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Annual General Meeting.—Presidential Address: The Winds of North Africa: Major H. G. Lyons.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.

THURSDAY, JANUARY 18.

LINNEAN SOCIETY, at 5.—The Comparative Morphology of the Sorus of Ferns: Prof. F. O. Bower.

MATHEMATICAL SOCIETY at 5.30.

ROYAL SOCIETY OF ARTS, at 4.30.—Between the Tigris and the Indus. The Beni-Israel: Sir T. H. Holdich.

CHEMICAL SOCIETY, at 8.—Alloys of Copper and Tin, Aluminium and Gold: Col. C. T. Heycock.

FRIDAY, JANUARY 19.

ROYAL INSTITUTION, at 5.30.—Soap Bubbles of Long Duration: Sir James Dewar.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

SATURDAY, JANUARY 20.

ROYAL INSTITUTION, at 3.—The Lakes and Mountains of Central Africa: A. R. Hinks.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

No. 2464, Vol. 98] THURSDAY, JANUARY 18, 1917 [Price Sixpence.

Registered as a Newspaper at the General Post Office.]

THURSDAY, JANUARY 18, 1917.

AN APPRECIATION OF WORK.

(1) *Pictures of the Wonder of Work.* By Joseph Pennell. Pp. lii. (London: W. Heinemann, 1916.) Price 7*s.* 6*d.* net.

(2) *Joseph Pennell's Pictures of War Work in England.* With an Introduction by H. G. Wells. Pp. xii + plates 51. (London: W. Heinemann, 1917.) Price 6*s.* net.

(1) THE author of this interesting volume of illustrations was recently requested by the Ministry of Munitions to record his impressions pictorially and in his own inimitable way of the wonder of the work now going on in the mills and factories of Britain and of France in order to enable us to understand better the efforts being made to win the war. These drawings are to be exhibited in all our great cities, and, judging from the quality of the illustrations in the book before us, such an exhibition will attract considerable public attention.

It is so seldom that a word of appreciation is heard of the conditions of life in our smoky centres of toil that to find an artist of high repute giving himself up enthusiastically to discover the wonder, the power, the romance, and the tragedy of it all is to arrest our attention whether we will or no.

In this handy volume is a collection of pictorial representations of the work of the world as done in mine, mill, and factory, and as seen under many different conditions and in many lands. To the author the vision of mill-wheel and crane, of tall chimney and of smoke unlimited, is as full of interest and of inspiration as the vacant landscape or the wooded hillside for the artist of another type of mind. The book is a pictorial record of the wonder of work, in the doing of it rather than of the product itself, and it brings home to the mind more vividly than by words the price that is paid by one-half of our people on behalf of the well-being of the whole. Though the conditions of manual work may improve as time goes on, it is certain that much of the indispensable work of the world will always be done under conditions of stress and strain almost beyond belief by those who dwell far from centres of toil. It is well that these conditions should be recorded, not only for our information, but to awaken in us sentiments of wonder at the skill, the strength, and the persistence of man in overcoming difficulties, and of gratitude to those by whom the work is done and by whose self-sacrificing service we all receive advantage. In this volume we have such a record conveying to us in a few strokes of the artist's pencil a vivid sense of life and reality.

The striking drawings are accompanied by some very shrewd and characteristic comments which add much to the interest of the book as a whole. "It is far easier," says the author, "to paint a heavenly host or a dream-city in one's studio than to make a decoration out of a group of miners or to draw a rolling-mill in full blast, yet one of these subjects can be as noble as the other." He has, as he says, "something to say in his own way about his own time." "I am simply an artist searching for the wonder of work—not for morals, political economy, stories of sweating, the crime of ugliness. I am trying to record the wonder as I see it, that is all." We congratulate Mr. Pennell on the success of his effort.

(2) This is a further volume by the same author, dedicated to the same purpose as the work already noticed. The production of munitions of war is delineated by a succession of marvellously clear and effective pencil drawings showing the various stages involved in the production of munitions from the iron-mine and the coal-mine onwards through the processes of steel melting in furnaces, of treatment in hammers and presses, and of manufacture in machine-shops, in which women as well as men are taking so great a part.

As Mr. Wells says in his Introduction: "Through all these lithographs runs one present *motif*, the *motif* of the supreme effort of Western civilisation to save itself and the world from the dominance of the reactionary German Imperialism that has seized the weapons and resources of modern science."

Mr. Pennell has had exceptional facilities afforded him for obtaining these pictures. No such opportunity is available to the ordinary citizen, and next to the privilege of actually visiting the works themselves, no more effective means are available for obtaining a clear and vivid idea of all that is meant by the manufacture of munitions of war than that provided in this most interesting collection of drawings. W. RIPPER.

ADJUSTMENT OF OBSERVATIONS.

Theory of Errors and Least Squares. By Prof. Le Roy D. Weld. Pp. xii + 190. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 5*s.* 6*d.* net.

THIS work, which embodies the material used by the author as lecture notes at Coe College, Iowa, is intended not only as a text-book for undergraduates, but also as a book of reference which a research worker can read through in a few evenings and then put into immediate practice. An interesting feature of the work is the wide range involved in the illustrative examples, which include applications to numerous branches of science. The mathematical treatment in the text is very elementary, requiring little more than a knowledge of the meaning of differentiation. This is supplemented in the appendix by a few pages involving rather more advanced methods, but in the main the book is free from mathematical difficulties to a degree quite unusual in works on least squares.

The first chapter deals with the meaning of measurement, estimation, and errors of measurement, and is followed by some useful exercises, which junior science students will find very suggestive. In the next chapter the occurrence and general properties of errors are treated, the distinction between errors and mistakes is carefully explained, and the reader will derive from these few pages a very clear idea of the kind of errors with which it is the mission of least squares to deal. This is followed by a chapter on the general theory of probability treated algebraically, and containing a brief explanation of the application of the theory to practical problems, such as life insurance, together with some examples from mortality tables.

We then reach the most important part of the book, chaps. iv. and v., comprising an exposition of the theory of errors and least squares on very elementary, but quite orthodox, lines. The great variety in the problems introduced to illustrate the text is very noteworthy: statistical tables, electrical resistance, balance constants, volumetric solutions, specific gravity bottles, surveying, transits of stars, the resolution of apparent parallax into actual parallax and proper motion, the solubility of salts, are all made to serve. The problems on chemical work are particularly suggestive, while the one on locating a distant station in surveying is of interest in employing rectangular co-ordinates instead of angles. There is an unfortunate mistake in the first numerical example of a normal equation (p. 75); the right-hand side of the equation should read 3·676, and the results of the problem as given in the text are appreciably inaccurate.

Chap. vi. is on empirical formulæ, and includes some useful hints as to the choice of mathematical expressions to represent the unknown relations between variables. A problem on the "reduction of pendulum to zero arc," on pp. 107 to 110, in which time is measured to the millionth of a second and arcs are recorded in whole degrees only, looks rather uncanny, but may be unexceptionable. The next chapter is on weighted observations, and follows the usual lines. In the final chapter, on the general theory of precision, an elementary knowledge of integration is assumed. The appendix, to which, as already mentioned, the more difficult analysis is relegated, contains also a very complete table of formulæ, all of which have been deduced in the text. On the whole, this is a good book, and being far less mathematical than most other works on the subject, it is likely to appeal to a wider class of readers.

NOXIOUS INSECTS.

Medical and Veterinary Entomology. By W. B. Herms. Pp. xii+393. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1915.) Price 17s. net.

THIS excellent text-book is based on manuscript used in teaching in the University of California and in the San Francisco Veterinary College. It is not intended to be a very comprehensive treatise, but an attempt to systematise the subject. It, however, goes beyond this, as new matter is here and there incorporated, thus making the volume of greater value. It is mainly adapted to the American continent, but will be found of general usefulness elsewhere. For instance, there is only a key of the North American genera of Tabanidæ. The first chapter is an introduction. The second deals with parasites and parasitism in general; the third with insect anatomy and classification, with a useful working key to the orders of insects. The mouth-parts are shortly but very concisely treated in chap. iv.; this portion might well have been amplified.

Cockroaches, beetles, and thrips are dealt with, and the small yet important part played by cockchafers in the spread of *Echinorhynchus gigas* and the uses of Spanish fly, etc., are concisely detailed. There is an interesting chapter on lice (pp. 52–68); we notice here that the human clothes louse is still called *Pediculus vestimenti* instead of *P. humanus*; the figures given here are not good. Bed-bugs and cone-nose bugs form the theme of chap. viii. An excellent précis on mosquitoes or Culicidæ is found in chap ix. (pp. 89–100), the classification used being that of Theobald and others, and not of the American dipterologists. Mosquito-carried diseases and control are also explained, and a full key of classification given under the Theobaldian system.

Other blood-sucking flies are dealt with, such as the buffalo-gnats, or Simulidæ, and horse-flies, or Tabanidæ, and notes on their control and relation to diseases are given. Naturally, the house-fly is fully described, twenty pages being devoted to its life-history, habits, and its relation to diseases, and another twenty-two pages to its control. The African tsetse-flies, or Glossinæ, and the horn- and stable-flies, are also fairly fully dealt with in chap. xv. (pp. 207–232).

An interesting account of Myiasis is given, including attacks of flesh-flies and bot-flies, or Œstridæ, and others, such as the Congo floor-maggot and the West Indian and American screw-worm. The portion dealing with the ox warble-flies, pp. 251–254, is not quite up to date; for instance, it is said that the larvæ are licked off by the tongue, and so pass into the œsophagus, Carpenter's researches in Ireland evidently being unknown to the author; these clearly prove that the larvæ enter by the skin, especially of the legs, and it is unlikely that any enter as described in this work. Nothing is said of their attack on human beings, the so-called "creeping disease," which is frequent in some countries. The remainder of the work is taken up with chapters on fleas and louse-flies, ticks, mites, including scab in sheep, scaly leg in fowls, and itch, and also an account of venomous insects and arachnoids. The section on louse-flies (Pupipara) might well have been extended; the account of the sheep "ked" is very brief, whilst all that is said of the Hippoboscidæ is contained in five lines, dealing with *H. equina*. Fuller information on *Pediculoides ventricosus* might also have been given, and the recent work of Willcocks in Egypt and others included.

The work ends with a four-page appendix dealing with general classification of bacteria and protozoa.

F. V. T.

HISTORY OF MATHEMATICS.

Historical Introduction to Mathematical Literature. By Prof. G. A. Miller. Pp. xiii+302. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 7s. net.

DETAILS of the history of mathematics are better left to specialists, who still have plenty of occupation in clearing up doubtful points and amending errors. But there is a growing opinion among teachers that not only for themselves, but also for their pupils, some knowledge of the course of mathematical discovery is eminently desirable. Besides being a factor in a general education, it is stimulating to the learner, and supplies to the teacher a view of human activity and invention which ought to be suggestive from the psychological side. If there be a "natural" order of learning mathematics, it cannot be wholly different in the race and the individual; though, of course, this consideration ought not to be turned into a fad. A year should not be wasted on heuristic acquisition of the multiplication table.

To serve the purposes indicated, we want books which are not too long, put the main facts into proper perspective, avoid doubtful assertions, and show the trend of mathematics at the present time. In all these respects Prof. Miller seems to us to be successful. As to the perspective, a considerable proportion of the space is given to modern mathematics; this is quite justified by the remarkable progress, and in some ways revolution, of recent times. But the earlier history is by no means neglected; thus we have accounts of ancient and medieval arithmetic, geometry, and algebra, including the theory of irrationals—all in broad outline, but very well arranged. Among modern topics, we have a chapter on the development of mathematics since the close of the eighteenth century, and one on mathematical literature; the last ought to be very useful to those who are serious students of the subject.

The last chapter gives brief biographies of twenty-five deceased mathematicians, ranging from Euclid and Archimedes to Lie and Poincaré. The list could scarcely be improved upon, and the notices, on the whole, are excellent. For instance, justice is done to Cauchy's great achievements, at least those in pure mathematics, and the author scarcely professes to deal with applied mathematics. At the same time, notice is taken of Newton's theory of gravitation and of Poincaré's work on celestial mechanics, so that we cannot help being surprised when we find nothing said about Rowan Hamilton's contributions to dynamics or even his researches on systems of rays. It is curious how many seem to think of Hamilton as the inventor of quaternions and of nothing else.

The appendix gives a brief list of books, and is, we think, the most uneven part of the work; it almost seems as if the author had looked round his bookshelves and put down the titles of those volumes that caught his eye. For instance, under "Bibliographies and Encyclopædias" we have, among twenty entries, Mr. Somerville's bibliography of non-Euclidean geometry; the value of this is indisputable, but it is far too special a work for a list of this kind. Again, under "Teaching and Philosophy," we have the "Monographs" edited by Prof. J. W. A. Young; these are quite special things, like the Cambridge Tracts and other such publications, and to put them here among eighteen entries shows a lack of proportion.

Two things may strike the reader of the biographies: the full names are not always stated, and no indication is given of Jewish nationality. The last is a small matter; but the comparatively large number of Jews who have become eminent mathematicians and physicists is certainly remarkable.

Prof. Miller has the great merits of being lively and enthusiastic, and appreciating the beauties of his science. His anecdotes and *obiter dicta* are always interesting, and sometimes highly amusing; for instance, Abel writes of Cauchy: "Ses travaux sont excellents, mais il écrit d'une manière très confuse." Unless we are greatly mistaken, Abel deserves this criticism much more than Cauchy. Again, it will be news to most people that "Omar Alkhayami" (FitzGerald's Omar Khayyám) "made a statement in his algebra which seems to imply that he was able to determine the coefficients of the successive terms in the expansion of a binomial raised to any positive integral power."

We hope that copies of this book will find their way into many of our school libraries; quite a large part of it ought to be thoroughly enjoyed by a mathematical boy. It is well printed, too, and comparatively cheap. G. B. M.

OUR BOOKSHELF.

The Origin of the Earth. By Thomas Chrowder Chamberlin. Pp. xi+271. (Chicago: The University of Chicago Press; London: At the Cambridge University Press, 1916.) Price 6s. net.

THIS book forms the third of a series of publications intended to "present the complete results of series of investigations which have previously appeared only in scattered articles, if published at all." Needless to say, it is occupied mainly with a presentation of the planetesimal hypothesis, associated with the name of the author and his collaborator, Prof. F. R. Moulton. The original investigations on the planetesimal theory have perhaps been rather more scattered than most, so that an account of them in a compact and continuous form is especially welcome.

Prof. Chamberlin's theory is frankly tentative and speculative, and the reader is invited throughout to form his own judgment of the value of what is offered for his acceptance. The reader will proceed with caution, as indeed he is advised to do, for the progress of astronomy makes it evident that much to which the author originally pinned his faith is no longer tenable. Spiral nebulæ are proving to be something bigger than the author at first imagined them to be, and both mathematicians and observers feel doubts as to whether their particular branches of astronomical science will altogether confirm the author's predictions as to the course of events. At the same time the author has always regarded his theory as one to be continually modified in the light of new facts, so that the question of present interest is whether the theory can be fitted to new knowledge without entirely losing its original character.

The book will be welcomed as providing a complete and authoritative account of a hypothesis which must be considered along with others in our efforts to unravel the history of our system.

J. H. J.

The Earliest Voyages Round the World, 1519-1617. Edited by P. F. Alexander. Pp. xxiii+216. (Cambridge: At the University Press, 1916.) Price 3*s*. net.

IN the century, 1519-1617, covered by this travel-book there were six voyages round the world—one Spanish, led by a Portuguese, Magellan; two English, led by Drake and Cavendish; and three Dutch, led by Van Noort, Speilbergen, and Le Maire and Schouten. Mr. Alexander includes in this volume Pigafetta's account of the Magellan expedition; Francis Pretty's narratives of Drake's piratical voyage, and of Cavendish's first voyage; and an account of Le Maire and Schouten's discovery of the route round Cape Horn. There are numerous illustrations, including a sixteenth-century map of Drake's voyage corrected by the great navigator; a dozen pages of useful notes; a brief introduction to the narratives; and a table of important dates in the history of discovery. As a contemporary source book, which maintains the atmosphere of the great days of the early voyages, this compilation will prove extremely useful and stimulating.

Large-Scale Map of the French Battle-Front. (London: G. W. Bacon and Co., Ltd.) Paper, 1*s*. net; cloth, 1*s*. 6*d*. net.

THIS map, on a scale of four miles to an inch, shows the battle-front from Peronne to Verdun. There is a gap of about twenty miles to the south of Peronne, but the advance of the Allies will no doubt soon bring this part of the battle-line within the area of the sheet. The map shows woods in green, and the present front, approximately as it was on November 10, by a red line. There is, unfortunately, no attempt to show elevation either by contours or spot-heights. Rivers, railways, and canals are clearly and accurately shown, and there is an abundance of names. The map should make it easy to follow the course of any advance on this front, though the absence of indications of relief will not help the reader to grasp the significance of the line of front. There is a companion map at the same price of the British front to the north.

LETTERS TO THE EDITOR.

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

The Permanence of Finger-Print Patterns.

I RECEIVED a few days ago Sir Wm. J. Herschel's brochure, "The Origin of Finger-Printing." His object—in addition to examining other claims to this method—is stated to be the desire to place on record the discovery of this method of identification "in Bengal in 1858," and the author seems to be piously grateful for the "gift granted" to him of that great and most useful discovery. The evidence for this early date is contained in the imprint of a single hand of one Kōnāi, made at that time. This was issued on a single sheet some years ago, but when, as an eager student of the subject, I applied to the publishers for a copy, I was told it was issued only for private circulation, and could not be supplied to me. I now hasten at the first opportunity to give my own opinion of this impression, long guarded so carefully from the inspection of the expert critic.

The fateful lines so dear to palmistry are quite nicely shown up, and many of the skin furrows, or *rugae*, on the palm are printed with considerable clearness. That is, the part of the hand not at all used in the official system of identification is well done, but what of those parts on which the system entirely relies? The significant pads at the last joint of each finger, which are full of intricate patterns in every human, or monkey, finger, are not shown at all. They are mere uniform blotches of ink. There is absolutely no trace of a pattern of the simplest kind in any one of the five fingers shown. I wish to be understood as not exaggerating for any controversial effect, and appeal to any trained detective if this is not as I represent. No identification could be effected on such a basis, and the system was therefore clearly *not* discovered in 1858 by the baronet. I cannot perceive that even now the author has any adequate conception of what the system is, now in general and satisfactory operation throughout the civilised world. A most curious confusion has arisen from an original police blunder that no two single finger patterns are ever alike, for which, I think, Sir William himself is mainly responsible. I am quite sure that there is no scientific basis for such an assertion. My syllabic system of classification, applied to a large collection, would enable such an assertion to be severely tested, but I know of no other method in existence which could do so. To compare finger by finger in a large collection is utterly impossible. But by giving a short syllabic name to the pattern of each finger those names can be assorted apart from the hand collection, and those which are similar can be compared individually. I have no doubt in my own mind that such a search would reveal closely similar fingers in different individuals, so closely similar indeed that the slightest blur in printing would lead to the fallacious conclusion of identity. It was on getting a clear perception of this very dangerous fallacy, still manfully held and expounded by one or two police experts, that from 1879–80, when I first made public the method, I insisted on the use of the whole set of ten fingers, serially and consecutively printed, for criminal identification. It affords an example of mutations, but for trivial purposes fewer fingers might do very well. The English method, now practically used everywhere, cannot be greatly improved upon in this respect for identifying old convicts on reconviction.

The question of what degree of evidence a single bloody smudge may give of the identity of some supposed miscreant with a convict having a previous official record is a matter for dispute. Still more is that of a case where, say, the right forefinger of Richard Roe may be practically identical with the left ring-finger of John Doe. Such similarity would be no evidence whatever for personal identification. In labouring to be brief I trust I have not been quite obscure. Sir William, in his review of the history of this discovery, has not made any reference to my little contributions on the subject. He, however, did acknowledge my priority of publication in your columns of November 22, 1894, and for that "gift granted" I must feel grateful.

HENRY FAULDS.

Stoke-on-Trent.

I HAVE to thank you for your courtesy in forwarding me a copy of Mr. Faulds's letter to you, and, in compliance with your request, I submit the following remarks.

The only point I feel bound to notice is his complaint that I have not mentioned his name in my story of "The Origin of Finger-Printing." Mr. Faulds's own account of his claim has been so fully placed before the public in his letters to you from Japan, of October, 1880, and later, that I think I was right in keeping to that period of history, twenty years further back than his, which lay within my own knowledge.

But his present letter breaks through all bounds of social courtesy, and it is only his position as a professed man of science that justifies me in correcting him. Mr. Faulds has the temerity to scout my statement that I was moved to study finger-printing by the fascination of Kōnāi's hand-mark (taken as it was for the same purpose as finger-prints now are). The finger-tips were badly smudged, but the small furrows on the palm were exquisite, and moved me to take better impressions than his from my own fingers, as I tell the reader on the same page, only Mr. Faulds ignores it. This is not the spirit of science.

I will now, with your permission, show reason why I could not honestly have introduced Mr. Faulds's name. His letter of 1880 announced that in the previous year his attention was directed to the peculiarities of finger impressions on pottery, and that he had come to the conclusion, by original and patient experiment, that finger-prints were sufficiently personal in pattern to supply a long-wanted method of scientific identification, which should enable us to fix his crime upon any offender who left finger-marks behind him, and equally well to disprove the suspected identity of an innocent person. (For all which I gave him, and I still do so, the credit due for a conception so different from mine.) But he went on to say:—"There can be no doubt of the advantage of having a copy of the for-ever-unchangeable finger-furrows of important criminals."

This expression made me protest at once, in my reply, that I could not understand how, in less than two years, he could have come to the knowledge that the furrows were unchangeable. It had taken me nearly twenty years of sustained experiment to demonstrate this persistence of the patterns for at least fifteen years of a man's life, and it is plainly impossible for any man with a scientific turn of mind to put this doctrine forward after only twenty months or so of experiment. My reply, therefore, of 1880 expressly challenged his authority for the statement, and he has never justified it. My challenge did oblige him to meet it as best be could, but the nearest approach I have seen to an answer is the following extract from an article of his in *Knowledge*, April, 1911:—

"The mode I took to test whether the ridges ever shifted their situation or changed their form was by shaving away their elevations . . . having first taken careful imprints of the patterns. After the skin grew up again, fresh imprints were taken and compared with the old ones, . . . but in many hundreds of cases, tested thus three or four times, not one solitary example of a variation in pattern was detected." His return to England broke the further investigation. He goes on to say:—"The firm conviction, however, was established in my mind, which nothing has occurred to change, that skin furrows for the purposes of identification are invariable throughout life."

This quotation is his latest statement of his authority, but it needs to be read with an extract from a previous letter of his, dated June 5, 1909, in which he says:—

"One of my earliest experiments was to shave off the ridges of the finger-tips with razors; the pattern on the skin was reproduced with quite unvarying fidelity, unless part of the true (deep) skin was removed."

I take it that this is the only foundation he has for his claim to have known the law of persistency in 1880. I leave it to men of science to judge whether his experiments sufficed to prove persistency of a finger pattern for life.

W. J. HERSCHEL.

Warfield.

The Date of the Introduction of the Term "Metabolic."

THE concept and the term "metabolism" have played such a prominent part in the development of physiological science that it should be interesting to know by whom, and when, the term was first used. Prof. Bayliss, in his "Principles of General Physiology" (1915, p. 263), says that, so far as he can discover, "metabolism" was first used by Sir Michael Foster in his "Text-book of Physiology," the first edition of which was published in 1883. It seems, however, that there is a still earlier use of the term in the writings of no less well known an investigator than Theodore Schwann, enunciator of the cell-theory. The passage I allude to occurs in the chapter called "Theory of Cells," the last in Section III. of Schwann's classic, "Microscopical Researches into the Accordance in the Structure and Growth of Animals and Plants, by Dr. Th. Schwann, Professor in the University of Louvain," published in Berlin in 1839. My translation of it is that made in 1847 by Dr. Henry Smith, of London, for the Sydenham Society; it runs thus (p. 193):—"The question, then, as to the fundamental power of organised bodies resolves itself into that of the fundamental powers of the individual cells. . . . These phenomena may be arranged in two natural groups: first, those which relate to the combination of molecules to form a cell; secondly, those which result from chemical changes either in the component particles of the cell itself or in the surrounding cytoblastema, and may be called *metabolic* phenomena (τὸ μεταβολικὸν, implying that which is liable to occasion or suffer change)." The italics are in the original. Here, then, so far as I know, is the first use of the term "metabolic," though undoubtedly not the first occurrence of the conception of chemical changes in living matter. Schwann uses the term "metabolic" exactly in its present-day sense, the phenomena of change, interchanges, of material in and by living matter.

The year 1839 may be taken as the date of the introduction into biological terminology of the expression "metabolic," and the person Theodore Schwann, at one time professor in the ancient University of Louvain.

As soon as I came across Prof. Bayliss's statement I wrote to him pointing out what seemed a use of "metabolic" earlier than 1883. Not possessing the work in the original, I asked Prof. Bayliss what was the exact word translated "metabolic," as I wished to know whether it was any derivative of "Stoffwechsel," the present-day German word for "metabolism." Prof. Bayliss replied at once to say that he had found the original passage, which he kindly transcribed for me as follows:—"Zweitens, Erscheinungen, die sich auf chemische Veränderungen, sowohl der Bestandtheile der Zelle selbst, als des umgebenden Cytoblastems, beziehen, diese kann man *metabolische* Erscheinungen nennen (τὸ μεταβολικὸν) was Umwandlung hervorzubringen oder zu erleiden geneigt ist."

"Metabolische," and not any derivative of "Stoffwechsel," is, therefore, the word employed. This is not the only passage in which Schwann uses the word; on p. 197 he speaks of "metabolic power," and again later, in contrasting a crystal and an organism, he remarks that the metabolic properties are "quite peculiar to cells." The word occurs twice more at the close of this remarkable chapter.

As the origin of anything cannot fail to be interesting, and as the word "metabolism" is so very much used in biological exposition, I have thought it well to ask you to publish these remarks.

D. FRASER HARRIS.

Cultural Amœbæ from the Intestine of Man.

I SHOULD like to thank your reviewer for his commendatory remarks in NATURE of December 21, 1916, on the account of the parasitic Protozoa which I contributed to the "Animal Parasites of Man." Without in any way wishing to raise a discussion, I think it should be pointed out, in respect to his statement about *Amoeba limax*, that much information concerning these cultural organisms that may occur in the human intestine will be found under the designation "cultural amœbæ" on pp. 42, 618, 742 and 743 of my work. As your reviewer rightly infers, *A. limax* is not now strictly the name of a single species, but rather of a group or type of free-living forms which show differences among themselves, but can be cultivated on artificial media. It is not easy to point out marked differential characters between them and Entamœbæ, especially after consideration of the work of Drs. Williams and Calkins, to which reference is made by me on p. 42 and pp. 742 and 743 of the book.

H. B. FANTHAM.

Cambridge.

DR. FANTHAM has given information concerning the culture of "cultural amœbæ," and mentions (p. 618) that they are non-pathogenic, but beyond the statement (previously overlooked), on pp. 42, 743, that they exhibit morphological variations there is no note of their characters. The account does not therefore afford adequate help to those who, during microscopic examination of a stool, find for the first time amœbæ with a very large karyosome, and desire to know what they are. Although amœbæ of the *limax* type exhibit variations under different methods of culture, as described by Williams and Calkins, reference might have been made to the striking karyosome by which amœbæ of this type, as found in the human intestine, are often distinguishable. In view of the frequent references in recent literature to "amœbæ of the *limax* type," some account under this designation might have been given, *e.g.* on p. 42, following the account of the morphology of species of Entamœba from the intestine.

THE REVIEWER.

FLOUR STANDARDS.

REFERENCE was made in NATURE of November 23 and 30, 1916, to the Order directing that millers shall increase the yield of flour from wheat by about 5 per cent. The result was that the corresponding proportion of "offal" was mixed in with the flour. An Order has now been made to the effect that a further 5 per cent. *must* be added to the flour. This may be done either by taking another five parts of offal for that purpose, or (and this is a most important new departure), at the miller's option, by adding five parts of flour derived from barley, maize, rice, or oats. In addition, he *may* add voluntarily another five parts, making ten parts in all over and above the previous increase in flour yield of seventy-one to about seventy-six parts of flour from 100 parts of wheat. The result is a compulsory 10 per cent. or a voluntary 15 per cent. more bread with the use of the same quantity of wheat.

In his article in NATURE of November 30, the present writer deprecated any further addition beyond the first 5 per cent., except in case of dire necessity, because of the deterioration in quality of the resultant flour. The necessity has apparently arisen, but the use of flour from other cereals is a valuable alternative in the present difficulty. Except for the absence of gluten, barley and the other flours indicated will not differ greatly from wheaten flour. They will not of themselves have rising power, and consequently the gluten of the wheaten flour present will have to buoy up the whole loaf during fermentation. But, on the other hand, there will be an absence of the proteolytic and starch-converting enzymes which are so active in the whiter portion of the offal of wheat, and act so adversely on the gluten and starch of the flour.

So early as January, 1915, the *Lancet*, in a leading article, suggested the use of cornflour in order to eke out the wheat supply. In consequence some experiments were made by Lieut. W. Claude Jago, the results of which were published in the *Lancet* of February 13 of the same year. Loaves of bread were baked from (1) London household flour only, (2) a mixture of ninety parts of the same flour and ten parts of cornflour, and (3) a mixture of eighty parts of the flour and twenty parts of cornflour. The bread from the mixtures was slightly less in volume, but fairly equal to that from the flour only in texture and appearance. This judgment was confirmed by the editor of the *Lancet*, who stated that the loaves "appeared to be quite acceptable." Cornflour is, of course, maize starch, and is manufactured very largely in the United States. If this variant of maize flour be permitted, its employment will result in a considerably larger yield of bread and of a type which will accord with the reasonable tastes and requirements of the British public.

WILLIAM JAGO.

MORTALITY TABLES AND EXPECTATION OF LIFE.

IN Nature of July 6 (xcvii., pp. 383–384) reference was made to a statement by Dr. W. W. Campbell, president of the American Association for the Advancement of Science, that recent discoveries in preventive and curative medicine had increased the average length of life by many years, and that the increase so caused had been great for those healthy men whose lives had been accepted as risks to be insured by life assurance companies. While it was admitted that there was a high probability in favour of that conclusion, it was also pointed out that the tables in existing use had been available for fifteen years only, and that the time had not come for them to be superseded by fresh observations. Upon this Dr. Campbell stated in Nature of September 21 (p. 48) that the data upon which those tables are founded go back to the thirty years from 1863 to 1893, and do not therefore give full effect to the improvement in the duration of life which he believes has arisen during the last fifty years.

Observations recently made in America and in Australia have raised questions as to this alleged improvement which call for careful consideration. They affect principally the middle-aged man—that is, the man of forty years or more. They do not, therefore, directly negative Dr. Campbell's conclusion, which relates to persons under that age as well as to some above it. Dr. C. F. Bolduan, who is director of the Bureau of Public Health Education in New York, is quoted in the *Lancet* and the *Times* as having stated in an official report that the death-rate in the United States registration area at the age period forty-five to fifty-four has increased by nearly 2 per cent. during the last ten years, and that between fifty-five and sixty-four by nearly 7 per cent. When these figures are compared with those representing the variation in death-rates between 1850 and 1900, as given in Mr. Gore's report to the New York International Congress of Actuaries, they acquire some significance. That report records for ages forty to forty-nine a diminution in the rate of mortality of $7\frac{1}{2}$ per cent., for fifty to fifty-nine of $7\frac{3}{5}$ per cent., and for sixty to sixty-nine of $6\frac{1}{5}$ per cent. If it is the fact that this favourable tendency has been checked at a time when not only the discoveries referred to by Dr. Campbell, but other contributory causes, such as better sanitation, have been in full operation and should have produced a further diminution in the rate of mortality, it is evident that some adverse influences are at work which ought to be investigated. Dr. Bolduan finds them in over-strain and over-eating, and a committee appointed by the Department of Trade of the Commonwealth of Australia to inquire into the causes of death and invalidity has made a report on the risks of middle age which arrives at similar conclusions.

Whether a like reaction is observable in this country may be doubted. The report of Mr. Warner to the actuarial congress mentioned above showed that, as between the investigation of the Institute of Actuaries ending in 1863 (termed H^M) and that of the Assurance Companies ending in 1893 (termed O^M), the expectation of life for males uniformly increased—at age forty from 27·4 years to 27·9; at age fifty from 20·3 to 20·6; at age sixty from 13·9 to 14·1; at age seventy from 8·5 to 8·7. It is unfortunate that the body of experience available relating to female mortality is insufficient for a similar comparison to be made, for there is reason to think that female life is now passed in better hygienic conditions than formerly.

The remedy suggested in America and Australia consists in a campaign against avoidable adult mortality; but there is some force in the caution of the *Lancet* that risk lies in the direction of faddiness.

PROF. THOMAS PURDIE, F.R.S.

THE value of a close, sympathetic relationship between professor and student is perhaps not fully recognised, and certainly can be properly appreciated only when it has formed part of a personal experience. The power of winning the affection and confidence of young men was a marked feature of the personality of Prof. Purdie, whose death was announced in Nature of December 21 last; and no record of his life, however slight, would be complete without special reference to the wonderful insight and understanding that bound him to his students. During the twenty-five years he occupied the chair of chemistry in St. Andrews he devoted himself to the development of character in the undergraduate quite as much as to the simpler duty of converting him into a chemist.

Purdie's early experience in life enabled him to escape the limitations frequently imposed on the specialist. Born at Biggar in 1843, he spent seven years of his youth in South America, where, under conditions which were always primitive and often dangerous, he lived an active, open-air life. All his time, however, was not spent in the saddle. The flora of the pampas and the minerals of the hills claimed his attention and interest, and aroused the spirit of inquiry which was never thereafter quenched. On his return to this country at the age of twenty-seven, definite direction was given to these scientific instincts by a conversation with Huxley while walking under the cliffs at St. Andrews, and probably to this impetus can be traced his subsequent career as a chemist.

After studying at the Royal School of Mines under Frankland, he went to Würzburg, where he came under the inspiring influence of Wislicenus, and a close and lasting friendship sprang up between the two men, who had much in common. His teaching experience was gained at South Kensington and Newcastle-under-Lyme, and in 1884 he was appointed to the vacant chair at St. Andrews. The University must for all time be grateful to the electors for their choice. Cramped accommodation, imperfect equipment, and the fact that chemistry had then no official place in the curriculum were not regarded by him as insuperable difficulties. Original papers, many of which bore the names of students to whom he had communicated the spirit of research, flowed in steady succession from St. Andrews. Fifteen years ago he put into operation a scheme which had long been in his mind. He presented to the University a fully equipped research laboratory. This building, although erected in memory of his uncle, will always be regarded in St. Andrews as the outward symbol of Purdie's life-work. With rare foresight the laboratories were made self-supporting by means of a generous endowment. This not only enables students to work free of charge, but can be used to assist them to remain at the University after graduation. In the best sense of the expression, Purdie founded a "research school." His publications on optical activity, on the process of alkylation, and on the chemistry of sugars, apart from their intrinsic importance, must be regarded as models of accurate scientific work.

Not only the successful student, or those who made chemistry a special study, drew inspiration from Purdie. His arresting personality, his eloquence in the lecture-room, and his philosophic treatment of the subject attracted men from every faculty, who now remember gratefully all they owe to him.

The severe handicap of periodic attacks of asthma he bore uncomplainingly and with characteristic cheerfulness. His sympathies were immense; his door was never closed, his help never denied, to one in trouble. His tastes were simple and his interests varied. During vacations he travelled extensively or plied his rod on Highland lochs, and, as was once said of him, "on the links he played a good game—for a professor." Although he retired about eight years ago, he may be said to have died in harness, for the department he created and the work of the University he loved remained absorbing interests to the end.

Recognition and honours came to him, and he must have had the satisfaction of looking on his work and finding it good; but what he probably prized most in his official life was the warm feeling he aroused in his students—a feeling which no St. Andrews man would wish to remain unexpressed.

J. C. I.

DR. N. H. J. MILLER.

It is with deep regret that we record the sudden death of Dr. N. H. J. Miller, at Harpenden, on Friday, January 12, from heart failure. Dr. Miller had worked for many years at Rothamsted; he began under Lawes and Gilbert, having gone there in 1887 direct from college, and continued up to the day of his death. His chief work was the measurement of the amount of the combined nitrogen brought down in the rain, and of the amounts of nitric nitrogen washed out from the soil. Both measurements were indispensable for the settlement of important controversies in agricultural chemistry.

Liebig had argued that plants derived their nitrogen supply from the ammonia brought down in the rain, and supported his view by analyses which seemed to bear it out. He therefore urged that nitrogen need not be artificially supplied. "If the soil be suitable," he wrote, "if it contains a sufficient quantity of alkalis, phosphates, and sulphates, nothing will be wanting. The plants will derive their ammonia from the atmosphere as they do carbonic acid." Had this view not been promptly controverted, it might have done untold harm to the new science and industry of artificial manuring by giving it a wrong turn at the outset, for Liebig's position was very exalted.

Lawes and Gilbert were unable to accept this statement, because they knew that in practice plants did require nitrogenous fertilisers, but they were equally unable to refute it because they had only isolated analyses of rain-water to go upon. The pioneering work of Warington had shown its improbability, but only a long-continued series of analyses could finally dispose of it. This Miller undertook, and he continued the work without intermission for thirty years. A large gauge was erected at Rothamsted, 1/1000 of an acre in extent, and he himself analysed a sample of every collection of rain. The results completely and finally disposed of Liebig's erroneous view, and they have provided a remarkably continuous set of observations on the composition of rain which is never likely to be excelled. Nowhere else is there an unbroken series of analyses extending over so long a period made by one and the same man.

The analysis of the drainage water settled equally conclusively a difficult and fundamental problem in soil chemistry. It was known that uncropped soils suffered a loss of nitrogen through the effect of weather, but the extent and nature of the loss were not known. In any single year it is too small to be investigated, and the only hope of success is to follow the change for a long period on the same plot of land. This Miller did on the drain gauges. All the drainage water was collected and analysed and the nitrate determined; the results showed that the land lost in the form of nitrates from 35 to 40 lb. of nitrogen per acre per annum. After the work had continued for many years all these annual losses were added together, and a sample of soil was taken for the determination of the total nitrogen; this was compared with the initial amount so as to give the loss. To the great satisfaction of Dr. Miller and those who had followed the experiment, the loss of nitrogen thus directly determined agreed within 10 per cent. with the amount of nitrate washed out. The result not only demonstrated the accuracy of the working, but it showed that in these conditions the loss is mainly due to the leaching out of nitrate. Miller's detailed analyses show how the loss is distributed and provide a wealth of material for discussing the many important problems connected with it.

The work was tedious and would have been impossible for anyone with less patience and inspired with less conscientious ideals. But Miller knew the importance of getting the figures right, and spared no pains to keep his records unbroken.

Dr. Miller was deeply interested in the literature of agricultural chemistry, and unreservedly placed his knowledge of it at the disposal of his colleagues. For many years he did nearly the whole of the abstracting in agricultural chemistry for the Chemical Society, and of late years he wrote the society's annual report on the progress of this subject. He will long be remembered as a painstaking, accurate worker—unhasting, unresting—who, having undertaken a long investigation, would not relinquish it until he had finished it.

E. J. Russell.

NOTES.

At the meeting of the Royal Astronomical Society on Friday, January 12, the president announced that the council had awarded the gold medal of the society to Mr. W. S. Adams, of the Mount Wilson Solar Observatory, for his investigations in stellar spectroscopy, and especially for his determination of absolute magnitudes.

We learn from *Science* that the Bruce gold medal of the Astronomical Society of the Pacific for the year 1917 has been awarded to Prof. E. E. Barnard, of the Yerkes Observatory, for his distinguished services to astronomy. The formal presentation will take place at the annual meeting of the society at San Francisco, on the evening of January 27.

The disease known as "epidemic jaundice" has occurred of late on the Western front. It is caused by a delicate spiral microbe, or spirochæte, which is present in the blood and tissues in small numbers at certain stages; it was discovered by Inada and other Japanese observers in 1914. The organism probably has its natural habitat in the rat, from which man becomes infected either by direct contact or possibly by insect-carriers.

The death is announced, in his seventy-first year, of Dr. T. H. Bean, a former president of the American Fisheries Society. He was for many years connected with the U.S. Fish Commission, and was curator of fishes at the U.S. National Museum from 1880 to 1887. He was director of the New York Aquarium from 1895 to 1898. Since 1906 he had been fish culturist of the State of New York. Dr. Bean was the author of several volumes on ichthyology.

Mr. Udny Yule, one of the honorary secretaries of the Royal Statistical Society, has been appointed head of the Information and Statistical Bureau of the Ministry of Food. With Mr. Yule will be associated Prof. T. B. Wood, Drapers professor of agriculture in the University of Cambridge, and Prof. W. H. Thompson, professor of physiology, Trinity College, Dublin.

The Food Controller announces that he has appointed a committee to make such arrangements as may be necessary and expedient for the increase of supplies of fertilisers in the United Kingdom and for controlling, so far as may be necessary, their output and distribution. The following are the members of the committee:—Capt. C. Bathurst, M.P. (chairman), Mr. H. R. Campbell, Sir James J. Dobbie, Mr. R. R. Enfield, Capt. R. B. Greig, Mr. T. H. Middleton, Mr. W. Anker Simmons, Prof. W. Somerville, Mr. G. J. Stanley, Mr. R. J. Thompson, and Prof. T. B. Wood. Mr. H. Chambers will be the secretary to the committee.

The council of the Geological Society has this year made the following awards:—Wollaston medal, Prof. A. F. A. Lacroix (Paris); Murchison medal, Dr. G. F. Matthew (Canada); Lyell medal, Dr. Wheelton Hind (Stoke-on-Trent); Bigsby medal, Mr. R. G. Carruthers (H.M. Geological Survey); Wollaston Fund, Dr. P. G. H. Boswell (Imperial College of Science); Murchison Fund, Dr. W. Mackie (Elgin); Lyell Fund, Dr. A. H. Cox (King's College, London) and Mr. T. C. Nicholas (Trinity College, Cambridge); Barlow-Jameson Fund, Mr. H. Dewey (H.M. Geological Survey).

Prof. and Mrs. Herdman have recently established and endowed an institute at Port Erin, Isle of Man, as a memorial to their son, Lieut. George A. Herdman, who was killed in action near Montaubon, in the battle of the Somme, on July 1, 1916. Lieut. Herdman spent a great part of his boyhood at Port Erin, associating with the local fishermen and working at the Marine Laboratory, and was well known there. The institute has been handed over permanently to the Commissioners of Port Erin. It is intended for the rest and social intercourse of the men, boatmen, and fishermen of the port, and to extend hospitality to fishermen, yachtsmen, and sailors visiting the harbour. Arrangements are made for the provision of refreshments and recreation, and opportunities for mutual self-education are being given by the collection of a library of works on navigation, fisheries, and general science. The institute was formally opened by Prof. and Mrs. Herdman, and is now available for the men.

Pneumonia is a disease of great importance to South African mining communities, contributing from 30 to 60 per cent. of the total mortality among native mine labourers. An exhaustive investigation upon the disease was conducted in 1911 and 1912 by Sir Almroth Wright and co-workers, and he recommended inoculation with pneumococcus vaccine as a preventive. Dr. F. S. Lister has now completed a further experimental study of the subject. He finds that several races of pneumococci are associated with pneumonia in the Rand, and that rabbits inoculated three times with killed pneumococcal vaccine in suitable doses are resistant to at least eight times the lethal dose of living pneumococcus for an untreated rabbit. For the prevention of the disease in man he recommends that three inoculations, at seven-day intervals, should be employed, each dose consisting of 6000 million pneumococci of each strain against which immunity is desired (the South African Institute for Medical Research, No. VIII., 1916).

The death is announced in the *Morning Post* of Vicomte Charles de Foucauld, the French traveller and scholar. Thirty-five years ago Foucauld resigned from the French Army to travel in Morocco. In the disguise of a Jew merchant he explored parts of the Atlas region which were, and still are, closed to Christians. An account of these travels, entitled "Reconnaissance en Maroc," was published in 1888, and is still regarded as a standard work. It contains invaluable sketches and views and geographical information collected at great risks. After a brief period of travel in the Caucasus, Foucauld became a Trappist monk and returned to Africa. He visited the Targui country, explored it for several years, and collected a vast amount of information on the language, customs, and literature of its people. Later he elected to settle in the desert, and for several years had lived at Tamanraset, half-way between Algeria and French Guinea, where he devoted himself to a study of the country and its people. He never attempted proselytising. Foucauld is reported to have met his death at the hands of brigands, but it is hoped that the valuable manuscripts on the Touareg people which he was preparing may have escaped destruction.

Prof. G. Elliot Smith contributes to the Journal of the Manchester Egyptian and Oriental Society for 1915–16 an important paper on "Ships as Evidence of the Migrations of Early Culture." In this commentary upon certain aspects of the history of shipbuilding, he lays special stress upon the factors which influenced the early development of the shipbuilder's craft in Egypt. "I have indicated how the dug-out became transformed when more efficient tools enabled the Egyptians to shape the vessel, and add beams, at first tied to its sides, to increase its capacity. The shape of the papyrus-boat determined the earliest form of the ship; and the Egyptian conception of the vessel as a living thing led to subsequent modifications in its build. All of these features, with distinctive methods of rigging and steering, represent so many tokens of characteristic Egyptian inventions which can be recognised whereon ships have been built."

The current number of the *Quarterly Journal of Microscopical Science* (vol. lxii., part 1) contains a very complete and interesting account of the development of *Alcyonium digitatum* by Miss Annie Matthews. As this common British species forms the usual laboratory type of the Alcyonaria, an up-to-date description of its development will be of great value to zoological students, and Miss Matthews's work is not only up to date, but also readable. One of the most interesting features of the development is the occurrence of additional, imperfect mesenteries in the primary polyp, a very remarkable fact in view of the constancy with which the normal eight mesenteries occur throughout the entire group, possibly indicating an ancestral condition in which many mesenteries were present. Much light is also thrown upon the order of appearance of the polyps in the young colony, and upon many details of development.

An important paper on the early larval stages of the fresh-water eel (Anguilla) and some other Atlantic Muraenoids, by Dr. J. Schmidt, appears in *Meddelelser fra Kommissionen for Havundersogelser, Serie Fiskeri*, Bind v. The author has had the good fortune to obtain a number of specimens of between eight and nine millimetres in length, which are carefully described and figured. He also describes and figures numerous specimens of the American eel, *A. rostrata*, and a number of Leptocephalid forms which he regards as new species. He gives some valuable figures illustrating the development of the hypural bones, and a number of others, greatly enlarged, showing the teeth during these early stages. As to the nature of the food seized by these teeth, and the precise use of the anterior grasping teeth, which are long, median in position, and forwardly directed, nothing appears to be known.

The *National Geographic Magazine* for November, 1916, is devoted to the description of the larger American mammals, and is illustrated by no fewer than thirty-two coloured plates of remarkable beauty by Louis Agassiz Fuertes, and in addition to these are a number of uncoloured plates of no less merit. The text is by Mr. E. W. Nelson, the assistant-chief of the U.S. Biological Survey, and is thus in every way worthy of the illustrations. The descriptions are of necessity brief, but they are sufficient to furnish a survey of the salient features of each of the species described; its haunts, range, and numbers. We regret to note that the prong-horn antelope is almost as much in danger of extermination as the sea-otter. Having regard to the jealous guardianship which is now displayed over the native fauna, it is surprising to be told that complaint has to be made of "the despicable work of poachers, who are shooting elk [wapiti] for their two canine teeth, and leaving the body to the coyotes." Information has been received that more than 500 were ruthlessly slaughtered for this purpose about the border of Yellowstone National Park during the winter of 1915–16 In referring to the size of the bull sperm-whale no mention was made of the very great disparity in size between the male and the female, nor is any mention made of the teeth of the upper jaw of the male.

We regret to learn that that old-established and very useful journal, the *Zoologist*, ceased to exist with the issue of the December number. In name, at any rate, it still survives, since it has been incorporated with *British Birds*, published by Messrs. Witherby and Co. All other branches of natural history which found a place in the *Zoologist* will, however, now be excluded. This we gather from the January number of *British Birds*, which, at the same time, makes the welcome announcement that in future its pages will be open to articles and notes on the avifauna of other parts of the western portion of the Palaearctic region, or, in other words, of Europe and North-West Africa. This number includes some valuable observations "On the Breeding Habits of the Red-backed Shrike," by Mr. J. H. Owen. The author believes that the cock is responsible for the "larder" peculiar to the shrikes, and that it is usually made during the incubating period, presumably for the use of the female. The indigestible parts of the food are thrown up by the young birds, he remarks, in the form of pellets. These are often so large that the very young birds are unable to expel them, so that they have to be drawn out of the mouth by one of the parents. Both birds take part in cleaning the nest, and the excrement for the first few days is swallowed by them, but later it is generally carried away and dropped at a distance from the nest.

According to the *Chemical Trade Journal* of December 30 the Trade and Industry Committee of the Royal Colonial Institute has investigated the properties of the grass lalang, which is found in large quantities close to the coasts of Malaya, as a possible paper-making material. The grass, which can be obtained for the mere cost of collection, is shown by chemical analysis to be capable of yielding a good quantity of cellulose, quite suitable for the manufacture of paper. It is very susceptible to the action of dilute alkalis, but the final product is unusually pure and readily resolved. After washing, the pulp obtained is uniform in quality and of good colour, and, subject to judicious treatment for the improvement of the latter, it would furnish a paper very suitable for printing purposes. A high-class wrapping paper, strong, and having a comparatively high resistance to folding, would be obtained by using a mixture of half lalang grass pulp and half cotton beaten together.

The November issue of the *Journal of the Board of Agriculture* contains a useful summary of experimental work with palm-kernel cake carried out during the past year by Prof. C. Crowther and his colleagues in the Agricultural Department and Institute for Research in Animal Nutrition of the University of Leeds. The work includes studies of the palatability, digestibility, and keeping properties of the cake, together with an examination of its effects upon the yield and composition of milk and butter. Apart from an initial reluctance of the animals to eat the cake, which was traced to difficulties of mastication, the results were generally favourable, and demonstrated that the cake possesses qualities which should secure its permanent inclusion in the list of feeding-stuffs widely used on British farms. Further work with palm-kernel products is reported by Prof. C. Crowther in the December issue of the same journal, in an account of a practical feeding experiment with pigs, carried out on behalf of the Co-operative Wholesale Society at their farm near Clitheroe. In this experiment with three groups of eighteen pigs each, palm-kernel cake and extracted palm-kernel meal were compared with the grade of milling offals known as "thirds." The cake proved an efficient and economical substitute for "thirds," and appreciably superior to the meal. These results should usefully supplement the great efforts now being made to secure for this country the palm-kernel crushing industry, the great importance of which from Imperial and national points of view was strikingly revealed in the recently issued report of the Edible Nuts Committee of the Colonial Office.

AN article on river frontiers in Europe, by Prof. L. W. Lyde (*Scottish Geographical Magazine*, xxxii., pp. 545–555), is an able rejoinder to Sir T. H. Holdich's well-known views on the subject. Prof. Lyde holds that as war is not a normal condition, it is surprising that the accepted theory of frontiers is essentially a military one, the object of which is not to effect an international equilibrium across it, but to make international intercourse, peaceful or otherwise, impossible. Prof. Lyde maintains that the principle of democracy is sufficiently mature to demand that boundaries should make for peace as well as for security. A navigable river encourages peaceful intercourse, and so has a civilising influence which cannot be said of any barrier which keeps peoples apart. Sir T. H. Holdich admits that a river makes a good boundary except on its plain course. But this contention, Prof. Lyde says, must be modified in the light of events in the present war. The Danube proved to be an absolute defence to Belgrade during four months in 1914, and in the great Russian retreat rivers backed by railways were defensive positions of enormous strength. Prof. Lyde cites the Plate, the St. Lawrence, and the lower Danube to show that a navigable river does not of necessity form an unstable boundary and become the property of the most pushing nation on its banks. Again, economic equilibrium, a necessary factor in international equilibrium, is more likely to result from a river frontier, as that will hold a fair balance of the mineral and other wealth on either side. The author holds that if the new map of Europe is based on purely military lines, Europe will have to expiate it once more on purely military lines.

MR. E. L. TROXELL traces back the one-toed horse to a new species, *Pliohippus lullianus*, discovered by him in the Lower Pliocene of S. Dakota (*Am. Journ. Sci.*, vol. xlii., p. 335, 1916). This horse presents the unique feature of an ulna unfused at any point with the radius.

AN interesting case of the replacement of calcite by iron pyrites as the cementing material of a sandstone is given by Mr. T. A. Jones in a note on Permo-Triassic sandstones of South-west Lancashire (Proc. Liverpool Geol. Soc., vol. xii., p. 257, 1916). It may be remembered that even quartz has been thus replaced during the formation of concretions in certain Karroo sandstones (see NATURE, vol. xcv., p. 216).

GEOLOGISTS interested in the much-discussed stratigraphy of New Zealand will find new material concerning the junction of Cretaceous and Cainozoic horizons in a paper by Mr. P. G. Morgan ("Notes of a Visit to Marlborough and North Canterbury, with especial reference to Unconformities post-dating the Amuri Limestones," Geological Survey, N.Z., tenth annual report (1916), p. 17). The unconformities traced by the author do not, as the title might imply, assign a date to the Amuri Limestones, but are above this horizon, and the lowest one divides the upper limestone from the Weka Pass Stone. This break is shown to be widespread, but, like the others, may not be continuous throughout New Zealand.

A "CATALOGUE of the Collection of Meteorites" belonging to the Geological Survey of India, and preserved in the Indian Museum in Calcutta, is given by Mr. J. Coggin Brown in the Memoirs of the Geological Survey of India (1916, vol. xliii., part 2, pp. 149–287). The private collection of the late R. P. Greg, purchased in 1865, formed the nucleus of this collection, which now represents 379 meteoritic falls, and is the largest in Asia. Previous catalogues were prepared in 1867 by Thomas Oldham, and in 1879–80, with a supplement in 1901. The main part of the present catalogue is occupied by an alphabetical list of the specimens arranged under the geographical names of the falls. There are brief descriptions of the individual specimens and their weights are recorded. A second short list gives an outline of the Brezina classification of meteorites, with the names of falls represented in the collection under each of the seventy-four groups.

AMONG the Memoirs of the National Academy of Sciences of Washington (1916, xiv., pp. 1–29) Dr. G. P. Merrill, the head curator of geology in the United States National Museum, has recently published a report on researches on the chemical and mineralogical composition of meteorites, with especial reference to their minor constituents. When preparing an earlier paper on a similar subject he had been struck with the comparatively small number of trustworthy analyses available, and the apparent similarity in, and simplicity of, the composition of meteorites. At his instigation careful analyses were made of twenty typical meteorites, ranging from irons to stones, by Dr. J. E. Whitfield, of Messrs. Booth, Garrett, and Blair, in Philadelphia, and the results obtained are tabulated, and in some instances compared with those published by earlier workers. Occasionally considerable discrepancies were revealed, the most remarkable being in the case of the Collescipoli stone, in which none of the rare elements noted by Trottarelli could be found; on the other hand, whereas the latter gives nearly 8 per cent. of sulphur, Dr. Whitfield found none, and yet in the description of the stone the presence of metallic sulphide is noted. The analysis of meteorites is a task calling for care, skill, and unlimited patience owing to the paucity of material usually available and the necessity for testing for so many elements which can only be present in extremely small amounts, and it should, moreover, be combined with a careful microscopic examination of thin sections; obviously such work can only be undertaken as a labour of love.

SOME excellent specimens of the important tungsten ores, wolframite and scheelite, have just been received at the Imperial Institute from the Federated Malay States, and can be seen in the Malay Court of the Exhibition Galleries. As is now well known, the most important use of tungsten ores is in the manufacture of tungsten steel, of which large quantities are now being employed in munition factories in Sheffield and elsewhere in the manufacture of high-speed tools and for other special purposes. Tungsten is also used in the form of wire in the manufacture of metallic filaments for electric lamps. Wolframite, commonly called wolfram, which forms the bulk of the tungsten ore produced, occurs in various parts of the main mountain range in British Malaya, and in Pahang and Trengganu. Scheelite is mined in Perak and Selangor.

THE current issue (vol. xlvii., part 3) of the Records of the Geological Survey of India contains a review of the mineral production of India during 1915, compiled by the Director of the Survey. The results may fairly be described as satisfactory, having regard to the conditions set up by the European War. The total value of the mineral products shows an increase of more than 700,000*l.* above that for 1914, some of this increase being undoubtedly due to the higher prices obtained for many of the products. The most important of these, however—coal—actually shows a decrease in value of 126,000*l.*, although the output has risen from 16,464,000 tons to 17,104,000 tons, due to the lack of sufficient shipping to transport it, in consequence of which the price at the pits necessarily declined. The gold output is practically the same as in 1914, but important increases in production are shown in tinstone, wolfram, and lead ore; these minerals come almost exclusively from Burma, where considerable attention has recently been paid to the improvement of the means of transport and other facilities for the development of the mineral resources of the country. Petroleum is another mineral the production of which shows a very considerable increase. There has been a fall, on the other hand, in the output of manganese ore and iron ore; the reason for the former is to be found in the difficulty of obtaining tonnage and in the high rates of freight. In this connection it is interesting to be able to chronicle the first attempt to utilise the ore within the peninsula, the Tata Company having put a furnace on to ferro-manganese, of which 2658 tons were produced. Attention may also be directed to two pamphlets issued by the Department of Mines and Geology of the State of Mysore, one giving a brief account of the mineral resources of the State, which include, in addition to gold, ores of chromium, iron, and manganese, and the other a synopsis of the laws and regulations governing the issue of mineral licences; both these publications should prove of great interest to all who are, or are likely to be, interested in mining in this part of India.

IT is well known that the factors which determine the rate of evaporation of water from the earth's surface are the depth of the surface of the water underground, the nature of the soil above this surface, the temperature and humidity of the air, and the speed with which it is moving. To a great extent the nature of the influence of each of these factors on the evaporation is known, but it has not been possible to determine the quantitative laws connecting them. The results of a research carried out by Messrs. F. S. Harris and J. S. Robinson at the Utah Agricultural Experimental Station during the past four years, and published in the United States Department of Agriculture Journal of Research for December 4, 1916, appear to justify the belief that before long these laws will have been discovered. By keeping the water level only a centimetre below the level of the surface of the sand or soil used, the authors have greatly reduced the effect of capillarity, and are able to give curves showing the effects of percentage of water in the soil, of the amount of dissolved salts in the water, of the size of grains and compactness of the soil, and of the speed, temperature, and humidity of the air on the rate of evaporation. Copies of the paper may be obtained from the Government Printing Office, Washington, at 10 cents a copy.

WHILE the name of Pappus of Alexandria is associated in the minds of modern mathematicians with Guldin in the theorem relating to the volume and area of the surface traced out by a moving closed curve, practically nothing is known of the life of the geometer himself. An introductory paper on Pappus is now given by Dr. J. H. Weaver in the December Bulletin of the American Mathematical Society. Of the eight works attributed to him, the only one extant even in part is the "Collectio," which is a summary in eight books of the works of preceding Greek mathematicians, of which Dr. Weaver gives a general account. Of this an edition was published by Hultsch, of Berlin, in 1876–78. Reference is also made to Sir T. J. Heath's article on Pappus in the "Encyclopædia Britannica," eleventh edition.

AN outline of the mathematical course of an Italian technical school is given by Prof. Virgil Snyder in the Bulletin of the American Mathematical Society (xxiii., 3). The account refers to the Reale Istituto Tecnico Superiore of Milan, where, as elsewhere in Italy, the course extends over five years, and includes a two-year course in mathematics, physics, and chemistry, as also in Italian and two other languages. Candidates for admission are required to be familiar with plane and solid geometry, plane trigonometry, algebra including determinants, theory of equations, graphical processes, and elementary projective geometry. Differential calculus is only commenced as a portion of a heavy course in the first term, and integration in the second term is taken by the students, together with an extensive discussion of analytical solid geometry.

WHEN all the roots of an algebraic equation are complex with modulus unity, it is fairly evident that the equation must be reciprocal. Writing in the *Tohoku Mathematical Journal* (x., 3), Mr. A. Kempner, of Urbana, U.S.A., gives certain extensions of previous work relating to equations having roots of this special form, and in particular proposes a simple proof of the theorem that if *one* such pair of roots exists the equation must be reciprocal provided that it is irreducible in the domain of rationality formed by the coefficients. The journal contains the usual summary of new books and contents of mathematical periodicals, of which the latter form a very useful reference catalogue of current mathematical literature. We could wish, however, that this portion, appealing as it does to readers of all nations, did not contain so much matter in Japanese characters, or that a translation were given in English or French.

WE have received an official publication of the Government of South Australia entitled "An Investigation into the Prospects of Establishing a Paper-making Industry in South Australia," by Mr. W. A. Hargreaves, being Bulletin No. 1 of the Department of Chemistry, of which the author is director, and "issued under the authority of the Hon. R. P. Blundell, Minister of Industry." Of indigenous raw materials for paper-making Australia presents a conspicuous dearth, and Mr. Hargreaves's conclusion from his exhaustive investigations is that the only immediate industrial proposition is the utilisation of cereal straws: lime-boiled for "strawboards" and caustic-boiled for "cellulose" papers—*i.e.* for printings and writings; in the latter case the paper-furnish requiring from 30–40 per cent. of bleached wood cellulose, which means an imported raw material. The cost of production of the bleached straw pulp from the hypothetical works' cost-sheets is 7*l.*–8*l.* per ton; the process described and "costed" is based on the caustic-soda boil, with 80 per cent. recovery, and the assumption that "the losses of caustic soda are made up with sodium sulphate, because it is cheaper." There is no reference to the consequent modification of the entire scheme in terms of the main product (cellulose) and of the offensively malodorous volatile by-products. To the main report is appended one by Mr. D. C. Winterbottom on "Supplies and Cost of Raising 'Marine Fibre,'" the remarkable product of *Posidonia australis*. For the industrial utilisation of this product more than one "promotion" has been attempted; according to the author, two of these survive, of which the Posidonia Fibres Syndicate is producing six to seven tons per week at Port Broughton. On his estimate of the costs of dredging, etc. (4*l*. 10*s*. 6*d*.), and subsequent handling, the clean, air-dry fibre cannot be produced to sell at less than 17*l*. per ton. A second appendix, by Mr. J. C. Earl, on the paper-making value of various South Australian raw materials, deals with six indigenous products of little promise.

War problems and after-the-war problems are discussed by writers of every varying shade of opinion in *Scientia*, the Italian equivalent of our own *Science Progress*, but which exhibits a more international tendency by publishing French translations of English and Italian articles. Thus Prof. Sayce (xix., 5) considers that the history of the Assyrian empire under Tiglath Pileser and his successors affords a lesson as to what may be expected from a military nation imbued with the spirit of world-conquest. In the same number Prof. Roberto Michels, of Turin and Bâle, deals with the demolition of the international labour movement. Prof. Knut Wicksell (Lund, Sweden) discusses the influence of over-population in stimulating wars, and expresses the somewhat sanguine prophecy that with the present decline of the birth-rate in European countries peace conditions may become more possible (xix., 6). Prof. A. Pillet, of Paris (xx., 12), considers that the problem of the war from the Allies' point of view involves the entire crushing of the German Empire. Peace conditions and what is to happen after the war form the subject of speculations at the hands of Prof. E. Catellani, Padua (xx., 8), and E. Cecotti, Messina (xx., 6). Sir Alfred Hopkinson (xx., 12), while emphasising the strict adherence to the principles of international law in the operations of the Allies, blames the neutral countries for not taking action in enforcing the observance of similar principles on the enemy. But an attempt is made to apply the methods of exact science to the problem of when and what offers of peace should be made by a victorious belligerent, in a paper on "The Economic Dynamics of War," by Prof. John Bates Clark, of Columbia University. In his opinion the time for making the offer is when the gain to be derived from continuing the war is more than outbalanced by the sacrifice required for its continuance. And the terms to be exacted from the vanquished side should consist of all that the prospective victor could gain by pushing his conquest to the bitter end *minus* the cost of so pushing it. If these terms are offered and can be secured there is no advantage for either side to continue the struggle.

The Open Court Company will publish very shortly a translation, from the first edition, of "The Geometrical Lectures of Isaac Barrow." The work will contain a portrait of Barrow, and an introduction and notes by J. M. Child.

OUR ASTRONOMICAL COLUMN.

Aurora Borealis.—Mr. Denning writes that though the moon was nearly full on the evening of January 4 there was a brilliant occurrence of aurora observed from widely distant stations. The Rev. W. F. A. Ellison observed it from Fethard-on-Sea, near Waterford, and describes it as a particularly magnificent display. From Edinburgh, at about 10 p.m., there was also a fine exhibition, extending along a considerable range of the northern horizon. Rapid variations were apparent in the details, the light alternately appearing and disappearing. Clouds were very prevalent at low altitudes in the northern region, and the glow spread upwards from behind these with striking effect. At Bristol there was an auroral glow between about 8 and 9 p.m., and at 8.30 a bright streamer shot upwards to about 15° W. of the Pole star. But the appearance was rendered somewhat inconspicuous by the unusual brilliancy of the moon, due to the very clear atmosphere.

Dr. A. A. Rambaut, Radcliffe Observatory, Oxford, sends us the following notes of observations of this aurora made by Mr. W. H. Robinson at that observatory, and also of the bright meteor of the same date, referred to in last week's Nature (p. 379):—A bright haze in the northern sky attracted considerable attention at Oxford soon after 8 p.m. on January 4. A long segment of an auroral arch lay along the horizon, with its apex at a small altitude in the N.N.W. Isolated streamers appeared, but generally for a few seconds only. The finest display occurred at 10.15 p.m. (or perhaps a minute or so later), when streamers suddenly developed all along the arch, lasting for a very brief interval, a white haze taking its place. At about 10.15 p.m. a brilliant fireball attracted notice, which ran rapidly downwards from the direction of the moon, passed 2° or 3° east of Jupiter, and burst, with a blue colour, 10° or 15° below the planet, its trail swiftly disappearing. The light of the meteor was distinctly more intense than that of the moon. An approximate estimate places the track from 3h. 0m., +18° (first seen), to 0h. 45m., +5°.

Clouds on Mars.—In the course of a report on the planet Mars, in which observations made by members of an international organisation are summarised and compared, Prof. W. H. Pickering makes several interesting references to clouds which appeared on the planet during the opposition of last year (*Popular Astronomy*, vol. xxiv., p. 639). Clouds were seen frequently by all the observers, and Prof. Pickering points out that the clouds always lie over the so-called desert regions of the planet, apparently being precipitated so soon as the fertile regions are reached. Dissolution is sometimes very rapid. Only a few years ago it was claimed by some observers that clouds were rarely or never to be seen on Mars, but during the last opposition the planet was scarcely ever seen without them. The existence of clouds in the atmosphere of Mars appears to have been first established by Sir Norman Lockyer in his observations during the opposition of 1862.

The Cepheid Variables.—The results of some further investigations of the relations between the orbital elements of Cepheid stars have been given by Dr. Ludendorff (*Astronomische Nachrichten*, No. 4869). He finds that for several stars resembling δ Cephei, the elements are closely related, as shown in the formula

$$100e \cos\omega = -21{\cdot}8 + 0{\cdot}963(1-e^2)^{\frac{3}{2}}K^3P.10^{-3},$$

where e, ω, P are respectively the eccentricity, angle from periastron to node, and the period in days, while K is half the total amplitude of the radial velocity.

A similar formula is applicable to stars resembling ζ Geminorum, the two numbers on the right-hand side of the equation then becoming $+2{\cdot}4$ and $+0{\cdot}73$. Further confirmation has been obtained of the relation previously given by Dr. Ludendorff, $2K = 47{\cdot}3$ A, where A is the range of variation in brightness expressed in magnitudes; this, however, appears to be valid only for stars of types F to G.

GEOLOGICAL WORK IN CANADA AND AUSTRALASIA.

THE Geological Survey of Canada publishes in Memoir 72 an account of "The Artesian Wells of Montreal," which is suggestive to investigators in other limestone districts. Out of 179 deep wells, only about twenty yield less than 5000 gallons a day. The water usually comes in greatest abundance from depths of 300 to 1000 ft., and rises to within 30 ft. of the surface. The chance of finding a good supply below 1000 ft. is small, and it seems that the source of the water (p. 26) is the rain that falls on the St. Lawrence highlands and lowlands and creeps into the Palæozoic sediments. This water moves in the limestone along fissures and cracks, and is held up at no particular horizon; the closing of the fissures as the depth increases is held to explain its practical absence below 1000 ft. The author, C. L. Cumming, discusses the origin and possible interactions of the dissolved salts; the proportion of sodium carbonate is high for water in sedimentary deposits (p. 48), and this salt may be derived from flow over the crystalline rocks of the Laurentian highlands.

FIG. 1.—The Rocky Mountain Trench, looking east across the Kootenay River near Cranbrook, B.C. From "Geology of Cranbrook Map-Area, British Columbia."

Four considerable memoirs deal with districts in British Columbia, and are accompanied by geological maps conveniently folded in pockets at the end. Memoir 55, by J. A. Allan, on the "Geology of Field Map-area, B.C. and Alberta," covers the mountainous district on the west slope of the Rocky Mountains, where Mt. Goodsir rises to 11,676 ft., with residual glaciers on its steep north-east descent. One of the most famous stretches of the Canadian Pacific Railway lies within the area, and the continuous Cambrian section studied by Dr. C. D. Walcott in recent years occurs on Mt. Bosworth, in the north-east corner of the map. A mass of igneous rocks rich in alkalies was intruded through the older Palæozoic strata in post-Cretaceous times, and has been cut into by the valley of the Ice River. The richness of the prevalent nepheline-syenite in lime is attributed (p. 186) to its absorption of limestone at the contact-zone. The author points out (p. 42) the necessity for distinguishing cirques formed by local excavation at high levels, by the action of Russell's "mountain-side" type of glacier, from those left behind as hanging valleys. This distinction is even now worthy of emphasis, although Matthes's work on "nivation" in the Bighorn Mountains has justly attracted attention.

Texada Island, the elongated and steeply flanked ridge that rises from the Strait of Georgia, north-west of Vancouver, is described by R. G. McConnell (Memoir 58). The main rock is a great body of porphyrite of Lower Jurassic age, which shows pillow-structure (plates iv. and v.), here called nodular structure, though it seems to be an intrusive mass. Magnetite lenses, which sometimes form low hills, have encouraged mining. They are held to be contact-products (p. 77), connected with the younger intrusive rocks, which are in part of Lower Cretaceous age.

The Cranbrook map-area has been studied by S. J. Schofield (Memoir 76), on account of the development of gold-mining in lodes in the eastern part of the Kootenay electoral division. The district is well served by railways, which connect it southward with Montana, and northward with the main Canadian highway west of Field. It includes the south end of the "Rocky Mountain Trench" (p. 10), which extends to the borders of Alaska. In this tectonic feature the Kootenay River runs southward, amid parklike and largely alluvial country, while deeply dissected mountains of pre-Cambrian sediments rise beyond Cranbrook on the west. The Rocky Mountains on the east present the appearance of a distinct range, their crests of remarkably even altitude being touched here and there with snow (Fig. 1). The composite Purcell sills (p. 75), with upper zones of micropegmatitic granite and lower gravitational zones of gabbro, have much interest for petrographers.

The singular course of the Kootenay River brings it round the Purcell Range again into British Columbia, along the flooded valley known as Kootenay Lake, and westward out of this hollow to join, and largely to form, the rapid Columbia River descending on Washington and Oregon. Rossland (Memoir 77) lies on the upper part of the Columbia, close to the International Boundary, which cares for none of the things of physical geography. The alpine landscapes here lie away upon the east, and the town has grown up in the last twenty-five years among glacially moulded and often wooded hills. From its sulphide ores the output of copper rose to a maximum in 1902. Gold is extracted from massive pyrrhotine and copper pyrites, in which it is occasionally visible in a free form. C. W. Drysdale, in this memoir of 317 pages, deals with mining matters first. The ores made their appearance (p. 92) in fissures in connection with the intrusive rocks of the Jurassic mountain-building stage, and secondary enrichment, including the rise of gold, occurred during the Miocene disturbances. The author inclines (p. 186) towards a "three-cycle hypothesis" of the development of the surface-features around Rossland, beginning with the dissection of the Cretaceous peneplane, of which very few traces now remain. The Laramide upheavals were the cause of this dissection, which continued through Eocene times. Movements in the Oligocene period led to the destruction of much of the Eocene deposits by renewed erosion; and then Miocene diastrophism, accompanied by the introduction of mineral ores, provided a surface in which broad fairly mature features were established by the close of the Pliocene period. Renewed upwarping started the present cycle, which includes the modifying erosion of the Glacial epoch. The author's treatment involves some repetition from the sketch on pp. 41–43 to the final chapter on geological history (p. 244). His views are opposed to R. A. Daly's broad conception of the Purcell and Rocky Mountain ranges as derived from the continuous dissection of the folded Laramide mass. The scenery, whether of mines or mountains, the rocks and minerals, and even the useful cores obtained from prospecting bore-holes, are well and fully illustrated.

In a paper on the "Nephelite Syenites of Haliburton County, Ontario" (Amer. Journ. Sci., vol. xl., p. 413), W. G. Foye gives reasons for believing that the syenites rich in alkalies arose in the invading granite magma in consequence of the interactions which converted the local limestone into amphibolite. The production of calcium silicates set free solutions richer in sodium than the invading granite, and these in places modified the granite mass. The field evidence adduced thus supports R. A. Daly's theory of the origin of nepheline-bearing rocks.

From Australasia we receive E. C. Saint-Smith's report on the Stanthorpe district of S. Queensland (Queensland Geol. Surv., Publication No. 243). The granites of the region show the characteristic "bouldery" weathering associated with tropical sunlight and clear starry nights. These granites and the finely grained more acid types that cut them have brought up cassiterite, wolfram, and molybdenite. The intrusion is possibly of Mesozoic age. In Publication No. 249 L. C. Ball gives a cautious description of the "Oil Shales in the Port Curtis District," where fireclays may prove to be an important asset.

E. C. Andrews (New South Wales Geol. Surv., Mineral Resources, No. 18) regards the copper lodes of the Canbelego district (p. 63) as connected with Silurian or even older earth-movements. He reports in detail on the mines, which are associated with those of the Cobar copper- and gold-field, and lie up-country more than 300 miles north-west of Sydney. On p. 62 cerussite has by an accident become included in the oxides.

R. L. Jack, with the aid of a team of camels, has explored a region between the Musgrave Ranges and the 28th parallel of latitude in South Australia (Geol. Surv. South Australia, Bulletin No. 5), and reports that the country could rear stock if a trustworthy water-supply could be obtained. He advocates (p. 35) the sinking of further wells; but the forethought required in undertaking such work is shown in the necessity for choosing "a good season, when water is obtainable to enable the first wells to be sunk." The memoir, in addition to geological data, contains papers on the flora and on magnetic observations. The Government astronomer, G. F. Dodwell, contributes maps showing the magnetic declination, inclination, and horizontal intensity in South Australia.

Bulletin No. 61 of the Geological Survey of Western Australia, by J. T. Jutson (price 2s. 6d.), is a volume for geographical libraries and for any general reader interested in colonial progress. Its title, "An Outline of the Physiographical Geology (Physiography) of Western Australia," is well borne out in its systematically written chapters. Numerous maps and landscapes illustrate the surface-features and the flora. The tropical weathering and the arid condition of the interior will impress scholars in our islands, and the memoir may well be used by those who wish to illustrate geographical principles by a new and unhackneyed field. H. P. Woodward's "Geological Reconnaissance of a Portion of the Murchison Goldfield" (Bull. 57) is of equal interest through its excellent illustrations of the country, several of which reappear in Jutson's memoir. We are thus able to realise sheet-denudation caused by sudden rains falling on dry surfaces, laterite caps on crumbling desert hills, and water-holes of dubious character. The holes mentioned on p. 35 have a palæontological interest, since they were found, on being "cleaned out," to be full of dead kangaroos, thus serving as an example of the localisation of such remains in arid lands. Students of prehistoric man will note the valuable and fully illustrated account (pp. 74-89) of the native red-ochre mine at Wilgie Mia, where initiated medicine-men worked the pigment and developed a valuable trade (Fig. 2). The association

FIG. 2.—Natives working red ochre at the cave of Wilgie Mia, Western Australia, with the aid of timber staging. From "Geological Reconnaissance of the Murchison Goldfield."

of the ochre with legendary blood-stains (p. 88) may be compared with the story of the origin of the hæmatite veins on the face of Slieve Gallion in Co. Londonderry.

The New Zealand Geological Survey, now under the direction of P. G. Morgan, has issued Bulletin No. 17, on the Buller-Mokihinui sub-division, a district on the coast of Westport. Despite preliminary difficulties of access, and in a district of deep gorges and high rainfall, a large industry has been established in bituminous coals that were formed in Eocene lakes. One seam on Magatini Creek is 54 ft. thick, and the authors, P. G. Morgan and J. A. Bartrum, write (p. 155): "The numerous magnificent outcrops of clean, almost ashless, hard coal in this locality cannot fail to arouse enthusiasm in the spectator." This shows the right spirit; and the volume also reveals the impression made by beautiful river-scenery. The word *Gräben* for *Graben* occurs in several places; we cannot be too careful when importing such words into our geographical nomenclature, and we have recently noted the strange form *ösar* nearer home.

G. A. J. C.

SCIENCE IN PUBLIC SCHOOLS.

THE seventeenth annual meeting of the Association of Public-School Science Masters was held at Eton College on January 3 and 4. In his presidential address, Prof. H. H. Turner dealt with two main points, namely, that few boys have in them the making of scientific investigators, and that more openings are required for those who possess these attributes. Just as some boys have no sense of appreciation for music, so others are dead to scientific things, and may have a habitual dislike to them. It must, of course, be acknowledged that such types exist, but like indifference or antipathy can be found to all school subjects. Prof. Turner dealt with instruction in science as if its intention was to produce experts, whereas up to the age at which specialisation is permitted in a school course, the scientific teaching should be that which can claim a place in general education as justly as the teaching of letters, history, and mathematics. Boys who specialise in science afterwards may become investigators, but at present the careers open to them are few, and the prospects in them are unpromising. Prof. Turner suggested the formation of a Research Civil Service, parallel to the existing Administrative Civil Service. There is plenty of work to be done, such as the survey of our Empire, geodetically, magnetically, gravitationally, bathymetrically, and in other ways. There are forestry and fisheries, and industrial research of many kinds. Work is less likely to fail than workers. Modern researches are often of embarrassing length and involve much labour, but schools may help with some of them, and Prof. Turner gave a number of instances, of which "upper-air research" was one. He quoted Capt. Cave's opinion that such work is suitable for boys, and would be scientifically valuable. Mr. O. H. Latter, of Charterhouse, in seconding a vote of thanks to the president, proposed by Mr. C. E. Ashford, of the Royal Naval College, Dartmouth, thought that the views of parents would have to be taken into consideration when contemplating purely scientific investigation in schools. In this connection he read the following letter received by him as typical of the attitude of many parents towards certain studies of natural history:—

"I wonder if I may ask your co-operation in regard to my son? I believe you are the principal natural science master, and that he has been under your tuition from time to time. The boy's extraordinary liking for what I regard as the most repulsive branch of natural history newts, beetles, and insects—is a source of much disappointment both to his mother and to me. Can you either directly or indirectly turn his mind to a higher and more refined branch of the subject—birds, trees, or flowers? I cannot help feeling that the tendency of his present study is degrading, and I shall be glad to know if you think you can influence him in the way I suggest. If you can, I shall be extremely grateful to you."

Prof. R. A. Gregory, in opening a discussion on "Science for the Rank and File," said it is necessary to distinguish clearly between courses of work suitable for the rank and file and those intended as preliminary training for scientific or industrial careers. One has to do with science as an essential element of a liberal education; the other with vocational instruction. The former is at least as important as the latter, and little justification can be found for the concentrated attention given to a few subjects, with the view of imparting knowledge of experimental methods, when such a course means that the wonders of the fields beyond are kept outside the range of vision. For the imparting of the rudiments of a liberal education to all pupils the descriptive and qualitative school science of a generation ago is better adapted than the quantitative work in the narrow fields mapped out for instruction to-day. A plea was made for the introduction of descriptive lessons and reading intended to stimulate interest in scientific work and achievement and their relation to modern life, instead of limiting the teaching to dehumanised material of physics and chemistry.

Different aspects of this general subject of science for all were put forward in papers on:—A scheme of instruction in science for all boys throughout their school career, *i.e.* some science indispensable for all boys, by Mr. F. S. Young (Bishop's Stortford); the teaching of science on the classical side, by the Rev. S. A. McDowall (Winchester); the age for beginning serious science, by Mr. W. D. Eggar (Eton); classics the basis of a scientific education, by the Rev. A. L. Cortie, S.J. (Stonyhurst); how far can the advantages derived from teaching classics be derived from science? by the Rev. F. G. Forder (Charterhouse).

On the second day of the meeting, the first subject of discussion was technical bias in schools, and the papers read were:—School science in its relation to modern industrial problems, by Mr. E. R. Thomas (Rugby); school chemistry with a technical bias, by Mr. W. J. Gale (King's College School, Wimbledon); value and danger of giving a technical or topical trend to scientific education, by Mr. D. Berridge (Malvern). There was also a discussion on the place of text-books in science teaching, opened by Mr. G. N. Pingriff (University College School).

In the course of the discussion on technical bias in schools, Prof. A. Smithells said that in teaching science it should never be forgotten that however perfect might be the inculcation of scientific method, however sound the mental discipline, however powerful the intellectual weapon they supplied, unless they showed how science bore upon the environment and avocations of human life—unless, in fact, they humanised it—science could not flow effectually into the general culture of the nation.

Mr. C. L. Bryant, secretary of the association, in reading the report of the committee, said that towards the end of 1915 it was decided to arouse public opinion on the lack of appreciation of science in this country, and as the result of the work of a sub-committee, Mr. M. D. Hill was able to form what became known as the "Neglect of Science Committee." The committee of the association has also drawn up a memorandum containing a statement of facts, principles, and policy, which served as a text for discussion between a deputation and the Government Committee on Science in Education. In view of the growing opinion that training in science forms an essential part of a liberal education, the committee of the association has drafted a scheme of work which it considers to be suitable for all boys at the public schools up to the age of about sixteen and a half years. The meeting passed, *nem. con.*, a motion expressing general approval of this scheme.

FERTILISERS AND AGRICULTURAL PRODUCTION.

THE January issue of *Blackwood's Magazine* contains an important article by Prof. W. Somerville entitled "Increased Agricultural Production." As indicative of the present position of British agriculture, the author points out that of the food consumed we produce only one-fifth of the wheat, rather more than half the meat, one-quarter of the butter and margarine, one-fifth of the cheese, and nearly all the milk. The chief factor causing the reduction of the area of land tilled was the great increase in the amount of wheat imported from North America in the 'seventies and 'eighties. In the past forty-three years Great Britain has lost $3\frac{1}{2}$ million acres of tillage crops, including $1\frac{1}{2}$ million acres of wheat, and has produced no more meat, although the milk production has doubtless increased. This fact supports the contention that the area of land under crops may be largely increased without any decrease of stock-keeping.

After contrasting the English and German increase in food-production in the past forty years as shown by the recent Memorandum of the Board of Agriculture, and summarising the recommendations of the English, Scottish, and Irish Committees for increased food production during the war, Prof. Somerville urges that the post-war problem of a large permanent increase in food-production is the more difficult to solve. The solution of the problem is complicated by the consideration that if a durable peace is obtained there will be a long period available for the reconstruction of our agriculture, whilst if only an "armed" peace results from the present conflict, rearrangement will be necessary in the shortest possible time. Given that it is desirable to secure an increase of a million acres of wheat, many consider that this could be effected by guaranteeing a minimum price, which presumably would have to be extended to oats as well as to wheat, since the latter is of quite subordinate importance in Scotland and Ireland.

A rather more attractive suggestion is that farmers should be granted a bonus on the area of grass land converted to arable: this has recently been adopted in France. But there is one way in which an immediate and large increase in production can be effected, namely, by using on British land the whole of the ammonium sulphate produced in this country. Of the 400,000 tons of this fertiliser annually produced, 294,000 tons were exported in 1915, and for 1916 the amount was probably about 250,000 tons. If the latter were used on one-fourth of the area under wheat, oats, roots, potatoes, and hay, it would only give 60 lb. to the acre. Representing sulphate of ammonia in terms of wheat, the amount exported in 1916 is equivalent to $2\frac{1}{2}$ million quarters of wheat—*i.e.* an addition of more than 30 per cent. to our present home-grown supply. Further, the exportation of fertiliser and importation of wheat require shipping to the extent of 800,000 tons, and result in an adverse trade balance of 4,575,000*l.*

The case for prohibiting the export of ammonium sulphate is enormously strengthened by the reduction in the import of sodium nitrate in 1916. Since the latter decrease has not been compensated for by increased use of sulphate of ammonia, the land must have suffered a reduction in fertility. The 40,000 tons of basic slag exported in 1916 could be used on British land even more easily than the ammonium sulphate. It would suffice to produce 3,200,000 lb. of meat annually for five years, and here again considerations of freight and exchange are in favour of prohibited export. The use of basic slag on second-rate and inferior pastures is the most certain way of increasing production of food, and it is important now, because it involves only a fraction of the man and horse labour necessary for tillage.

Prof. Somerville is of the opinion that some measure of compulsion will be necessary, and advocates the establishment of local committees to decide which farms can make best use of the sulphate of ammonia and basic slag available, and which grass lands are to be tilled. Although recognising their obvious advantages, he considers that the creation of small holdings would prove more a hindrance than a help in regard to the production of the major part of the people's food.

ITALIAN METEOROLOGY.[1]

A NUMBER of useful meteorological memoirs by Prof. Eredia, of the Central Meteorological and Geophysical Institute of Rome, deal with various aspects of the meteorology of Italy. No. 1 is the Italian meteorological observers' handbook, copiously illustrated, in which full instructions are given regarding the installation of instruments for a normal station, along with practical hints regarding its maintenance. Instructions are also given for the taking of phenological observations. "The Variation of the Climate in Italy" (No. 2) is a reprint of a paper read at the tenth International Geographical Congress held in Rome during 1913, in which the mean annual temperature from 1866 to 1910 at sixteen stations is discussed. The warmest year was 1879, except in the insular areas, while 1900 was the coldest. The temperature variations, it may be said, are in general the reverse of those in the British Isles. Fog frequency over the region embraced by Lombardy, Venetia, and Emilia, based on data for twenty-three stations over the period 1892–1914, forms the subject-matter of No. 3. From May to August there are few fogs, the maximum taking place in winter. Maps of fog frequency are given for the autumn, winter, and for the year, while several isobaric charts indicate the conditions associated with some winter fogs.

The storm of October 7, 1915, along with a synopsis of storm frequency at the Tripoli Observatory from 1892 to 1914, is dealt with in No. 4. Isobaric charts referring to 8 a.m. and 9 p.m. illustrate the progress of the October storm. At Tripoli during the twenty-three years under consideration 164 storms were observed, the greatest number recorded being twenty in 1906, and the least number two in 1913 and 1914. The frequency by seasons shows that autumn is the stormiest time of the year with sixty-nine instances, followed by spring with forty-five, winter with thirty-three, while in summer only seventeen were noted. The diurnal period shows a maximum in the three hours ending 9 p.m., when storms are six times more numerous than in the three hours ending with 3 p.m. The rainfall associated with the storms discussed is small. In forty-five cases none was measured, and in forty-one other cases less than 5 mm. fell. In nineteen instances the fall exceeded 20 mm. A general review of the various drosometers hitherto employed for the registration of the amount of dew is given in No. 5, along with a description of a new form employed by the institute, which has many features to recommend it.

R. C. M.

ETHNOBOTANY OF AMERICAN INDIANS.

IN the thirtieth annual report of the Bureau of American Ethnology, Mr. M. C. Stevenson publishes an elaborate article on the ethnobotany of the Zuni Indians. This tribe had discovered the medicinal value of a large number of plants, one of the most important of which is the Jamestown weed (*Datura meteloides*), and the writer observes that from the symptoms caused by this drug, its homoeopathic adaptability to hydrophobia will be at once evident. "There is no drug so far proven that deserves as thorough and careful a trial in this dread disease as stramonium." "They learned the value of *Datura meteloides* as a narcotic perhaps centuries before the birth of Baron Stoerck, of Vienna, who first brought it to the atten-

[1] (1) "Norme per l'impianto e per il funzionamento della stazioni termo-udometriche." Pp. 41. (Rome, 1916.) (2) "Le variazioni del clima in Italia." Pp. 23. (Rome, 1915.) (3) "Le nebbie in Val Padana." Pp. 12+charts. (Rome, 1916.) (4) "Sul temporale verificatori a Tripoli nell' ottobre 1915 e sulla distribuzione dei temporali en Tripolitania." Pp. 17. (Rome, 1916.) (5) "Sulla misurazione della rugiada." Pp. 11. (Firenze, 1915.)

tion of the medical profession, and the use of antiseptics while Lister was still unknown. How long ergot has been employed by the Zuni for the chief purpose to which it is devoted by civilised men, no one can say."

The subject of the ethnobotany of the American Indians is discussed in an elaborate report on "Iroquois Foods and Food Preparation," by Mr. F. W. Waugh, published as Memoir No. 86 by the Department of Mines, Canada. We have a full account of their agricultural methods and customs, their cooking and eating customs, and the utensils employed in gathering, preparing, and cooking food. The method of rain-making is of interest. The performer, stripped to the waist, or clad only in a breech-cloth, burns tobacco, and calls upon the Thunder Man, in return for his offering of tobacco, to provide abundant rainfall. Another curious custom is that of subjecting girls at puberty to the task of grinding a quantity of the hardest grain which can be found: if she fails to accomplish the task she is believed to be unfit for married life. Spoons used in eating are decorated with designs which are disclosed in dreams, and interpreted by the local seer. Such dream-objects presented to the sick secure recovery.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—Ten public lectures on "Science and the Empire: the Exploitation of Plants," arranged in co-operation with the Imperial Studies Committee, will be delivered at University College during the term which opened on Monday. The introductory lecture on January 22 will be by Prof. F. W. Oliver, and the remaining lectures are to be as follows:—Plant food and soil problems, Prof. W. B. Bottomley; Timber production in Britain, Dr. E. J. Salisbury; Cotton, Dr. W. Lawrence Balls; Tea-making, Dr. S. E. Chandler; The plant as healer, Dr. E. N. Thomas; Tropical exploitation, with especial reference to rubber, Dr. J. C. Willis; Vegetable dyes, Dr. S. M. Baker; Diseases of plants, Dr. H. C. I. Gwynne-Vaughan; Coal, Dr. Marie C. Stopes. All these lectures are open to the public without fee.

MR. JOSEPH YATES, of the Blackburn Technical School, has been appointed head of the chemistry department of the Derby Technical College.

THE sum of 20,000*l.* has been given anonymously to the Higher Institute of Medicine for Women at Petrograd for the foundation of scholarships in the name of Count Vorontzoff, who died in 1916.

A SERIES of popular lectures by Miss Edith A. Browne on "The Tropical Products and Industries of the Empire," illustrated by the collections of the Imperial Institute, began yesterday, and will be continued on Wednesdays in January, February, March, and April, at the Imperial Institute, at 3 o'clock. Admission to the lectures is free by ticket, for which application should be made to the director of the Imperial Institute, South Kensington.

AT the Guildhall Art Gallery on January 12 the Lord Mayor took the chair at the annual general meeting of the Royal Drawing Society, when the annual report was presented and speeches were made on the need for convincing educationists of the value of drawing for school work in general, but especially with reference to science teaching. A letter was read from Sir Robert Baden-Powell approving the work of the society, and stating that in the training of the junior Boy Scouts badges had been introduced for proficiency in drawing of a kind that displayed observation, memory, sense of proportion, reason, and so on. Dr. F. A. Bather showed how the society's method of making pupils draw objects from written descriptions encouraged the precise use of language and the precise interpretation of it. Few people knew how to read or write, but this method taught them how to do both, as well as to draw. Sir John Cockburn agreed that reading and writing were most difficult arts, and maintained that children should first be given such a knowledge of concrete objects as could best be gained through drawing and modelling. The same applied to arithmetic. It was absurd to teach children their weights and measures until they knew what was really meant by a quart, a bushel, or a pound. The endeavour of this society to make drawing a natural mode of expression in all branches of school work certainly deserves warm encouragement.

WE have received particulars of the dedication of the Ceramic Engineering Building at the University of Illinois, Urbana, Ill., on December 6–7, 1916. The American idea of the meaning of the term "ceramic" is interesting in view of a recent assumption in England that "ceramic" refers only to pottery, and that the English Ceramic Society ought, therefore, to deal with nothing but pottery. This assumption is not in accord with general usage. The ceramic industries to be treated in this building cover the technology of all mineral products except ores and minerals of organic origin, and it is stated to include all kinds of clay products; plasters, mortars, cements, and concrete; all varieties of glass; enamelled metals; and refractory, insulating, and abrasive materials. The new Ceramic Engineering Building covers a ground area of 67 ft. by 180 ft.; it is a three-story structure with a basement, and, from a description in the dedicatory pamphlet, it appears to be handsomely equipped. It is said that the department of ceramic engineering is intended (1) to train engineers for the direction and control of various operations connected with ceramic industries; (2) to cultivate intimate relations with the clay-workers of the State; (3) to co-operate with the State Geological Survey in the systematic study of all the ceramic resources of the State; and (4) to prosecute research in special ceramic problems, and the more fundamental scientific problems connected with the behaviour of ceramic materials in the various processes to which they are subjected during manufacture. The staff includes Prof. E. W. Washburn as head of the department, Prof. C. W. Parmelee, Assistant Prof. R. K. Hursh, and Instructor H. C. Arnold. Addresses on the development of the various ceramic industries were given at the dedication by Messrs. S. W. Stratton, J. P. Beck, W. D. Yeates, W. W. Marr, H. J. Burt, C. Bragdon, and C. F. Binns. The ideals described in the dedicatory pamphlet are splendid, and it would be equally splendid if they were realised in the near future.

SOCIETIES AND ACADEMIES.

WASHINGTON, D.C.

National Academy of Sciences, November, 1916 (Proceedings No. 11, vol. ii.).—C. **Barus**: Path differences within which spectrum interferences are observable. The method of observing interferences in the zeroth, first, second, third, and even fourth order, successively, without essential change of the parts of the apparatus, is noteworthy. The present experiments furnish a striking example of the uniform breadth of the strip of spectrum carrying the fringes, quite apart from the dispersion of the spectrum.—C. **Barus**: Non-reversed spectra of restricted coincidence. The method, apart from any practical outcome, is worth pursuing because of the data it will furnish of the width of the strip of spectrum carrying interference fringes under any given conditions.—L. J. **Henderson** and E. J.

Cohn: The equilibrium between acids and bases in sea-water. The ocean, which, because of the presence of free carbonic acid, was originally acid, and has been becoming more alkaline from the accumulation of basic material, is at present in an epoch where the growing alkalinity is checked by the *buffer* action of acids of approximately the strength of boric acid. These buffers regulate the reaction of sea-water in a manner similar to the way in which bicarbonates and phosphates regulate the reaction of blood.—H. S. **Washington**: An apparent correspondence between the chemistry of igneous magmas and of organic metabolism. The object is to direct attention to what appears to be a congruous relation of two pairs of elements in the organic world; it would appear that iron and sodium are necessary for animal metabolism, while magnesium and potassium are essential to vegetable metabolism.—W. **Trelease**: The oaks of America. A summary of a manuscript now prepared for submission to the academy for publication as one of its scientific memoirs. Three hundred and fifty-four species of oaks, of which about one-half are new, are recognised. The relations to fossil oaks are pointed out.—E. V. **Huntington**: A set of independent postulates for cyclic order. Five postulates are given for cyclic order.—R. M. **Yerkes**: A new method of studying ideational and allied forms of behaviour in man and other animals. A description of the author's method of multiple choices for the deduction of reactive tendencies and the study of their *rôle* in the attempted solution of certain types of problem. The method involves the presentation to the subject of a problem, or series of problems, the rapid and complete solution of which depends upon ideational processes — G. N. **Lewis** and T. B. **Hine**: Electrical conduction in dilute amalgams. The resistance of amalgams of lithium, sodium, and potassium is studied at constant pressure and shows extraordinary differences; the resistances at constant average atomic volume are also calculated and found to differ materially from those at constant pressure.—R. M. **Yerkes**: Ideational behaviour of monkeys and apes. The general conclusions which may be deduced are that the ape exhibits various forms of ideational behaviour, whereas the reactive tendencies of monkeys are inferior in type.—W. D. **Harkins**, R. E. **Hall**, and W. A. **Roberts**: The osmotic pressure and lowering of the freezing point of mixtures of salts with one another and with non-electrolytes in aqueous solutions. The general result obtained with mixtures already investigated is that the lowering of the freezing point of the mixture is very nearly that which would be calculated on the basis that each salt produces a lowering of the freezing point proportional to its own concentration and to the mol-number which it has when present alone in a solution of salt concentration.—H. **Blumberg**: Certain general properties of functions.—S. W. **Williston**: Sphenacodon, Marsh: a Permo-Carboniferous theromorph reptile from New Mexico. Reconstruction of a fossil reptile found in a bone bed from which some collections were made so early as thirty-eight years ago, but which seems to have been almost forgotten until recently.—L. J. **Henderson**: On volume in biology. When equilibrium has been established in a heterogeneous system (capillary and gravitational phenomena being absent) the volume of the phases is not relevant to the state of the system, but in nearly all physiological changes the regulation of volume is of great importance.

CALCUTTA.

Asiatic Society of Bengal, December 6, 1916.—Sarat Chandra **Mitra**: Secrecy and silence in North Indian agricultural ceremonies. The author discusses the taboos against speaking and the presence of outsiders which are observed throughout northern India at the times of (*a*) sowing the seeds; (*b*) threshing the harvested crops; (*c*) winnowing the threshed-out grain; (*d*) heaping up the cleaned grains; and (*e*) measuring the same. The popular explanation of the observance of this taboo against speaking is that, if any kind of talking is done while the aforesaid operations are going on, the evil spirits would come and deprive the corn of its substance and nutritive properties. The author thinks that this explanation is not plausible enough. He has, therefore, broached the theory that all supernatural beings dislike not only being recognised and spoken to, but also being seen; that the Earth-mother or the Earth-deity is one of these supernatural beings; and that, as all the aforementioned agricultural ceremonies are performed in honour of the Earth-mother, she does not wish that anybody should speak to her or profane the scene of these operations—the scene of her hallowed presence—by breaking the silence that reigns.—N. **Annandale**: Zoological results of a tour in the Far East. Batrachia and reptiles. No attempt was made to collect batrachia or reptiles indiscriminately. In the former group specimens were collected mainly with two objects: to obtain material (1) for a systematic study of the frogs, *Rana tigrina*, *R. limnocharis*, and allied forms, and (2) for the comparison and description of larval forms, more particularly of those that exhibit peculiar characters correlated with life in rapid running water. In the collection of reptiles only aquatic and amphibious species are represented. In reference to the batrachia it is shown that three species (one practically confined to India and Ceylon, one widely distributed in continental Asia east of the Bay of Bengal, and a third characteristic of the Malay subregion) have been confounded under the name *R. tigrina*. The first of these is the true *R. tigrina* of Daudin, the second must be known as *R. rugulosa*, Wiegmann, and the third as *R. cancrivora*, Gravenhorst. Most of the reptiles are well-known forms, the most interesting being the lizard, *Tropidophorus sinicus*, which lives at the edge of hill-streams in Hong-Kong. —C. A. **Paiva**: Zoological results of a tour in the Far East. Aquatic Hemiptera from Tale Sap, Peninsular Siam. The paper deals with ten species (of which one is new to science) belonging to nine genera and six families. The majority of the species are very widely distributed Oriental forms, but one has hitherto been known only from Burma, one from Laos, and one from the Siamese Peninsular province of Patani. All are true fresh-water forms, except the last, which is probably estuarine. The most interesting feature of the collection is the fact that it includes specimens of a new species of the subgenus Kirkaldya (genus Microvelia), which has hitherto been known only from North America.

CAPE TOWN.

Royal Society of South Africa, October 18, 1916.—Dr. L. Péringuey, president, in the chair.—Miss A. V. **Duthie**: African Myxomycetes. In this preliminary paper an attempt has been made to compile a list of the species of Myxomycetes previously recorded from Africa in various journals and monographs, and also to record forms which have been accessible to or collected by the author.—Miss A. V. **Duthie**: Hybrid forms in the genus Satyrium, with descriptions of two new forms. The paper contains a description of two hybrids from Tulbagh, one *Satyrium erectum* ×*coriifolium*, the other *S. erectum* ×*bicorne*. A detailed description, with illustrations, is given of the vegetative and floral structures in each form.—L. **Simons**: Ionisation of gases and the absorption of Röntgen rays. The independence of X-ray effects of molecular aggregations and the dependence only on the atoms present, together with the fact that it has been shown that the absorption of a given wave-length in a solid varies as the fourth power of the atomic number of the solid, whilst for a gas the primary β ionisation also varies as the fourth power of the atomic number of the atom ionised, leads to the conclusion that absorption in solids (apart from scattering) is due throughout to the production of β particles. Expressions are found for the fall in the constant of proportion between the absorption per atom and N^4 when a K line ceases to be excited, and when an L line ceases to be excited.—M. **Rindl**: Note on the occurrence of daphnin in the arthrosolen. The author has determined the presence of daphnetin and glucose in *Lasiosiphon polycephalus*, a perennial shrub which flowers in August and September, known to the South African farmers as Januariebosje, and assumes that the glucoside daphnin has been present and hydrolysed in the process of extraction.

BOOKS RECEIVED.

Manual of Psychiatry. By Dr. J. Rogues de Fursac and Dr. A. J. Rosanoff. Fourth edition. Pp. xi+522. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10s. 6d. net.

Food and Health. By Prof. H. Kinne and A. M. Cooley. Pp. vi+312. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 3s. net.

Theoretical Chemistry from the Standpoint of Avogadro's Rule and Thermodynamics. By Prof. W. Nernst. Revised by H. T. Tizard. Pp. xix+853. (London: Macmillan and Co., Ltd.) 15s. net.

Bacon's Large-Scale Map of the Salonika Battle Front. (London: G. W. Bacon and Co., Ltd.) 1s. net.

Tropical Agriculture. By Dr. E. V. Wilcox. Pp. xviii+373. (New York and London: D. Appleton and Co.) 10s. 6d. net.

Scheme for Maternity and Child Welfare Work. By Misses I. Macdonald and K. C. Atherton. (London: Royal Sanitary Institute.) 1s. net.

Functions of a Complex Variable. By T. M. MacRobert. Pp. xiv+295. (London: Macmillan and Co., Ltd.) 12s. net.

A Laboratory Course of Practical Electricity for Vocational Schools and Shop Classes. By M. J. Archbold. Pp. ix+211+Exp. 98. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5s. net.

A Critique of the Theory of Evolution. By Prof. T. H. Morgan. Pp. x+197. (Princeton: University Press; London: Oxford University Press.) 6s. net.

Human Physiology. By P. G. Stiles. Pp. 405. (Philadelphia and London: W. B. Saunders Co.) 6s. 6d. net.

Farm Spies: How the Boys Investigated Field Crop Insects. By Prof. A. F. Conradi and W. A. Thomas. Pp. xi+165. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 2s. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 18.

LINNEAN SOCIETY, at 5.—The Comparative Morphology of the Sorus of Ferns: Prof. F. O. Bower.

MATHEMATICAL SOCIETY, at 5.30.—Some Asymptotic Formulæ in Combinatory Analysis: G. H. Hardy and S. Ramanujan.—Singular Solutions of Ordinary Differential Equations of the First Order: M. J. M. Hill.—The Nature of a Moving Electric Charge and its Lines of Electric Force: H. Bateman.

ROYAL SOCIETY OF ARTS, at 4.30.—Between the Tigris and the Indus. The Ben-i-Israel: Sir T. H. Holdich.

CHEMICAL SOCIETY, at 8.—Alloys of Copper and Tin, Aluminium and Gold: Col. C. T. Heycock.

FRIDAY, JANUARY 19.

ROYAL INSTITUTION, at 5.30.—Soap Bubbles of Long Duration: Sir James Dewar.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—The Manufacture of Gauges at the L.C.C. Paddington Technical Institute: A. G. Cooke, W. J. Gow, and W. G. Tunnicliffe.

SATURDAY, JANUARY 20.

ROYAL INSTITUTION, at 3.—The Lakes and Mountains of Central Africa: A. R. Hinks.

MONDAY, JANUARY 22.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Yunnan and the West River of China: E. C. Wilton.

ARISTOTELIAN SOCIETY, at 8.—Monism in the Light of Recent Developments in Philosophy: C. E. M. Joad.

TUESDAY, JANUARY 23.

ROYAL INSTITUTION, at 3.—The Old Brain and the New Brain, and their Meaning: Prof. C. S. Sherrington.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The Physical Features of "Adam's Bridge," and the Currents across it, considered as affecting the Proposed Construction of a Railway connecting India with Ceylon: F. J. Waring.

WEDNESDAY, JANUARY 24.

ROYAL SOCIETY OF ARTS, at 4.30.—Relief Work in Belgium: W. A. M. Goode.

GEOLOGICAL SOCIETY, at 5.30.—Easter Island: W. Scoresby Routledge.

THURSDAY, JANUARY 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Dynamics of Revolving Fluid: Lord Rayleigh.—Spectroscopic Observations on the Active Modification of Nitrogen. V.: Hon. R. J. Strutt.—Magnetic Induction and its Reversal in Spherical Iron Shells: Profs. J. W. Nicholson and E. Wilson.—The Two dimensional Motion of a Plane Lamina in a Resisting Medium: S. Brodetsky.

FRIDAY, JANUARY 26.

ROYAL INSTITUTION, at 5.30.—Epicurean Philosophy: Prof. G. Murray.

PHYSICAL SOCIETY, at 5.—A Clock of Precision: C. O. Bartrum.—The Effect of the Water Vapour in the Atmosphere on the Propagation of Electromagnetic Waves: Dr. F. Schwers.

SATURDAY, JANUARY 27.

ROYAL INSTITUTION, at 3.—The Lakes and Mountains of Central Africa: A. R. Hinks.

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

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THURSDAY, JANUARY 25, 1917.

SHAKESPEARE AND PRECIOUS STONES.

Shakespeare and Precious Stones. By Dr. G. F. Kunz. Pp. 101. (Philadelphia and London: J. B. Lippincott Co., 1916.) Price 6*s*. net.

THE author of this contribution to the literature of the Shakespeare Tercentenary has long been known as the most prominent expert authority on gems and jewelry in the United States. He has acquired a wide knowledge of the various sources of origin of precious stones from the earliest times up to the present day, and is familiar with the pedigree of every jewel which has made itself famous among the generations of mankind. It was fitting, therefore, that, among the various essays in connection with the Shakespeare celebration last year, Dr. Kunz should discourse on the knowledge which the great dramatist possessed of precious stones. He has compiled a daintily printed volume in which he has collected all the poet's references on this subject, and he adds comments on the probable sources from which the gems of Elizabethan and earlier, as well as later, times have been obtained. His reverence for the memory of Shakespeare has led him to make all his quotations from the First Folio of 1623—an affectation which, with no compensating advantage, gives his readers a little additional trouble in finding the passages cited. The number of those who can refer to the First Folio must be extremely limited, even in New York.

It was inevitable that Shakespeare should be much less familiar with precious stones than with the living things of natural history of which he has made so much use. At Court functions and entertainments by the leaders of society he must have seen, at least from a distance, great ladies "walled about with diamonds," or "decked with diamonds and Indian stones." It is to the distant sheen and glitter of the gems that he usually alludes in his plays and poems, rather than to their individual character when seen close at hand. He refers, for instance, more than twenty times to the diamond, without much indication that he knew what was the special quality which has given that gem its deserved pre-eminence. Out of the seven references to the diamond in "Cymbeline," there is only one where this distinctive quality is recognised—"that diamond of yours outlustres many I have beheld."

The names of the gems are often used by the poet as adjectives of colour, and with no reference to the other qualities of the stones. Thus in the only mention of the emerald in the Plays the name is simply a synonym for green. Mrs. Quickly tells her fairies to

> write
> In emerald tufts, flowers purple, blue, and white.

The ruby also is chiefly used as a colour-epithet, applied more especially to lips and cheeks. This gem is introduced, however, with delicate effect into the fairy world, where around the queen

> The cowslips tall her pensioners be;
> In their gold coats spots you see:
> These be rubies, fairy favours.

The jewel most often alluded to by Shakespeare is the pearl, which he mentions upwards of thirty times. Yet in no single passage does he, by a descriptive epithet, indicate the peculiar kind of beauty which has made this gem to be so prized in every age. One of his favourite similes is to compare tears to pearls. When Proteus in "The Two Gentlemen of Verona" was banished, his Silvia was said to have poured forth on his behalf "a sea of melting pearl, which some call tears." Again, when Cordelia in "King Lear" heard of the indignities put on her father, her eyes filled with tears,

> which parted thence
> As pearls from diamonds dropp'd.

Another comparison of which the poet makes effective use is to liken dewdrops to pearls, and nowhere with more exquisite delicacy than in his fairy world, where it is one of the functions of the fays to

> seek some dewdrops here,
> And hang a pearl in every cowslip's ear.

Further, when Oberon saw the garlands with which Titania had bedecked the hairy scalp of the transformed Bottom, he could not but exclaim:

> That same dew, which sometime on the buds
> Was wont to swell, like round and orient pearls,
> Stood now within the pretty flowerets' eyes,
> Like tears, that did their own disgrace bewail.

There is an allusion to the origin of the pearl in "As You Like It," where, among his sententious remarks, Touchstone tells the Duke that "rich honesty dwells like a miser, sir, in a poor house; as your pearl in your foul oyster." Dr. Kunz, on rather slender grounds, is inclined to believe from this passage that the poet may have been acquainted with some of the repulsive details of the pearl fishery.

Shakespeare could sometimes put the names of precious stones to a contemptuous purpose. In "The Comedy of Errors" we hear of a kitchen-wench who had a "nose, all o'er embellished with rubies, carbuncles, sapphires"—a portraiture which in later days was imitated by a Scots ballad-monger, who wrote that

> many a Cairngorm pimple
> Blazed upon the face of Kate Dalrymple.

It is seldom that Shakespeare's references to gems indicate that he was probably making use of his own personal acquaintance with them. Perhaps the best example of this knowledge occurs in "Twelfth Night," where the Clown, in taking leave of the Duke, exclaims: "Now the melancholy god protect thee; and the tailor make thy doublet of changeable taffeta, for thy mind is a very opal." The singular variability of colours in this stone as it is turned round in the light makes it a good illustration of mental vacillation.

Y

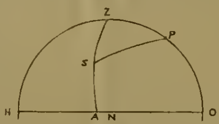
Dr. Kunz cites, among the precious stones mentioned by Shakespeare, a number of substances which, though they can scarcely be reckoned precious, have long been employed in jewelry, such as agate, amber, coral, jet, and rock-crystal. His little volume, though without literary distinction, contains much information on the subject of which it treats, and will be welcomed by lovers of the great dramatist.

IDENTIFICATION OF STARS.

Star Identifier and Diagrams for the Graphical Solution of Problems in Nautical Astronomy. By J. E. McGegan. (London: The London Name Plate Manufacturing Co., and J. D. Potter, 1916.) Price 10*s.* 6*d.* net.

BY the pamphlet and diagrams prepared by Mr. McGegan he suggests a method by which, when an observer has taken an altitude of a star the identity of which is doubtful, he can, if he also observes the compass bearing of the object at the same time, ascertain its declination and right ascension, and thus identify it in the Nautical Almanac.

The problem is very simple, provided the data can be accurately observed, as the annexed diagram will show: where P is the pole, Z the zenith, N the place of the observer, H O the horizon, while S is the star observed which requires to be identified. The arc S A will be its altitude, the arc P O the latitude of the observer. Consequently, the arc Z S will be its zenith distance, and the arc P Z the colatitude, whilst the angle P Z S will be its azimuth, which can be obtained by correcting the compass bearing observed to the true bearing, and then deducting the result from 180° to find the azimuth. There is consequently a spherical triangle P Z S, with two sides and the included angle known, to find the third side P S (the polar distance) and the angle Z P S (the hour angle). By applying the hour angle to the right ascension of the meridian of the place, readily ascertained from the Nautical Almanac, the right ascension of the star is obtained and its declination from its polar distance.



To solve the problem without much calculation Mr. McGegan has ingeniously constructed two diagrams on equal scales, one the diagram of a hemisphere divided into circles of declination from the equator to both poles; and into meridians representing sidereal hour angles, or circles of right ascension; a second diagram on celluloid, which is transparent, represents a semicircle marked in circles of altitude from the horizon to the zenith, and of arcs of azimuth 0° to 90° east and west from the meridian.

There is, in addition, on the diagram of right ascension and declination a quadrant at the side marked from 0° to 90° to represent latitude.

Now if the position of the star by altitude and azimuth be marked on the celluloid semicircle, and the semicircle be placed over the diagram of the hemisphere in such a manner that its centre coincides with the centre of the hemisphere, and its horizon cuts the quadrant marked outside the hemisphere at the latitude of the observer, then the position on the celluloid will show on the diagram of the hemisphere under it the declination and hour angle of the star to be identified.

In actual practice this is seldom, if ever, necessary. Star observations at sea are only of use when the horizon is clear and well defined—for instance, at twilight morning or evening, or when Venus or Jupiter passes the meridian at an interval of more than 2½ hours from noon. When the horizon is well defined the stars are nearly always too faint to enable compass bearings of them to be observed.

Stars on or near the meridian can at twilight nearly always be seen through the sextant, when invisible to the naked eye, if their approximate altitude be placed on the sextant. For longitude only very bright stars are available at twilight, and navigators know well where they are situated and where to look for them.

As the celluloid semicircle easily slips out of its place over the diagram of the hemisphere, it would be an advantage if a screw-pin were placed through the centres of both with a clamp and screwed tightly, when the horizon line had been placed on the appropriate latitude on the side of the diagram of the hemisphere.

AN ARABIC ALGEBRA.

Compendio de Algebra de Abenbéder. Texto árabe, traducción y estudio por José A. Sánchez Pérez. Pp. xlvii+117. (Madrid: E. Mastre, 1916.)

THIS work is "a compendium of algebra composed by the sheikh Abu Abdullah Muhammad b. 'Umar b. Muhammad, generally known as Ibn Badr." Practically nothing is known about the author, and not much about the date of the treatise. The MS. on which this edition is based was written in A.H. 744 (=A.D. 1343), and the text contains a reference to Abu Kāmil (trans. p. 57, text p. 39) and "his book about algebra." The editor takes this Abu Kāmil to be Abu Kāmil Shujā' b. Aslam al-Ḥāsib (the reckoner). The treatise comprises a theoretical part and a collection of problems, or rather a set of numerical examples of particular types, followed by problems relating to practical affairs of commerce, etc. The theoretical range includes (in this order) quadratic equations, quadratic surds, law of integral indices, rule of signs for multiplication (given without any comment), multiplication of ordinary polynomials, division of one monomial by another, rule of transposition. Among the problems we have cases of simultaneous equations of various kinds; and it is clear (p. 70) that the author was acquainted with the arithmetical theory of proportion.

To a certain extent Ibn Badr makes up formulæ of the type $f(x, y)=0$ or $f(x, y, z)=0$ to solve a whole set of problems; see, for instance, pp. 88–90. He also discusses some problems which lead to linear Diophantine equations; for instance (pp. 90–92), we have the problem:—

"A man sold three kinds of grain, wheat, barley, and millet; the wheat at 4 dirhems per measure (*qafīz*), the barley at 2 dirhems per measure, the millet at half a dirhem per measure. Altogether he sold 100 measures for 100 dirhems; how many measures of each grain did he sell?"

This leads, of course, to the equations $x+y+z=4x+2y+\frac{1}{2}z=100$, and hence to $7x+3y=100$; but Ibn Badr's analysis is quite different from this. The editor concludes (pp. xix–xx) from the occurrence of problems of this type that the author belongs to the twelfth or thirteenth century.

An interesting feature of the text is the way in which different technical terms are used. Thus *māl*, which properly means "wealth," is used by Ibn Badr not only in the sense of "capital," but also (*e.g.* text p. 18, line 1) in the sense of x^2, and this even when x is a quadratic surd. Does this arise from marshalling troops in squadrons, or possibly from reducing areas to equivalent squares? Other terms are noted by the editor.

So far as we can judge, the editor's work seems to be very well done. Besides the text and translation we have an introduction describing the (unique) MS., now in the Escurial Library, photographic facsimiles of the first and last pages, a very useful summary of the contents (using modern notation), and a few notes on the history of mathematics in Spain.

This and other recently published works indicate that Spain is becoming really alive to the value of scientific research; it may be added that it appears under the auspices of the *Junta para ampliación de estudios e investigaciones cientificas*.

G. B. M.

OUR BOOKSHELF.

Cours de Manipulations de Chimie Physique et d'Electrochimie. Par M. Centnerszwer. Pp. 182. (Paris: Gauthier-Villars et Cie, 1914.) Price 6 francs.

When a student actually measures the quantities involved in theory, a flood of light is frequently thrown on hitherto obscure points, and the object of the present practical course is to assist in the study of theory rather than to provide a training in manipulation. The book is orthodox according to the Ostwald school. It has been gradually evolved from teaching experience in the Riga Polytechnic, and meets with the approval of Walden. It thus has much to commend it.

Following the well-known Leipzig lines, it presents mostly familiar features, except that it is almost unique among books on practical physical chemistry in giving exercises on the measurement of critical constants. No other practical book, except Ostwald-Luther, so far as we are aware, deals with this subject, and in the short practical course at Leipzig the exercises on critical constants are marked as optional. The author's special experience in this field no doubt accounts for this novelty, and what makes it the more welcome is that the methods described have been put to the test.

Practical details are very fully given in the part on electrochemistry, which occupies 77 out of a total of 182 pages. We note, however, that a table of absolute potentials for elements is given instead of the more trustworthy and equally practicable potentials relative to the hydrogen electrode. This is possibly due to the elementary nature of the work, just as in most elementary books on general chemistry it is not considered wise to confuse the beginner by giving arguments in favour of the oxygen basis for atomic weights. The same desire for simplicity also explains the absence of reference to the degree of uncertainty in experimental results.

Francis W. Gray.

The Nation of the Future: a Survey of Hygienic Conditions and Possibilities in School and Home Life. By L. Haden Guest. Pp. 115. (London: G. Bell and Sons, Ltd., 1916.) Price 2*s.* net.

This little book, clothed in an ambitious and somewhat misleading title, deals entirely with the welfare of the school child and with the medical inspection and treatment of school children.

The first section deals with the disabilities to which school children are subject, their results, their treatment, and their prevention.

In the second section the method of carrying out the medical inspection of school children is described, the system being that which has been adopted by the London County Council. Finally, the case for the school clinic is presented to the reader.

The book is a popular one suited to the requirements of education committees, teachers, and health visitors, and as such may be useful. The text is illustrated with several plates.

Stars at a Glance. Pp. 48. (London: G. Philip and Son, Ltd., n.d.) Price 1*s.* net.

This simple guide to the stars will admirably meet the requirements of those who are commencing the study of astronomy or who have become interested in the heavens since the lighting restrictions came into operation. It provides an "aspect chart" for each month, which will enable the observer to make a general acquaintance with the stars visible at a specified time and date, and four additional charts showing the constellations in greater detail. An important feature is a calendar-index, whereby the proper chart to be consulted at any time may easily be selected. In conjunction with a compass-card which is provided, the charts may be conveniently used for purposes of night-marching. The text includes a useful introduction to the study of the heavens and some brief notes on the constellations and principal stars.

LETTERS TO THE EDITOR.

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

A Plea for a Scientific Quadruple Entente.

THAT result of the present war which will, without the slightest doubt, have the most important consequences for the future is the evidence it has brought to the nations of the Entente of the terrible danger that they have run of being victims of German hegemony in all fields of human activity—economic, technical, and scientific. This danger has diminished since the war burst upon us; it was very great during the long time of peace that preceded the war, but the war warded it off just in time, and the nations of the Entente have hastened to adopt as remedies all kinds of measures of initiative—governmental and private—which will certainly be successful. Thus, new industries have been created, and we are preparing to create others, to make ourselves independent of Germany in the manufacture of certain products of the greatest importance that Germany used almost exclusively to furnish. Again, we are now seeking means to protect ourselves against the "dumping" of German products after the war to the detriment of our national products. Again, institutions and other means are being created expressly to make still closer that co-operation of science and technology which has worked miracles in Germany. Finally, after having become convinced of the power which, as we see by the domination of great enterprises, dwells in organisation, we have undertaken to formulate and spread abroad the fundamental practical principles of organisation for whomsoever can, and should, learn and apply them in any branch of the work of society.

This pacific war of liberation from German hegemony, that is being prepared even during this bloody war and that must be continued more vigorously than ever after peace comes, must also be carried into the scientific domain, of which also Germany was gradually taking sole control. The numberless *Archivs, Jahrbücher, Zeitschriften, Zentralblätter,* and so on, which have been yearly increasing in number and volume, have gradually monopolised the whole of the scientific production of the world by gathering widely, and even demanding, the collaboration of learned men of all countries. Thus were apparently built up international scientific organs, but in reality German instruments of control and monopoly of science.

It is, then, in this domain that it seems necessary to prepare and begin our pacific war of liberation from German predominance. I am far from wishing that, after peace is concluded, we should try to keep alive the hatred that has been stirred up by the war. The friends of science would wish to do so less than anybody. Rather, if the war leads—and it can and must lead—to the establishment of the principles of liberty of peoples and of respect for those of nationality and intern tional justice, which can safeguard the peace of the world for a long time to come, it will be one of the chief tasks of science gradually to appease this hatred and to attempt to place this co-operation between various nations, and that feeling of international solidarity and human brotherhood upon which we seemed rightly to pride ourselves towards the end of the last century, on its old bases, which shall have become firmer because more just. But when we reflect that one of the motives which have been the most powerful in driving Germany to war has certainly been an immoderate pride and the pretension, which appears to us so ridiculous and was yet put forth by them in all seriousness, of being the chosen people, called upon by God to organise other peoples and show them the way towards a higher civilisation, the plan of taking away from Germany its hegemony in the scientific domain to arrive thus at lowering its unmeasured pride and its too high opinion of itself will appear as one of the surest means of guaranteeing peace for the future.

To take from Germany its scientific hegemony, one of the most suitable, efficacious, and prompt means is, it seems, the creation in each of the principal branches of science of "Archives," "Year-Books," and "Journals" in general, which are international in so far as collaboration and content are concerned, but which are edited and published in the countries of the Entente. As an eloquent symptom of that reaction against the stifling of the scientific production of the world thus exercised by Germany, we need only mention the recent creation at Petrograd of *Archives russes d'Anatomie, d'Histologie et d'Embryologie,* the very object of which is to permit Russian investigators to do without German publications.

The editing of each of these proposed publications ought to be done by representatives from the four countries: Great Britain, France, Russia, and Italy, and, if necessary, ought to have the moral and material support of the Ministers of Public Instruction and the most important scientific societies in these countries. Also the publishing should be entrusted to a society of four publishers chosen from among the principal ones of each country. Finally, each author should have the right to publish his work in his own language, but the articles not written in French should be followed, for the convenience of others, by their French translations—French being known to most educated people of all nations.

However, we ought not servilely to imitate the corresponding publications of Germany. Anyone who is even slightly acquainted with these publications will not have failed to notice a marked deterioration, in the case of most of them, in the course of the last few years. In fact, it is only too evident that their object was, not to spread many ideas or to make known the most interesting results of really important scientific researches, but to produce each year a certain number of hundredweights of printed paper, to the great profit of German publishing houses, if not to the honour of German science. The noticeable deterioration of these German publications is, then, due above all to the system of production on a large scale applied to the book-industry. But it is also favoured by the excessively analytic spirit of the Germans, which robs them of broad views and a resulting true perspective of things, and predisposes them to put on the same plane the whole of a collection of facts and researches in which nobody can distinguish what is very important from what is less important or not important at all.

The projected Entente publications must, then, in the first place, print less and select better. Then they must direct their attention to both synthesis and analysis; that is, they must always contain synthetic articles which attempt to group, at the moment of publication, the relations of analytical researches to the ideas or theories which will have been the inspirers and guides of those researches, and of which the seeker will have been more or less conscious. They must take account even of those researches which come from isolated thinkers who work on their own account and at one another's suggestion. Lastly, they must put the various writings into their correct plane by publishing at length the most important ones, giving long summaries of those which are less important, and merely announcing the results of researches which are too restricted or evidently unfruitful.

These publications must be, as I have said, international in so far as collaboration and content are concerned. The collaboration of neutral countries ought to be desired and sought, and, in the future, even German collaboration might be accepted, if the authors should wish to become acquainted with, and appreciated by, the scientific men of the nations of the Entente as well as of their own group of nations. Thus these publications would have the effect of taking away from Germany that monopoly of science at which it has arrived during fairly recent years with so much success. We would thus show it the value of the scientific contributions of other nations, and this would lower its immoderate and ridiculous pride which has been one of the causes of the present war. This, moreover, would be without taking the least hostile action against German science.

It may perhaps be permitted to the writer of this letter to recall how, before the war, amicable proposals were made to him from Germany—both by contributors and by other authorised representatives of German science—that, in the international scientific review which he has the honour of editing, the supplement which contains French translations of all articles written in German, English, or Italian, and published in the text in those languages, should be replaced by a supplement containing German translations of the English, French, and Italian articles. Evidently this international review seemed to them, conducted as it was, and is, by non-Germans, a kind of menace to their scientific hegemony, which they were trying to consolidate more and more. Thus, they tried to arrange that it should at least have a German air and colour to take away its dangerous look of a standard of revolt against German hegemony.

The hour has come to create and develop as much as possible in the principal branches of science, under the ægis and direction of the Entente, international scientific publications and reviews which should be fitted to destroy finally a monopoly which, if it foments sentiments contrary to the establishment of international relations founded on mutual esteem, constitutes a very grave danger for the progress of science. These suggested periodicals will thus contribute to re-establish on bases of independence and equality that equilibrium of nations which will be the greatest guarantee of a peace that is just, long, and to the benefit both of our present Allies and of our present enemies.

EUGENIO RIGNANO (Editor of *Scientia*).

Stability in Flight.

IN his paper on "Forced Oscillations of a Disturbed Aeroplane" (*Aeronautical Journal*, October–December, 1916), Dr. Brodetsky shows, on theoretical grounds, that among the chief conditions of safety and stability in windy weather are: (1) a small tail, or small ratio of tail/main-plane, and (2) comparatively small wings, or small ratio of total area/load. In a former paper by Prof. Bryan and Dr. Brodetsky (*ibid.*, April–June), the fact that long tails are on the whole disadvantageous is demonstrated. All these conclusions seem to agree well with what we may very easily observe in birds. Those birds the flight of which is what one might call skilful, or agile—that is to say, those which can rapidly dodge and steer, or which do not mind flying in high and shifty winds—are (I should say) all characterised on the whole by small tails and comparatively small and narrow wings. These features are conspicuous in many of our shore birds, sandpipers and the like, and the birds are equally conspicuous for their extraordinary stability, whether against wind or in their own sudden and acute changes of course. Seagulls, solan-geese, albatrosses, and swallows share, more or less, in the same structural characteristics. Powerful or long-continued flight is evidently quite a different thing. Thus the pigeon is a splendid flyer for mere distance, and even for speed; but it goes straight ahead, and its large tail and large rounded wings give it only a moderate "stability." In like manner a multitude of little birds, robins and the like, which we are apt to think of as bad or unskilful flyers, turn out to be very good flyers indeed upon their migratory journeys, when all they have to do is to pursue an even course in high and relatively calm regions of the atmosphere, and also (as we may suppose) in carefully selected weather. On the other hand, the really long-tailed birds, such as the magpie and some of the foreign jays, trogons, etc., are all very poor flyers, and are for the most part birds of the sheltered woodlands.

Another case in point is that of the hawks and falcons. The broad-winged hawks, such as the buzzards and the kestrel (the latter with its long tail, which it uses effectively for another purpose), were all despised of the falconer; the kinds with long and narrow wings, like the merlin and the peregrine, were the ones he prized.

I am curious to know what experts think of another matter, namely, the long, outstretched legs of such birds as the stork and heron. One used to be told that these serve as a rudder, making up for the insignificant size of the tail, but this explanation seems far from satisfactory. I imagine the long legs act as a very useful counterpoise to the long neck and bill; that they help to adjust the position, longitudinally, of the centre of gravity (which Borelli says ought to be directly under the articulation of the wings); and further, that the lengthened axis so formed, from beak to outstretched toes, may play the part of a sort of balancing pole, and contribute very materially to the creature's longitudinal stability. In any case, it is certain that these long-legged birds are extraordinarily graceful flyers, remarkable for their perfect balance and quiet, easy motions.

D'ARCY W. THOMPSON.

An Explosion Effect.

A RECENT explosion has, like all other similar occurrences been productive of many curious results, but one that I have noted seems worth special mention. There is a row of large houses in an exposed situation, directly facing the centre of explosion, but about three miles from it, and in front of one of these houses is a medium-sized pond. In this row most of the houses have escaped, only two or three broken or cracked windows being noticeable among the lot, with one exception. That exception is the house facing the pond, which, so far as glass is concerned, is wrecked. From appearances it might have been played over with a machine-gun. One house near, and also facing the pond, has only one window damaged, but in this case the sashes are destroyed as well as the glass. It appears that nearly every window situated on a line crossing the pond from the explosion centre has suffered extra violence. I believe similar results have been noted before over water, but this seems a very striking instance. I should, perhaps, add that the glass destroyed was of indifferent crown quality, whereas the other houses appear all to have thin plate-glass; but much crown glass has escaped damage in other positions, where heavy plate has gone to pieces, so I think it clear that the pond, and not the quality of the glass, was the contributory cause.

C. WELBORNE PIPER.

THE INFLUENCE OF PHOSPHORUS AND SULPHUR ON THE MECHANICAL PROPERTIES OF STEEL.

In drawing up specifications of the chemical composition of carbon steels the following five elements are invariably included: carbon, silicon, manganese, phosphorus, and sulphur. With respect to the first three it is always specified that the percentage present shall fall *within* certain limits, whereas as regards the last two only an *upper* limit is demanded. These specifications are based on the assumptions that while carbon, silicon, and manganese confer desirable properties on the iron with which they are alloyed, the character and degree of which can be regulated by the amount introduced, phosphorus and sulphur act unfavourably, and should be kept down to the lowest possible figures. They are universally regarded as embrittling agents, which must on no account be present above a certain limit in any particular case. In fact, if it were possible to reduce the percentage of these elements to nil in commercial steels, few, if any, engineers would hesitate to specify that such steels should be absolutely free from them.

The war, however, has upset a number of views which previously were regarded as well established, and in a paper presented at the autumn meeting of the Iron and Steel Institute in London entitled "The Influence of Some Elements on the Mechanical Properties of Steel" Dr. Stead has given a distinct jog to the opinion that sulphur and phosphorus are always and necessarily deleterious to the properties of the steel with which they are alloyed. The paper is one of considerable length, and deals not only with the five elements mentioned above, but also with copper and tin. It is in the nature of a stocktaking of the results reached in researches bearing on the influence of these particular constituents. Naturally carbon and the heat treatment of steel come in for the lion's share of attention, but it is only in the case of sulphur and phosphorus that Dr. Stead has arrived at conclusions which challenge generally accepted opinions, and which deserve—and on account of their far-reaching practical significance are certain to obtain—the most searching scrutiny and, indeed, criticism.

From first to last the word "shell" is never mentioned in the paper. Nevertheless it is the fact that it was the bombardment of Hartlepool, Scarborough, and Whitby in December, 1914, by the German battle-cruiser squadron which gave the impetus to Dr. Stead's investigation. Pieces of German shells were analysed by him and found to contain considerably higher percentages of sulphur and phosphorus than are permitted in British specifications of similar material. This at once raised in his mind the question whether it is really necessary to adhere to the particular percentages in vogue, and caused him to study anew the evidence upon which existing specifications have been based.

Considering phosphorus in the first instance, it would appear from the researches of Dr. Stead and d'Amico that within certain limits the effect of 0·1 per cent. of this element is comparable with that of carbon, as the following table shows:—

	The effect of 0·1 per cent. of carbon.	The effect of 0·1 per cent. of phosphorus	
		Stead	d'Amico.
	Tons per sq. in.	Tons per sq. in.	Tons per sq. in.
Yield point, raised...	1·78	2·5	2·3
Maximum stress, raised ...	4·18	2·4	4·1
	Per cent.	Per cent.	Per cent.
Elongation, reduced	4·35	0·7	1·36
Reduction of area, reduced ...	7·40	1·5	3·8

It will be observed that carbon causes a proportionately greater reduction of ductility than phosphorus, and, judged by this test, is a more powerful embrittling agent. Furthermore, it appears from Dr. Stead's experiments that a steel containing 0·30 per cent. of carbon and 0·50 per cent. of phosphorus resisted long-continued rotary stresses better than a steel with the same carbon percentage and only 0·04 per cent. of phosphorus. These steels were in the forged condition, and their structure was "very fine." Dr. Stead also claims that "there is no reliable record showing that sound steel rails containing from 0·07 to 0·09 per cent. of phosphorus break up on the track more frequently than those containing less phosphorus," and that "phosphoretic rails undoubtedly resist wear better than the same rails with less of that element present." He recalls the fact that previous to the use of steel rails, when iron was employed, it was customary "to have iron very rich in phosphorus in the heads of the rails, for it was recognised that the phosphoretic iron wore better than the purer material." His general conclusion is:—"When judging the properties of steel note should be made of the fact that in many cases when carbon is rather low phosphorus may be an advantage, for it has similar influence to carbon which it replaces. Phosphorus has got a bad name, like many other elements, but, far from always being an enemy, is often a friend."

As regards the influence of phosphorus on wrought iron, Dr. Stead affirms that the best Yorkshire and Staffordshire irons contain between 0·10 and 0·15 per cent. of this element, and that for structural purposes they are superior to the best Swedish irons, which contain a smaller amount. The elastic limit, yield point, and ultimate stress are all raised, and the irons weld more easily. The danger limit is put by him at from 0·4 to 0·5 per cent., in which range brittleness develops and also a tendency to very coarse crystallisation if such iron is heated to high temperatures.

Ever since the pioneering work of Brinell, Wahlberg, and Arnold, it has been recognised that provided rather more than sufficient manganese is present to form manganese sulphide with the sulphur in steel, no red-shortness occurs. Arnold and Waterhouse showed this in 1903 for a steel of the following composition:—

Carbon	Silicon	Manganese	Sulphur	Phosphorus
0·460	0·369	1·060	0·560	0·055

which rolled perfectly, and was found to be ductile both in the tensile and impact tests. They also proved conclusively that while sulphide of manganese in steel is not deleterious, sulphide of iron is very deadly in its effect, and showed why this was so. Nevertheless sulphur had got a bad name in the early days of steel-making, chiefly owing to the fact that it was impossible to introduce sufficient manganese without raising carbon unduly, the only material available being German spiegeleisen. When, however, the Ebbw Vale Steel Company was able to produce an alloy containing a much higher percentage of manganese this difficulty vanished. In spite of this, sulphur's bad name has stuck, and even to-day, according to Dr. Stead, steel rails are rejected which pass all the specified mechanical tests because the percentage of sulphur exceeds an arbitrary limit. He states that steel high in sulphur resembles wrought iron, and is, like that material, more or less fibrous. Perhaps his most interesting—certainly his most challenging—statement with regard to sulphur is the following:—"It is a fact that steel called free-cutting fibrous steel is being imported and used in England to-day, and the peculiar properties referred to are due to the deliberate introduction of sulphur into the steel. Such material contains about 0·15 per cent. sulphur. Sulphur, then, may be regarded as a friend when it is used intelligently, and not invariably as the enemy it is represented to be." A point, however, in connection with the question of the possible use of high-sulphur steels that requires careful investigation is whether such materials would be more liable to atmospheric corrosion than low-sulphur steels.

The issues raised by Dr. Stead with regard to the influence of phosphorus and sulphur in steel are of the utmost importance in their relation to the manufacture of steel in this country, both during and after the war. In the discussion on his paper he stated that at the beginning of the war sulphur was restricted to 0·04 per cent. in all shells, and that it was alleged that these would be liable to fail if the proportion was raised to 0·06 per cent., but that, thanks to Sir Robert Hadfield, the limit had been raised to the higher figure, and shells did not fail more in the gun than formerly. This raising of the limit has made it possible to increase the output of shell steel. Can the limit be raised still further? That is the question. The case that Dr. Stead has made out for reconsidering the particular limits imposed on sulphur and phosphorus in ordnance steel specifications is very strong. Chemical analysis is introduced into steel specifications in order to aid in securing that the requisite properties—chemical, physical, and mechanical—are obtained. If steels possessing those properties can be prepared which do not come within the chemical specification the latter requires revision. In such matters chemical analysis is the servant. It should not be allowed to become the master. By all means let the authorities concerned subject Dr. Stead's conclusions to the severest criticism, and test them experimentally in the most thorough way. It ought to be done without delay. He has raised the question in the interests of the nation. It is earnestly to be hoped that the authorities will approach it in the same way.

H. C. H. Carpenter.

WORK OF THE GOVERNMENT LABORATORY.

FROM the recently issued report of the Government Chemist,[1] it appears that 239,706 samples were analysed at the Government Laboratory during the course of the year 1915–16. This is an increase of some 9300 samples compared with the previous year, and of about 5000 compared with the year 1913–14, before the outbreak of war. The samples comprised a large variety of articles.

The greater part of the work of the department is carried out in the main laboratory at Clement's Inn Passage and in the branch laboratory at the Custom House. There are, however, eighteen chemical stations in different parts of the United Kingdom at which revenue samples alone are examined; these were responsible for the testing of an additional 144,186 samples of dutiable goods during the period in question. At one time the laboratory was devoted solely to revenue work. It was, in fact, established (in the year 1843) with the single object of checking the adulteration of tobacco. From time to time, however, State departments other than those concerned with fiscal questions have found that they required assistance in the form of analytical work or other matters involving chemical knowledge, and the services of the laboratory officials have been requisitioned to meet these demands, as well as to carry out the provisions of certain statutes relating to the adulteration of foods, drugs, and other articles. Thus from a purely revenue establishment the laboratory has in process of time become a general State laboratory for purposes lying mainly in the domain of analytical chemistry, but including also advisory work arising in connection with a considerable variety of chemical questions.

With this extension of scope the status of the laboratory has naturally undergone alteration. Some time ago the department was reconstituted, and it may be of interest to indicate its present standing. Whereas in the early stages of its career the laboratory was a small scientific branch placed under the control of a large fiscal department, it has now been made a separate and independent establishment supported by funds provided under a separate Vote in Parliament—namely, that for the "Department of the Government Chemist." The head is a scientific man responsible directly to Parliament for the expenditure of moneys voted. Thus the laboratory is now under a single administrative control, and, subject to general oversight by the Treasury, enjoys the privilege of independent action.

This alteration of status is a matter of some importance as indicating a sympathetic and sagacious policy for which the authorities deserve due credit. No doubt it might be said that the former arrangement had its counterpart in such instances as the Greenwich Observatory (placed under the Admiralty) or the Geological Survey (under the Board of Education). These, however, are not quite analogous cases. It was a question

[1] Report upon the Work of the Government Laboratory. Cd. 8394. (London: Wyman and Sons, Ltd., 1916.) Price 2½d.

of setting up an establishment to which all the departments should have, as it were, a right of access. The giving of the laboratory an independent position places on the same footing all the departments requiring its services. Necessary chemical assistance can be applied for as a matter of right rather than as a favour asked by one department from another, and the director of the laboratory has a freer hand in utilising his resources for the general benefit.

Thus the functions of the laboratory as now constituted may be briefly described as the giving of assistance, both experimental and advisory, on chemical questions to any other Government department or to any Government committee or commission which may require its aid.

The ordinary work includes a good deal of routine analysis, which falls chiefly into four categories. First, there are analyses made in connection with the collection and safeguarding of the revenue raised from dutiable articles—as, for instance, in the assessment of duty and rebates upon beer, spirits, wines, table-waters, tobacco, tea, coffee, cocoa, sugar, and saccharin. In this branch are also included analyses of medicines examined under the Medicine Stamp Acts, and chemical examinations required in connection with licensing regulations and the manufacture and sale of excisable commodities.

A second category includes work done in connection with the administration of certain Acts of Parliament under which chemical analyses are prescribed. These comprise, for instance, the examination of imported dairy produce under the Sale of Food and Drugs Act, 1899; analyses under the Butter and Margarine Act; samples taken under the Public Health (Milk and Cream) Regulations; disputed analyses of foodstuffs and drugs referred by magistrates for independent analysis under the Sale of Food and Drugs Act, 1875; and analyses of fertilisers and feeding-stuffs submitted by the Board of Agriculture as a preliminary to legal proceedings under the Fertilisers and Feeding-Stuffs Act.

A third branch is concerned with analyses required in connection with administrative regulations issued by various State departments. Such are, for example, analyses made for the Factory Department of the Home Office in reference to dangerous trades and to special inquiries affecting the health of industrial workers; and those for the Board of Trade in respect of medical supplies, disinfectants, and lime-juice required to be carried on board ocean-going ships. During the war this branch of work has been largely increased by the analyses of many articles submitted in connection with the issue of trading licences by the War Trade Department.

In the fourth category is included the examination of stores, supplies, etc., required by the various large departments, *e.g.* the Admiralty, War Office, Post Office, and so on. Thus the report points out—as indeed would be expected from the special circumstances of the time—that heavy demands for assistance have been made during the year upon the laboratory by the first two of these departments. Nearly 8300 samples, chiefly metals, were analysed for the Engineering Department of the Admiralty, and 8901 specimens of foodstuffs were examined in connection with the supply of H.M. Forces.

In addition to the ordinary routine operations, a considerable amount of research work is carried out by the laboratory in connection with questions referred to it by public departments seeking information and advice. Thus researches upon the composition and properties of celluloid and upon the alleged emanation of lead vapours from painted surfaces are described in the recently published reports of the Departmental Committees on Celluloid and on Lead Paints respectively. Other recent researches, carried out for the Board of Agriculture, relate to the utilisation of various by-products as feeding-stuffs, to the effect of air and moisture upon liver of sulphur during storage, and to the solubility of the phosphates in basic slags.

Apart from experimental work, various chemical questions arise on which the laboratory is consulted by public departments. Thus the report notes that numerous references concerning the use of alcohol were dealt with for the information of the Commissioners of Customs and Excise; whilst reports upon a number of subjects, including the supply of potash and the value of various refuse materials as a source of potash, were furnished to the Board of Agriculture and Fisheries. Many matters relating to contraband trading with the enemy (prohibition orders) were also submitted for advice.

In recent years, and especially since the scope of the laboratory has been extended, the work has shown rapid growth, both in quantity and in the variety of samples submitted. Naturally, therefore, questions of ways and means to cope with the increased demands have arisen. The present premises at Clement's Inn Passage were erected about twenty years ago, and at that period they were sufficient; but it is understood that they have now for some time been inadequate, and that the question of building-extension was actually under consideration when the outbreak of war caused the postponement of the matter. But the demands have not been postponed, and it requires no seer to foretell that, in view of the importance of science to administration which recent events have emphasised, the demands will, in fact, continue to increase. It is fairly evident that if the chemical work assigned is to be properly carried out the necessary equipment in buildings, staff, and appliances must keep pace with the requirements. A department devised to render service on chemical matters to all branches of the Executive is an excellent conception, but the effective carrying out of the idea depends, of course, upon the provision of adequate means. It may confidently be hoped that the project so well begun will be suitably completed, and provision made not only to cope with the pressing work of to-day, but to allow of the expansion which will certainly be needed to-morrow.

THE SCARCITY OF WASPS.

THE correspondence in NATURE recently (October 12 and 26 and November 16) on the scarcity of wasps during the late summer and autumn of last year raises some interesting and difficult questions. In various parts of Great Britain—from Wigtownshire, Cheshire, and Gloucestershire to Kent—this scarcity has been observed, following on an abundance of queens in spring. The wet and cold conditions prevailing in spring and early summer are suggested as the explanation by most of the writers who contributed observations, and this inclement weather would naturally be accompanied by a scarcity of the insects—caterpillars, greenfly, diptera, etc.—on which wasps feed their grubs. In a letter to the *West Kent Advertiser* for November 24, Mr. G. W. Judge suggests that famine rather than cold was responsible for the mortality. Mr. W. F. Denning's definite observation (*supra*, p. 149) of the dying out of five nests of *Vespa vulgaris* near Bristol in June is noteworthy in this connection. Mr. A. O. Walker's theory that the queens of last year's spring were largely infertile would be difficult to support by observation. Mr. O. H. Latter[1] has suggested that a mid-winter with much "open" weather—such as prevailed in January, 1916—is deadly to queens by tempting them out of safe winter quarters. This cause can, however, scarcely be invoked to explain the paucity of autumn workers after a spring like that of 1916, rich in queens.

The fact that worker wasps were abundant enough in some places makes it likely that other factors affecting the numbers of these insects still require investigation. Mr. H. St. G. Gray wrote (p. 209, *supra*) that they were too plentiful on the Somerset hills, and they certainly swarmed in the neighbourhood of Dublin during September. Referring to past records, I find that 1897 and 1907 were years marked by great scarcity of wasps in Ireland; the latter of these summers, at any rate, was abnormally wet and cool.

Most writers in NATURE and elsewhere express satisfaction at the temporary reduction in the wasp population. The damage done by wasps to fruit is undoubtedly great in normal seasons, and they also take a valuable portion of our food-supply by their habit of robbing bee-hives of honey. On the other hand, as Mr. Latter and Mr. Denning point out, wasps are of considerable service in destroying multitudes of harmful insects, with which they feed their larvæ. The fierceness of wasps has been greatly exaggerated; unless attacked or annoyed, their disposition is placid, though one requires, perhaps, to be an admirer of the insects to be able to watch with serenity a dozen of them crawling over one's food. From the point of view of rural economy, it seems desirable to encourage wasps until the fruit season, and then to wage such war on them as may be found necessary.

GEO. H. CARPENTER.

[1] "Bees and Wasps" (Cambridge University Press), p. 44.

NOTES.

ONE of the saddest incidents of the recent terrible explosion in a works engaged in refining explosives is the death of Mr. Andrea Angel, who was at the time acting as chief chemist and assistant-manager. The exact cause of the disaster is at present unknown, but it was preceded by an outbreak of fire. When the alarm was given, Mr. Angel, who was in his quarters, went at once to the scene of the fire and warned the operatives, many of whom undoubtedly owe their lives to his devotion to duty. Mr. Angel was born at Bradford in 1877. He was educated at Exeter School, from which he went to Christ Church, Oxford, as an exhibitioner. He took a first class in chemistry in the Honour School of Natural Science in 1899, was afterwards elected Dixon research scholar, proceeded to the degree of M.A. in 1903, and took the B.Sc. degree three years later. He acted for some years as lecturer in chemistry at Brasenose, and latterly at Christ Church, and was also tutor in chemistry to non-collegiate students. Shortly after the outbreak of war he gave up his work at Oxford and took up that on which he was engaged at the time of his tragic death. Mr. Angel was a fellow of the Chemical Society, and although the exacting duties of a college tutor left him little leisure for research, he was able to make several original contributions to the subject which have appeared in the Transactions of the society. He first published in 1902, in conjunction with his tutor, Mr. Harcourt, "Observations on the Phenomena and Products of Decomposition when Normal Cupric Acetate is Heated," and afterwards papers on "Cuprous Formate" in 1906 and on "The Isomeric Change of Halogen-substituted Diacylanilides into Acylaminoketones" in 1912. He was a man of a very lovable and unselfish nature, and will be greatly mourned by a wide circle of friends and old pupils.

AN important letter from Lord Blyth appeared in the *Times* on January 22 emphasising the necessity for the close co-ordination of science with practice in agriculture for the purpose of increasing the food production of the country. Lord Blyth's proposal is the immediate appointment of a Commission of men of science who shall devote their time exclusively to research in connection with the varying characteristics of the soil throughout the country, the crops most suited to each locality, the best methods of treating and manuring such land, the most suitable artificial manures to be used for each purpose, and the best substitutes for such of these as may be temporarily unobtainable by reason of scarcity or cost. As time is pressing the work should be put in hand at once and information promptly circulated through the War Agricultural Committees. This proposal will, we are sure, be received sympathetically on all sides, though, as a matter of fact, it is understood that such a Commission is already in process of formation. Throughout the war the agricultural colleges and experiment stations have rendered useful service, and have demonstrated more convincingly than ever the close connection between science and agriculture. Indeed, never before has agricultural science had so much recognition as now, either from farmers or from men engaged in pure science, and it is hoped that the new conditions will do much to strengthen still further the development of scientific agriculture in this country.

PARTICULAR attention is directed to the important letter which appears in another column from Prof. Eugenio Rignano, the well-known psychologist and editor of the Italian scientific monthly, *Scientia*. The question as to the establishment of year-books and international scientific journals in the countries of the

Entente is one of the most pressing at the present time. Hitherto, as is well known, we have been largely dependent on Germany for those yearly condensed and detailed reviews of progress in the different branches of science which form such an indispensable aid to all scientific workers. It is urgently necessary that the countries of the Entente should take a share—and perhaps the whole burden—of such publications in the future. Indeed, both because of the industrial harm that Germany has done us in the past by monopolising, to all intents and purposes, this department of scientific work, and because we ought certainly to overcome that inertia which German activity seems to impress on the rest of the world, it is very advisable to follow the leadership of commerce and produce more of the labour which is of such great use in science outside Germany. The present is the time for action, and we hope that Prof. Rignano's letter will meet with a ready response from those in power, as well as suggestions from British men of science.

DR. SIMON FLEXNER, director of the Rockefeller Institute for Medical Research, New York, has been elected a foreign associate of the Paris Academy of Medicine.

A PROPOSAL to introduce summer time again this year has been rejected by a majority of the Committee of the Prussian Diet, as it is considered that the change was a failure last year.

THE death is announced, at seventy-one years of age, of Mr. A. E. Jamrach, widely known among zoologists as a dealer in wild animals, which he imported from all parts of the world for zoological gardens, menageries, and private persons. For a long time almost the whole of the wild beast trade, both in this country and on the Continent, was under Mr. Jamrach's control.

THE death is announced, in his seventy-fifth year, of Dr. Henri Emile Sauvage, founder, and until recently director, of the Station Aquicole, Boulogne-sur-Mer. Dr. Sauvage studied fishes, both recent and fossil, from every point of view, and published a long series of memoirs and papers bearing both on zoology and geology, and on several economic questions connected with these sciences. From 1874 to 1883 he was assistant-ichthyologist in the Paris Museum of Natural History, and made many contributions to knowledge of the fishes of West Africa, Indo-China, and Madagascar. In 1891 he also contributed a large volume on the fishes of Madagascar to M. Grandidier's well-known work on that island. His most important writings on fossil fishes related to those of the French coal-bearing formations, but his smaller papers dealt with new species from many sources, among which may be mentioned Jurassic fishes from Catalonia (Spain) and from his own neighbourhood of Boulogne-sur-Mer. He was also for many years director of the Boulogne Museum, and took a deep interest in all local affairs. Dr. Sauvage was elected a foreign correspondent of the Geological Society of London in 1879, and a corresponding member of the Zoological Society in 1904.

THE death, on January 16, of Mr. Benjamin G. Cole brings to a close a remarkably long period of service as hon. secretary of a local scientific society. The Essex Field Club was founded in 1880 by Mr. William Cole, A.L.S., who is still its hon. secretary; but, two years later, his brother, above-mentioned, became associated with him as assistant hon. secretary, and served for thirty-five years continuously. Mr. Cole, a son of the late Mr. Julius Cole, of the Trinity House, was approaching the age of seventy, and was unmarried. In his earlier days he was a very ardent entomologist. In company with his brother William, Prof. Raphael Meldola, Mr. E. A. Fitch, Mr. W. J. Argent, and others, he collected very actively, chiefly in the fields (now built over) around Clapton, in Epping Forest, on the Essex marshes, and elsewhere. The pages of the *Essex Naturalist* and the entomological journals record not a few of his more interesting captures. Of late years his collecting was done mainly on the saltings and marshes around St. Osyth, where he lived in an old Martello Tower, converted into a dwelling, which enjoys a remarkably fine and extensive view over sea, land, river-mouth, and adjacent islands. Mr. B. G. Cole also assisted his brother as hon. curator of the Epping Forest Museum at Chingford.

THE death of Prof. J. B. Auguste Chauveau, which we announced in our issue of January 11, removes from among us one of the most famous and many-sided biologists of our time. He was born in 1827, and at the age of twenty-one was elected on the staff of the Lyons Veterinary School, of which he became director in 1875. He was later appointed Inspector-General of Veterinary Science in France, and at the time of his death he was professor of comparative pathology at the Paris Natural History Museum, where he built a new institute for the study of comparative physiology and pathology. His pathological work dealt mainly with the nature of contagion and of viruses, and included important work on tuberculosis, septicæmia, and smallpox. His treatise on the comparative anatomy of the domesticated animals is a monument to his fame as a veterinarian, but he is perhaps best known as one of the makers of physiology during the latter half of the last century, and one of the founders of the *Journal de Physiologie et Pathologie Générale*. Although he did work on the biochemical side (glycogenesis and sugar utilisation), the mechanical side more especially was his *forte*; the cardiac sound of Chauveau and Marey, and the dromograph of Chauveau and Lortet, are classical instruments which did much to perfect our knowledge of the circulation, and will live in scientific history. Personally he was an attractive figure; his fine presence was striking, his amiable characteristics made him much beloved, his untiring energy, even until late years, and his catholicity of outlook inspired the young generation of investigators who came in contact with him. Such men the world can ill spare.

THE report of the Bristol Museum and Art Gallery for the past year indicates that in spite of the war steady progress has been continued. Many convalescent soldiers have made use of the institution, and one Australian, invalided to England, has presented a collection of beetles made while he was on service in Egypt. A special exhibition of flowers, fruit, and insects to commemorate the Shakespeare tercentenary was on view, and to this department the late Mme. G. Jervis presented valuable botanical works. The insect collection has been rearranged, and is now more than of local importance. The inclusion of the Chaning Pearce collection of fossils from the Great Oolite, Bradford Clay, and Forest Marble of the west of England is of great value as an addition to the older series. A collection of sketches in oils illustrates events in the past history of the city.

PROF. FLINDERS PETRIE publishes, in *Ancient Egypt*, part iv. for 1916, an important paper on "Funereal Figures in Egypt." To reach the beginning of the use of such figures he goes back to existing beliefs in Africa, where the love and veneration of the family still remain in full force. Hence a token in some form of the dead is preserved in the household. The Egyptians seem to have retained the savage custom of keeping in the family the head of the deceased. For his benefit, however, it was held necessary to return it to the grave; and the next stage was the provision of a stone image of the head in the grave, in case the actual head was lost or injured. The stone mummy figures appear at first as a plain, bandaged mummy, without any hands or detail except the face, which gave it personality. It is on rough wooden figures of the Seventeenth Dynasty that the wood *shuabti*, whence came the name of the well-known Ushabti figures, first appears. Prof. Petrie gives a fine series of illustrations of the later developments of these figures, and provides a transcript and translation of the formulæ inscribed upon them.

THE *Indian Journal of Medical Research* for October, 1916 (vol. iv., No. 2), contains valuable papers on the epidemiology of malaria in Malaya and on anopheline mosquitoes by Mr. C. Strickland. Mr. E. H. Hankin details several simple tests for narcotic and anæsthetic drugs which should be of much use. Major Harvey discusses birth and marriage rates and fertility among Brahmins and Indian fighting communities. Capt. Fox describes experiments undertaken to ascertain the relative values of the various kinds of cholera vaccines. The most effective seems to be a heated vaccine without phenol, the next in order being living culture. A useful feature of the number is a summary of recent medical research in Germany dealing with dysentery, epidemic jaundice, paratyphoid fever, and methods of cholera diagnosis.

THE prize essay on "A Scheme for Maternity and Child Welfare Work," by Miss Isabel Macdonald and Miss Kate Atherton, is published by the Royal Sanitary Institute, price 1*s*. The essay is divided into two parts: (1) preliminary organisation, and (2) the scheme in operation. For a typical district with, say, 2500 births a year, the cost per annum for such a scheme is estimated at 1230*l*. for staff and 150*l*. for buildings (rent, rates, upkeep, etc.). The accommodation suggested comprises (*a*) waiting-room; (*b*) dressing-room; (*c*) weighing- and recording-room; (*d*) one or two consulting-rooms; (*e*) isolation-room; (*f*) dispensary; (*g*) office; (*h*) staff rooms and offices; (*i*) sanitary accommodation. As regards the scheme, it is remarked that ante-natal care can only be dealt with incidentally, as no machinery exists for the notification of pregnancy. This difficulty might, however, be met to some extent by co-operation with the district visitors of religious denominations. The compulsory notification of births enables the health visitors of the centre to visit the home within two or three days of the notification. Teaching would be given to mothers and voluntary workers on the feeding and health of children and general care of the infant. Infant consultations with a supply of milk and medicine would be available at the centre. Health lectures, day nurseries, and many other activities in connection with the centre are dealt with.

THE question of the physiological aspect of mountaineering is discussed at some length in a paper by Dr. A. M. Kellas on a consideration of the possibility of ascending the loftier Himalaya (*Geographical Journal* for January, xlix., No. 1). The physiological difficulties depend upon the deficiency of oxygen. The evidence from balloon ascents to high altitudes would tend to prove that the ascent of peaks of 28,000 ft. or 29,000 ft. would be impossible, but the balloonist ascends so rapidly that he has no opportunity of becoming acclimatised. The fact is of fundamental importance, for experience has shown that men can become accustomed to air deficient in oxygen. The case of Pike's Peak (14,109 ft.) is cited. Four factors concerned in acclimatisation to high altitudes are: first, the oxygen pressure in the alveolar air which rises; secondly, the number of red-blood corpuscles and the quantity of hæmoglobin in the blood, which increase in due proportion to each other; thirdly, the possibility of actual secretion of oxygen in the lung epithelium; and, fourthly, the more rapid circulation of the blood-stream during exercise. The conclusion which Dr. Kellas arrives at, after discussing these factors, is that towards the summit of Mount Everest (29,141 ft.) the climber would probably be near his last reserves in the way of acclimatisation and strength, but that he could accomplish the feat provided that the physical difficulties above 25,000 ft. are not insuperable.

THE Proceedings of the United States National Museum, vol. li., 1916, contains a long report, by Messrs. C. H. Gilbert and C. L. Hubbs, on the Japanese Macrourid fishes collected by the U.S. Fisheries steamer *Albatross* in 1906, with a synopsis of the genera. The authors find themselves in disagreement with previous workers on this group of fishes, not merely in the matter of nomenclature, but also on the more important questions of classification and the characters on which this is founded. They regard the branchiostegal rays as being more trustworthy than the dentition. The serration of the dorsal spine they also regard as affording a valuable character, while the position of the coracoid foramen, used by Regan and others, they consider as of no generic value in this group. But it remains to be seen whether the purely superficial characters adopted as a systematic basis in this report will stand the test of time.

THE Annals of the South African Museum (vol. xv., part v.) is devoted to the description of some South African Ichneumonidæ, and new, or little-known, Orthoptera. The account of the Ichneumonidæ has been written by Mr. Claude Morley, who describes several new species. Dr. L. Péringuey is responsible for the section on the Orthoptera. He describes a number of new genera and species of the families Acrididæ and Locustidæ. In his account of the remarkable and non-saltatorial Pneumorinæ he makes some interesting remarks on their powers of stridulation. Camping, on one occasion, in a waterless spot near the seaboard of Saldanha, he tells us, the deep voice of *Bulla immaculata* could be heard above the din made by innumerable geckoes, occupying clumps of reeds growing in this sandy spot. This was just after rainfall, when the noise made by the lizards was like the croaking of countless frogs. Dr. Péringuey also makes some noteworthy observations on the coloration of these extraordinary insects. His paper is illustrated by several text-figures and one plate.

IN the Journal of the Washington Academy of Sciences (vol. vi., No. 20) Mr. T. Wherry publishes the results of an interesting investigation on the soil conditions favoured by the walking fern, *Camptosorus rhizophyllus*. This fern, it is always stated, prefers a calcareous habitat. In the course of the present investigation, however, it has been collected not only on limestone, but also on granite, shale, sandstone, tree-trunks, and other substrata not usually classed as calcareous. Chemical analysis has shown that the actual soils in which the fern grows are rather high in their percentage of both total and soluble lime. Rocks with much lime suffer leaching during soil formation, and those poor in lime gain it through the decay of vegetable matter, and the average lime content of the soil on which the walking fern was found was about 4 per cent. The occurrence of chalk-loving plants therefore does not necessarily indicate the presence of lime in the underlying rock strata, except in cases where circumstances preclude the accumulation and decay of vegetable matter, and the resulting accumulation of lime in the soil. This investigation throws some light on the question of rhododendrons growing on limestone rocks referred to in NATURE of November 2, 1916 (p. 171).

MR. LEONARD HAWKES, in a paper on "The Building-up of the N. Atlantic Tertiary Volcanic Plateau" (*Geological Magazine*, 1916, p. 385), shows that the numerous red partings in the basaltic series of Iceland are due to layers of glassy volcanic dust. Similar dust is often carried over wide areas of the lava-deserts by wind-storms at the present day. The colour is due to oxidation, which here seems unconnected with any tropical climatic cause. The connection of a red layer with underlying decomposition of the basalt, as is the case in the great red zone in Co. Antrim, has not been proved in Icelandic observations.

GEOLOGISTS as well as mineralogists will always find new suggestions in Mr. W. T. Schaller's "Mineralogic Notes." In Series 3 (Bull. 610, U.S. Geol. Survey, p. 106, 1916) a new member of the melilite group is described under the name of Velardeñite, and the whole group is then discussed. A graphic tabulation of analyses indicates that melilite, which has hitherto occupied a very uncertain position, is an isomorphous mixture of åkermanite and sarcolite. On p. 138 an illustrated note deals with the giant crystals of spodumene in the pegmatites of the Black Hills, S. Dakota. These are often 30 ft., and may be 42 ft., long, and are about 4 ft. in diameter.

THE restrictions on the export of coal from the British Isles and its rising price are having serious results in Scandinavian countries. The deposits of coal at Andö, in the Vesteraalens, are of small importance, but are the only ones in Norway. Lately, however, Norway has sought to overcome her difficulties by the purchase from an American syndicate of vast coal-fields in Spitsbergen. The coal, although of Tertiary origin, is of good steam quality. Lignite has been known in Iceland for some time, but so far has had no economic value. However, according to *La Nature* (December 16, 1916), a Danish company is now extracting large quantities at Stalfjall, in the north-west of the island, both for local use and for export to Norway. The lignite occurs in bands of clay among basaltic strata, and its average depth is only six metres. Iceland should have no difficulty in exporting large quantities of this lignite provided it proves sufficiently useful to be in demand. It is said to occur among the same basalts in the Faröe Islands.

IN the *Geographical Journal* for December (vol. xlviii., No. 6) Mr. R. C. Mossman has an important paper on the physical conditions of the Weddell Sea. The paper is based on the work of the *Scotia* and the *Deutschland*, the only two ships which had scientifically explored the Weddell Sea previously to the *Endurance*, the work of which is, of course, not yet available. The observations from the South Orkneys observatory have also been utilised. In meteorology the most striking results are the correlations which Mr. Mossman has been at pains to work out between temperature and pressure conditions in the Weddell Sea and those in other parts of the southern hemisphere, and even in Iceland. For the last twelve years the August and September temperatures at the South Orkneys have been a direct index to the temperatures at Kimberley, South Africa, during the three months following, and there is also a marked sympathy between the South Orkneys barometric pressure in December and the height of the River Parana at Rosario, which is, of course, dependent on the rainfall over southern Brazil, and this is related to the barometric pressure. In December there is a marked tendency for high pressure to the south and south-east of Cape Horn, and Mr. Mossman suggests that when the Graham Land lobe of the Antarctic anticyclone is intensified the pressure over the interior of Brazil is correspondingly diminished, and *vice versa*. More remarkable perhaps is the pronounced opposition between the barometric pressure at Stykkisholm, Iceland, and the South Orkneys. Data from 1902 to 1914 show no break in this sequence.

THE nature of the particles of mineral matter which become embedded in the lung tissue in cases of miners' phthisis has been determined by Drs. W. Watkins-Pitchford and J. Moir by microscopical examination in polarised light of specially prepared sections of silicotic lungs, their results being given in Publication No. VII. of the South African Institute for Medical Research (Johannesburg, 1916). In polarised light the field is suggestive of a starlit sky, but in ordinary circumstances only the larger particles are so visible. The particles have the form of irregular and angular, more or less elongated, chips or flakes, the majority being less than 2 microns in diameter, and very rarely reaching as much as 14 μ. The smaller flakes, when lying flat, have not sufficient thickness to react on polarised light, and they are only seen as streaks when they are set edgeways (the light then traversing a longer path through the doubly refracting medium). Further, the particles are obscured by the tissue in which they are embedded. The method previously adopted of destroying the lung tissue by means of hydrochloric acid and potassium chlorate also resulted in the destruction of some of the mineral matter. This objection is overcome by treating the sections with nitric acid or strong hydrobromic acid. Such prepared sections were compared with preparations of the dust collected from the air in the Rand gold mines and of the powder obtained by finely grinding the rock ("banket") from these mines. The mineral species identified include quartz (constituting more than 99 per cent. of the particles), sericite-mica, rutile, zircon, and tourmaline, and perhaps chlorite. Similar particles of mineral dust were also detected in the tissue of normal lungs; for example, the two lungs of a farmer, who had never worked in the mines, were estimated to contain a hundred thousand million particles of foreign mineral matter, whereas in the lungs of a miner affected with the disease the estimate reaches the appalling number of twenty to thirty millions of millions of such particles.

THAT the zodiacal light owes its origin to the remains of comets captured by Jupiter was the theory proposed fairly recently by Fessenkoff. A criticism of this theory is now given by G. Armellini in the *Atti dei Lincei*, xxv. (2), 9, in which it is shown that one formula arrived at by Fessenkoff is in direct opposition to an analogous one given by Schiaparelli in 1871. The author is, however, led to accept a modification of Fessenkoff's theory in which collisions between the meteoritic material of the captured comet play an important part.

IN the *Atti dei Lincei*, xxv. (2), 10, Mr. G. Körner and Dr. A. Contardi describe the properties of the sixth form (eta) of trinitrotoluene, recently discovered by them, as announced in a previous number of the *Atti* (xxiv. (1), 9, May, 1915). In arriving at the preparation of this new trinitrotoluene it was not possible to have recourse to direct nitrification, and it was therefore necessary to employ the substitution of an amidic group with a nitroxyl in a convenient dinitrotoluidine. Of these latter, three were suitable for leading to the necessary transformation. An additional result obtained by these authors was the production of 60 per cent. of one of the dinitrotoluidines, of which previously it had been only possible to obtain 20 per cent. from the material employed. The paper also describes the properties of a considerable number of the corresponding dinitrotoluene halogen compounds.

A PAPER by Dr. S. Brodetsky, on the longitudinal initial motion and forced oscillations of a disturbed aeroplane, appears in the *Aeronautical Journal* for October–December, 1916 (No. 80). The main conclusion is that "the ideal aeroplane is one that combines the following characteristics: large velocity, small angle of attack, small ratio area/load, small tail fairly far behind the main plane, and considerable margin of stability." The practical man will probably say that this is what common sense would predict, but it is interesting to see how these conclusions follow mathematically from a few simple assumptions, and the history of modern aviation shows that they have not always been acted upon. As in the case of a balance, the increase of one virtue involves the decrease of another, and we have to make a compromise; examples of this will be found in the paper. Fortunately stability and speed go together, and the disturbing elements, in all probability, will be gradually eliminated in the case of rapid machines. Then will come the problem of combining comparatively low speed with sufficient stability: a question of design, as in the case of a bicycle. Prof. G. H. Bryan has contributed an interesting introduction.

IN the Journal of the Franklin Institute for December last Mr. I. Langmuir describes a new form of exhaust pump for the production of high vacua, which he proposes to call the "condensation pump." It may be constructed of metal or of glass. The metal form of the pump consists of a tall cylindrical vessel containing a shallow pool of mercury, which is heated electrically and gives off mercury vapour. The upward stream of vapour is concentrated towards the centre of the vessel by an inverted funnel, and on issuing from the funnel strikes the under surface of a bell-shaped deflector, which sends it downwards along the outer walls of the upper portion of the containing vessel. The space above the bell is in communication with the vessel to be exhausted, and the moving mercury vapour drags along with it the gas from this vessel. The outer wall of the containing vessel along which the mixture passes is cooled by an outer water-jacket, and the mercury vapour is condensed on it, and runs down into the pool at the bottom of the vessel. The gas continues its motion, and is taken from the lower part of the vessel by an auxiliary pump giving a pressure of 200 to 600 bars. A pump of this form, 7 cm. in diameter, exhausts 3000 c.c. of gas per second, and will reduce the pressure to 10^{-5} bar (1 atmosphere $=10^6$ bar).

A COPY of the "List of Publications of the Carnegie Institution of Washington," issued on December 1 last, has been received. Copies of each publication, except the monthly issues of the "Index Medicus," are sent gratuitously to a carefully selected list of the greater libraries of the world, while the remainder of the edition is offered for sale at a price sufficient only to cover the cost of publication and the carriage to purchasers. Persons desiring price lists or descriptive lists as issued may have them by applying to the Carnegie Institution of Washington. The catalogue received contains both price and descriptive lists, and the latter is a most useful guide to the character and precise contents of each of the volumes indexed, so that would-be purchasers may know exactly the kind of book they are ordering.

MR. LEONARD HUXLEY, who, it will be remembered, was his father's biographer, has written for early publication by Messrs. Smith, Elder and Co. "The Life and Letters of Sir J. D. Hooker, O.M., G.C.S.I."—a work which is sure to be of interest to very many readers of NATURE. It will be illustrated by photogravures and be in two volumes.

A SECOND and much enlarged edition in two volumes of Mr. A. Marshall's "Explosives: their Manufacture, Properties, Tests, and History," is to be brought out by Messrs. J. and A. Churchill. The first volume, containing a portrait of the Prime Minister, to whom the work is dedicated, will be published almost immediately. The work as originally published was reviewed in NATURE of June 3, 1915, and the author contributed an additional chapter, under the title of "The Nature of Explosives," to our issue of February 3, 1916.

OUR ASTRONOMICAL COLUMN.

ECLIPSES OF JUPITER'S SATELLITES.—In Harvard Circular No. 198 Prof. E. C. Pickering directs attention to the need for continued observations of the eclipses of Jupiter's satellites. He points out that the observations are easy and interesting, and such as can readily be undertaken by amateurs. While the probable error of a photometric determination of the time of an eclipse is about 2 seconds, the average deviation from the time computed by the tables of Prof. Sampson is about 7 seconds. These deviations appear to be real, and a possible explanation is that the apparent diameter of the planet, and therefore of its shadow, varies with the cloudiness of the Jovian atmosphere. Several independent observations tending to confirm large deviations from theory would thus be valuable.

PECULIAR STELLAR SPECTRA.—In a paper read at the nineteenth meeting of the American Astronomical Society Miss Cannon directed attention to some of the peculiar spectra which had been noted in the preparation of the New Draper Catalogue (*Popular Astronomy*, vol. xxiv., p. 656). It appears that while less than one-fifth of one per cent. of the 218,000 stars which have been classified fall outside the classes B, A, F, G, K, M, many stars which may be classed in these divisions show abnormal features. In all classes some stars have been found which show lines of unusual intensity; thus several hundred additional stars have been found to show the silicon lines λ 4128 and λ 4131, or the strontium line λ 4077, stronger than normal. The latter group is of special interest, as λ 4077 was the first line shown by Adams to be related in intensity to the absolute magnitudes of the stars. In C.P.D. $-59°$ 3038, mag. 7·2, a line near λ 3869, which may be a reversal of a well-known nebular line, has been found to be very strong. Real changes in the spectra of several stars have also been observed; thus in η Carinæ, as photographed in 1895, the hydrogen lines were stronger, and other bright lines fainter, than on the more recent plates. An extreme case of variation is R. Scuti, which ranges from G5 at maximum to Mb at minimum. The only new type of spectrum which has been found is that exhibited by the very red star B.D. $+43°$·53, the spectrum consisting entirely of light near the region of H_α, and the colour-index amounting to 5·4 magnitudes. This and

S Cephei, which has a similar spectrum, are the two reddest stars known at the present time.

THE TOTAL SOLAR ECLIPSE OF 1916, FEBRUARY 3.—A summary of the results of observations of this eclipse made at Tucacas, Venezuela, by an expedition from Cordoba, has been given by Prof. C. D. Perrine (*Monthly Notices*, R.A.S., vol. lxxvii., p. 65). The morning of the eclipse was unpromising, with heavy rain, but conditions improved to such an extent that there was only a slight haze during totality. The corona was of the intermediate type, somewhat resembling that of 1898, and the negatives show streamers to a distance of one and a half solar diameters. Five groups of prominences appeared at the bases of the four principal wings of the corona, and a series of well-marked hoods surrounded the prominences in the south-west quadrant. Photographs of the coronal spectrum were obtained with the prismatic camera, and with a slit spectrograph, but none of them show any trace of gaseous radiation. Good records of the chromospheric spectrum at the beginning and end of totality were secured, and these will give valuable data relating to the heights of different vapours in comparison with previous results. The photometric plates show that at the beginning of totality the total light of the prominences and chromosphere was greater than that emitted by the corona proper.

PARIS ACADEMY OF SCIENCES.

PROGRAMME OF PRIZES FOR 1918.

MATHEMATICS.—The Poncelet prize (2000 francs), to the author, French or other nationality, of the work most useful to the progress of pure mathematics; Francœur prize (1000 francs), for discoveries or works useful to the progress of pure or applied mathematics.

Mechanics.—The Montyon prize (700 francs), for the invention or improvement of instruments useful to the progress of agriculture, the mechanical arts, and the practical and speculative sciences; the Fourneyron prize (1000 francs), question for 1918: the theoretical and experimental study of ball bearings; question set for 1916 and carried on to 1918: important improvements in motors used in aviation; the Boileau prize (1300 francs), for researches concerning the motion of fluids contributing to the progress of hydraulics—these researches, if theoretical, must be verified by the results of experiment or observation; Henri de Parville prize (1500 francs), for original work in mechanics.

Astronomy.—The Lalande prize (540 francs), for the most interesting observation or memoir most useful to the progress of astronomy; Benjamin Valz prize (460 francs), for work in astronomy, conforming to the same conditions as the Lalande prize; the Janssen prize (gold medal), to the author of a work or discovery in physical astronomy; Pierre Guzman prize (100,000 francs), to anyone (without distinction of nationality) who finds a means of communicating with a celestial body—*i.e.* to make a signal to the body and receive reply. (The planet Mars is excluded.)

Geography.—The Delalande-Guérineau prize (1000 francs), for services to France or to science; the Gay prize (1500 francs), subject proposed for 1918: recent progress in geodesy; the Tchihatchef prize (3000 francs), for recompense or assistance of naturalists of any nationality distinguished in the exploration of the Asiatic continent or the adjacent islands, especially the less known regions—the explorations may be in any branch of natural, physical, or mathematical science; the Binoux prize (2000 francs), for work on geography or navigation.

Navigation.—The prize of 6000 francs for work increasing the efficiency of the French naval forces; the Plumey prize (4000 francs), for improvements in steam-engines or for any other invention contributing to the progress of steam navigation.

Physics.—The La Caze prize (10,000 francs), without restriction of nationality, for the best work in physics (the prize cannot be divided); the Hébert prize (1000 francs), to the author of the best treatise or most useful discovery in popularising or using electricity; the Hughes prize (2500 francs), to recompense the author of an original discovery in physical science, especially electricity and magnetism or their applications; the Danton foundation (1500 francs), for the encouragement of researches relating to radiant phenomena; the Victor Raulin prize (1500 francs) (limited to Frenchmen), for facilitating the publication of works relating to meteorology and the physics of the globe.

Chemistry.—The Montyon prize (unhealthy occupations) (a prize of 2500 francs, a mention of 1500 francs), for the discovery of a means of rendering some mechanical art less unhealthy; the Jecker prize (10,000 francs), for work most useful to the progress of organic chemistry; the La Caze prize (10,000 francs), for the best work in chemistry (open to foreigners and cannot be divided); the Cahours foundation (3000 francs), for the encouragement of young chemists of promise; the Houzeau prize (700 francs), similar conditions to the Cahours foundation.

Mineralogy and Geology.—The Cuvier prize (1500 francs), for the most remarkable work in mineralogy and geology.

Botany.—The Desmazières prize (1600 francs), to the French or foreign author of the best publication during the year on cryptogams; the Montagne prize (1500 francs), for important discoveries or work on the cellular plants; the de Coincy prize (900 francs), to the author of a work on phanerogams, to be written in Latin or French.

Anatomy and Zoology.—The da Gama Machado prize (1200 francs), for the best memoirs on the colour of animals, including man, and its origin in the animal kingdom; the Savigny foundation (1500 francs), for the assistance of young travelling zoologists, not receiving grants from the Government, and who occupy themselves more especially with the invertebrates of Egypt and Syria; the Jean Thore prize (200 francs), for a memoir on the habits or anatomy of a species of European insect.

Medicine and Surgery.—The Montyon prize (three prizes of 2500 francs, three honourable mentions of 1500 francs, citations), for improvements in medicine or surgery; the Barbier prize (2000 francs), for a valuable discovery in surgical, medical, or pharmaceutical science, or in botany in relation to the art of healing; the Bréant prize (100,000 francs), to the discoverer of a means of curing Asiatic cholera or of the causes of this disease (failing the award of the capital sum, the interest will be given as a prize for contributions to our knowledge of cholera or any other epidemic disease); the Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; the Mège prize (10,000 francs), to the author who continues and completes the essay of Dr. Mège on the causes which have retarded or favoured the progress of medicine, from antiquity to the present time; the Bellion prize (1400 francs), for work or discoveries especially profitable to the health of man; the Baron Larrey prize (750 francs), for the best work presented to the academy in the course of the year, by a doctor or surgeon in the Army or Navy, dealing with medicine, surgery, or military hygiene.

Physiology.—The Montyon prize (750 francs), for the most useful work on experimental physiology; the Lallemand prize (1800 francs), to recompense or encourage work relating to the nervous system; the L. La Caze prize (10,000 francs), for the work which has most contributed to the progress of physiology (the prize cannot be divided, and foreigners can compete); the Pourat prize (1000 francs), for the experimental study of some of the conditions which produce a variation in the quantity of water in different tissues; the Martin-Damourette prize (1400 francs), for therapeutic physiology; the Philipeaux prize (900 francs), for experimental physiology.

Statistics.—The Montyon prize (1000 francs) and two mentions (500 francs), for statistical researches.

History and Philosophy of Science.—The Binoux prize (2000 francs).

Medals.—The Arago, Lavoisier, and Berthelot medals.

General Prizes.—Prize founded by the State (3000 francs), question for 1918: to improve in an important point the study of the successive powers of the same substitution, the exponent of the power increasing indefinitely; the Bordin prize (3000 francs), for a study of the effects of pressure on chemical combinations in general, and in particular on those which are susceptible of a practical application; the Estrade-Delcros prize (8000 francs, undivided), for work in the physical sciences; the Le Conte prize (50,000 francs; encouragements), one-eighth for encouragements, the whole or part of the remaining seven-eighths in a single prize for new and capital discoveries in mathematics, physics, chemistry, natural history, medicine, or for new applications of these sciences; the Houllevigue prize (5000 francs), for work in mathematics; the Parkin prize (3400 francs), for work on the curative effects of carbon in cholera and other diseases; the Saintour prize (3000 francs), for work in physical science; the Henri de Parville prize (1500 francs), for original work on science or the popularisation of science; the Lonchampt prize (4000 francs), for a memoir on the diseases of man, animals, and plants from the point of view of the introduction of excess of mineral substances as the cause of these diseases; the Henry Wilde prize (one of 4000 francs, or two of 2000 francs, without distinction of nationality), for a discovery or work on astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; the Caméré prize (4000 francs), for a French engineer who has personally conceived, studied, and realised a work resulting in progress in the art of construction; the Gustave Roux prize (1000 francs, undivided), as recompense to a young French scientific worker; the Thorlet prize (1600 francs); the Lannelongue foundation (2000 francs), to one or two scientific men (or their widows or children) in needy circumstances; the Laplace prize of books, for the highest student leaving the École Polytechnique; the L. E. Rivot prize, to the four students leaving the Ecole Polytechnique and holding the first and second places in the two sections of the school; the Trémont foundation (1000 francs), for assisting works attaining an object useful and glorious for France; the Gegner foundation (4000 francs), to assist a poor scientific man, already known for the quality of his work, to enable him to continue his researches; Jérome Ponti foundation (3500 francs), for the encouragement of mathematical science.

The Bonaparte Fund.

Grants from this fund are made for facilitating the researches of workers who have already given proof of their capability in original work, and who lack sufficient resources to undertake or pursue their investigations. Requests for grants may be made directly by the candidates or proposed by a member of the academy. The request should contain an exact description of the work proposed and indicate the sum necessary to carry it out. Twelve months after the receipt of a grant, a report must be sent giving details of expenditure and of the first results obtained; after two years a *résumé* of the work carried out with the aid of the grant must be forwarded. The whole of these reports will form a special publication under the title of "Recueil du Fonds Bonaparte."

WORKSHOP METHODS OF OPTICAL TESTING.

At the request of the Ministry of Munitions the Optical Society held an exhibition of workshop methods of optical testing at King's College, Strand, on January 11, in order that by the interchange of workshop methods of test, the production of optical instruments for naval and military use might be expedited. Amongst others, Messrs. Chance Bros. exhibited a method for the rapid approximate assessment of strain existing in glass. A plate of mica is cemented between glass plates, the mica being of such thickness as to give a phase difference in the two beams of one wave for sodium light. This plate therefore gives approximately the sensitive first order purple colour between crossed Nicols. According to the orientation of the specimen double refraction will be evident from the change of the purple colour to a tint of a lower or higher order. Each tint corresponds to a definite phase variation produced by the double refraction of the glass, and hence an estimation of the tints exhibited gives an estimation of the phase difference produced in a beam on passage through the glass. The colours given in conjunction with the wave plate are independent of the intensity of the light; thus greater uniformity in testing for bad annealing is obtained than by the use of crossed Nicols alone, where the sensitiveness of the tests depends largely on the intensity of the source of light.

Messrs. Adam Hilger exhibited a new apparatus and process for finishing prisms and lenses which are imperfect in consequence of non-homogeneous material or inaccurate surfaces. The apparatus consists of a modification of the Michelson interferometer. A beam of light is passed through the optical element under test in such a way as to produce a series of interference fringes which constitute what may be called a contour map of imperfections. This map can be drawn on one of the surfaces of the prism or lens; superfluous material is then removed by local polishing until light is transmitted as in a perfect optical element.

Prof. Herbert Jackson exhibited samples of glass which had undergone a *weathering* test, by submission to the action of steam in an autoclave. The condition of glass surfaces after a standard test is an index of the behaviour of the glass when subjected to normal atmospheric exposure.

The National Physical Laboratory exhibited the photometer used in testing the luminosity of radium-painted dials. The dial under test is placed between two "artificial dials" illuminated by an electric lamp placed behind a suitable green filter; the candle-power of the lamp is varied by means of a resistance. The instrument is standardised by the use of a surface brightness photometer for various currents through the lamp. Samples of glass were also exhibited made from sands obtained in England, to replace sands hitherto obtained from the Continent.

SCIENTIFIC RESEARCH IN RELATION TO INDUSTRIES.[1]

INDUSTRY, and with it all our modern civilisation, depend on engineering. Engineering, however, is nothing but applied science, and science thus is the foundation, and scientific research the ultimate means, which have created our civilisation. Through ages the chief homes of scientific research have been the universities and other educational institutions. During the last generation, however, the industrial development has been so rapid, and the demand for the results of scientific research so great and urgent, that the universities have not been able to supply it, and the industries, especially the more powerfully organised modern industries, as electrical engineering, chemistry, etc., had to enter the field of scientific research. The country's educational institutions did not advance in fostering scientific research to the same degree as the industries advanced, and many universities and educational institutions rather retrograded in scientific research, became submerged in a false commercialism which figured the output of the college in student hours per professor, judged efficiency by the percentage of students graduated, and altogether too often wasted the university's best assets—its professors. Thus we find in our colleges men who had shown themselves capable as investigators to do scientific research work of the highest order overloaded with educational or administrative routine, and deprived of the time for research work. Private industries rarely commit such crimes of wasting men on work inferior to that which they can do; industrial efficiency forbids it.

Thus, when with the advance of industry a more rapid extension of our scientific knowledge was demanded than was given by the educational research institutions, scientific research laboratories were established in the industries. Some of them very soon showed their ability to produce scientific work of high character. As illustration, I may mention how an entirely new branch of chemistry, the chemistry of the free atom, has resulted from the work of Langmuir in the electrochemical research laboratory of the General Electric Company, and has been communicated to the literature of the subject by numerous papers.

Theoretically, there is a limitation imposed on scientific research work in industrial establishments. It should be of such a character that it may lead to results which are industrially useful. In reality, however, this is no limitation at all, but there is no scientific investigation, however remote from industrial requirements, which might not possibly lead to industrially useful developments, and obviously no immediate or direct usefulness is expected; any investigation offering a definite prospect of industrial utility is not scientific research, but is industrial development or design. Experience, indeed, has shown that it is rare that sooner or later some industrially valuable results do not follow, no matter how abstruse and remote from apparent utility a scientific investigation may appear, and any scientific research whatsoever is thus industrially justified.

To illustrate, when, by the consulting engineering laboratory of the General Electric Company, research work was undertaken on the electrostatic corona, and in general on the dielectric phenomena in the air, no immediate or direct benefit could be seen for the industrial company which financed the work, but it was justified by the consideration that a greater knowledge of these phenomena may extend the economic limits of long-distance power transmission, and thereby increase the industrial demand for transmission apparatus. Nevertheless, before the research was completed—if research can ever be considered completed—it had led to a re-design of practically all high-voltage transmission apparatus, and thus proved essentially valuable in industrial design.

Some research work can be carried out more efficiently by educational institutions, others by the industry. In general, for industrial research, better facilities in materials and in power are available, but high-class skilled labour, of investigators and research men, such as is available in university research by the graduate students, is expensive in the industry. Thus researches requiring little in facilities, but a large amount of the time and attention of research men, are especially adapted to educational laboratories, while investigations requiring large amounts of material or of power rather than the time of the investigators are specifically adapted to the industry, and often beyond the facilities of the educational institution. Efficiency thus should require a division of research between educational and industrial laboratories in accordance with their facilities, and where this is done the results are splendid. Thus, for instance, the phenomena of the dielectric field beyond the elastic limit—or, in other words, those of the disruptive effects in air and other dielectrics under high electric stress—were almost entirely unknown a very few years ago, and it was even unknown whether there is a definite dielectric strength of materials, analogous to the mechanical strength. This field has been very completely cleared up, and a comprehensive knowledge of the phenomena of the dielectric field gained, not only under steady stress, but also under oscillating stress, and under the transient stress of sudden electric blows or impulses, ranging down to the time measured by micro-seconds, as the result largely of the work of an industrial research laboratory—the consulting engineering laboratory of the General Electric Company under Mr. F. W. Peek—and an educational laboratory—Johns Hopkins University under Prof. Whitehead—both laboratories working independently and devoting their attention to those subjects for which they are specifically fitted, though naturally often overlapping and checking each other.

Unfortunately, this limitation of research work in accordance with the available facilities is not always realised, and especially educational institutions not infrequently attempt research work for which industrial laboratories are far better fitted, while research work for which the educational institution is well fitted, which the industry needs but cannot economically undertake, is left undone. It is usually the desire to "do something of industrial value" which leads universities to undertake investigations on railroading and similar subjects, in which the probability of adding something material to our knowledge is extremely remote, or to undertake investigations on industrial iron alloys in competition with the vastly greater and more efficient research of industrial laboratories in this field of magnetism, while all other magnetic research is largely neglected. Our knowledge of the phenomena of magnetism is therefore still very unsatisfactory, and it is obvious that a material advance can be expected only from a comprehensive study of the entire field of magnetism, and the little investigated non-ferrous magnetic materials thus would be the ones most requiring study.

The closer relation of industrial research laboratories to engineering practice leads to a tendency which, in general, may be expressed by saying that in the results of industrial research the probable error is greater, but the possibility of a constant error less, than in educational research. In any investigation typical conditions are selected. As these conditions naturally

[1] Presented at a joint meeting of the Franklin Institute and the Philadelphia Section, American Institute of Electrical Engineers, on October 18, 1916, by Dr. C. P. Steinmetz, Chief Consulting Engineer, General Electric Company, Schenectady, N.Y. Abridged from the Journal of the Franklin Institute, vol. clxxxii., No. 6.

never can be perfect, two ways of procedure are feasible: either to investigate the errors and disturbing factors and correct for them, or to select the condition of experiment so that the disturbing factors are negligible—for instance, experiment on a large scale. The latter method cannot give as high accuracy as the former, but the former method, while theoretically more accurate, may give a constant error, possibly of hundreds per cent., if some of the assumptions on which the corrections are based are not completely justified. Industrial research leans towards the first method as giving results which are safer in trustworthiness, even if somewhat less accurate, while educational research leans towards the method of applying corrections. As illustration, in magnetic investigations, the effect of joints in the magnetic circuit, etc., may be determined and corrections for it applied, or such a magnetic circuit may be chosen, that the effect of joints, etc., is negligible, and can be neglected, or taken care of, by a correction which is so small that its accuracy is not material.

In industrial research the liability exists of limiting the work to such a narrow field that it has little general scientific value; for instance, to determine the hysteresis loss in a magnetic material, without determining the magnetisation curve. In educational research inversely there is sometimes the tendency to generalise beyond the limits justified, and so draw wrong conclusions. For instance, numerous investigations have been made and conclusions drawn therefrom in treatises on the "arc," while in reality the investigation was made with the carbon arc only and applies only to this kind of arc; and as the carbon arc is not typical, but rather exceptional, for most other arcs the conclusions are wrong.

As regards the quality of the scientific research work done in industrial organisations compared with that done in educational establishments, there is no material difference, but the work done in the industry, just as that done in universities, varies from scientific research of the highest quality down to investigations which are of little, if any, value—investigations crude and inaccurate or directly erroneous in premises, in method, and in results and their interpretation, or investigations which, while correctly conceived and correctly made, are useless because essential conditions have not been controlled or recorded. Still worse are those pseudo-scientific investigations occasionally met which owe their conception to the desire of self-advertisement or are made for commercial or legal purposes, such as, for instance, to give the appearance of a scientific standing to some theory which some inventor had recorded in his patents. Such work—met occasionally, though less and less frequently—in industrial as well as in educational institutions, tends to discredit scientific research in the eyes of the layman, who cannot discriminate between science and pseudo-science.

The essential difference between industrial and educational research, however, is met in their method of publication: the publication mediums of scientific research carried on in educational institutions are the scientific publications published more or less under the direction or supervision of universities, while the publication mediums of the scientific research carried on in the industry are the technical or engineering papers, and only occasionally an abstract reaches the scientific publications. Unfortunately, a large number of men of science still look on publications in the technical Press as unscientific, take no cognisance of them, do not recognise them in scientific abstracts, reviews, etc., and, as a result, a large and steadily increasing part of the scientific research of the country is practically lost to men of science, and is not available or easily accessible, by not being recorded, abstracted, or indexed in the records of scientific progress. If, for instance, in the tables of physical constants published only a few years ago, under "hysteresis" are published the losses in a Siemens cable transformer (a type which had ceased to exist a quarter of a century ago), and practically all the mass of data on magnetism recorded in the engineering proceedings neglected, apparently as not "scientific," it shows that there is something wrong with the attitude of those responsible for the records of science. Amongst the worst offenders in this unjustified exclusiveness are the physicists, while the chemists make a commendable exception. In the "chemical abstracts" published by the American Chemical Society, the results of industrial research, as well as those of the chemical university laboratories, are recognised, and these abstracts are therefore comprehensive and valuable, which cannot be said of the abstracts of some other sciences. Possibly the reason is because applied chemistry is chemistry just as well as theoretical chemistry, while applied physics goes under the name of engineering, and the average theoretical physicist is rather inclined not to recognise engineering as scientific.

Some excuse may be found in the nature of the two classes of publications, the physical science publications and the engineering publications. The former accept for publication only scientific papers, exert a critical judgment, and the appearance in the scientific publication medium thus implies that the article, at least in the opinion of the editors, is of scientific value. This is not the case, and cannot be the case, with the engineering or technical publications. The technical Press is the medium of all the publications of those engaged in the industry, from scientific research of the highest value to mere commercial statements, and the appearance of an article in an engineering paper or transaction does not imply, nor is intended to imply, that it is of scientific value, but the discrimination of scientific worth, which in the scientific publications is attempted by the editors, has in the engineering Press to be left to the reader or abstractor. If, however, the purpose of the engineering publication is to bring together all classes of industrial records—and it thus includes commercial and other articles—this is no justification to refuse recognition to scientific papers contained in the same publication, but rather makes it desirable, and indeed necessary, in the interest of our nation's scientific efficiency, to find some means or organisation to carry out this discrimination and make available to the scientific world at large the scientific work contained in the annals of applied science—that is, engineering.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—In the course of the term just beginning, Congregation will be invited to consider an important proposal for establishing a new status for advanced students, and for enabling persons admitted to this status to obtain the degree of doctor under new conditions. It is proposed to limit admission to the status to persons who have taken the degree of B.A. at Oxford; or who, if they come from another university, have taken a four years' course and a degree, and have produced satisfactory evidence of their fitness to pursue a course of advanced study. The time to be devoted to study by advanced students before the degree of doctor can be taken will be either two or three years, according to circumstances. Opposition may be expected to this proposal, both in principle and detail, and it is yet too early to forecast the result of discussion. The advocates of the scheme speak of it as an attempt to meet a need which is likely to be of considerable importance at the end of the war.

The usual announcements of lectures and practical work have been issued by the various scientific departments. The number of undergraduates resident during the term is not expected to exceed four hundred.

DR. JOHANNA WESTERDIJK has been appointed extraordinary professor of phytopathology in the University of Utrecht; she is the first woman to receive such an appointment in Holland.

THE University of Stockholm has received from Mrs. Amanda Ruben the sum of 50,000 kronor (*circa* 2700*l.*) to found a readership in experimental zoology, the first post of the kind in Sweden.

ACCORDING to the *Nieuwe Courant*, Dr. P. N. van Kampen, University lecturer at Amsterdam, has been appointed professor of zoology and comparative anatomy in the University of Leyden, in succession to the late Prof. Vosmaer.

FOUR lectures will be delivered on "Climate and Health," on January 30, January 31, February 1, and February 2, by Dr. H. Campbell, at Gresham College, Basinghall Street, E.C. The lectures are free to the public, and will begin each evening at six o'clock.

DR. H. B. FANTHAM, Christ's College, Cambridge, recently chief protozoologist to the British Forces in Salonica, has been elected to the professorship of zoology in the South African School of Mines and Technology, Johannesburg, University of South Africa, and is shortly proceeding to take up the appointment.

A SPECIAL introductory medical course in physics, chemistry, and biology for students desirous of beginning their medical studies will be held at University College, and will begin on March 1. Intending students should communicate forthwith with the secretary, University College, Gower Street, London, W.C.

THE staff of the new Flemish University of Ghent includes six of the old professors and seven Dutchmen, but for the most part Flemings of various standing have been appointed by the Germans. A considerable number of Dutchmen refused. The students at present are chiefly between eighteen and twenty years of age; the older students who were at the University when war broke out are mostly at the front.

"THE Value of Drawing to the Scientific Worker" was the subject of a lecture, with lantern illustrations, given by Dr. F. A. Bather at the January Conference of Educational Associations, on the invitation of the Royal Drawing Society. As a means of expression, said Dr. Bather, drawing is no less useful than writing to the scientific worker. It is also an important method of scientific work. In the descriptive branches of science the researcher should be able to draw because he alone understands the points that are to be brought out. Even if he employs a draughtsman, he must make sketches for the artist's guidance, and must have sufficient knowledge of the craft to be able to control the result. The act of drawing directs his attention to features that might otherwise escape notice, and forces him to consider structural relations and meanings. In formulating and checking hypotheses, a drawing or model is of the greatest assistance. This is exemplified in such diverse fields as the restoration of extinct animals and the presentation of crystal structure. The power of visualisation, trained by the practice of drawing, enables one to appreciate verbal descriptions with rapidity and accuracy, and to translate them when necessary into concrete form. Accuracy of observation and an understanding of structure are more important in professional illustration than the skilled conventional technique of the pictorial artist. It is doubtful whether the scientific draughtsman can be trained elsewhere than in the laboratory. At any rate, the necessary training does not at present appear to be obtainable elsewhere. It should include the various modes of measurement and drawing to scale, the use of the simple and compound microscope, of the camera lucida and the photographic camera, a thorough knowledge of all process work, lithography, and working on photographs. Above all, the draughtsman must have a loving comprehension of the objects he portrays.

A REPORT from Manchester on "Engineering Education and Research," reviewed in NATURE for August 24, 1916, carefully distinguished between the problem of educating workmen on one hand, and members of the higher engineering staff on the other. Observing this distinction, another report, primarily concerned with the education of workmen, has been prepared by a committee of the Manchester Association of Engineers. The report recommends compulsory part-time *day* classes for all apprentices up to the age of seventeen, and suggests that the best apprentices should then be selected for further attendance at part-time day classes, evening classes being provided for the remainder. The recommendation that attendance at part-time day classes should be made compulsory for all employed persons under seventeen or eighteen years of age has already been made in the report on "Engineering Education and Research" mentioned above, as well as in the programmes of educational reconstruction issued by the Education Reform Council, by the Workers' Educational Association, and by the British Science Guild. Its repetition in the present report affords additional evidence of the willingness of employers to co-operate in giving effect to an Act of Parliament on these lines. This is excellent. So also is the advocacy of further co-operation between employers and education authorities. The principle upon which one paragraph in the report is based will not, however, meet with general acceptance; it is that all boys who are to leave school at fourteen should receive the same education up to that age. But the course at the Royal Naval College, Osborne, has taught us that general education improves by being focussed, especially on post-school activities. Objection may also be raised to the "Diagram of Scheme of General Education" that accompanies the report. The diagram shows separate schools (as in Germany), instead of separate "sides" (as is usual in England), for classics, modern studies, and other departments of higher secondary education. It also reproduces the complete divorce, from which Germany suffers, between technology and other university work.

SOCIETIES AND ACADEMIES.

LONDON.

Aristotelian Society, January 8.—Dr. H. Wildon Carr, president, in the chair.—C. D. **Broad**: Hume's theory of the credibility of miracles. Hume's general argument against miracles is weak. On his definition two miracles of the same kind (*e.g.* two raisings from the dead) could not occur. Yet believers in miracles hold this to be possible. If one reported exception to an alleged law ought to make *no* difference to the strength of our belief in it, why should two or more? But if one reported exception makes *some* difference in the strength of our belief in the law, how can we be sure *a priori* that it may not in certain cases reduce our belief to doubt or disbelief? If people had acted on Hume's theory, many scientific discoveries would not have been made. For exceptions to many alleged general laws ought, if Hume be right, to have been treated, except by their discoverers, as alleged miracles and disbelieved. Since those who observe the exceptions are experimentalists, and those who explain them are often mathematicians, such exceptions would never have been explained if the mathematicians had taken up Hume's attitude. Actually the belief of most people in most laws itself depends on testimony. Hence the arguments for and against an alleged miracle are arguments of testimony against testimony. Strictly, in accordance with his view of belief and induction, Hume had no right to talk about what we *ought* to believe as to matters of fact, but only to discuss the causes of our beliefs. And love of the wonderful is as good a cause of belief in a miracle as constant experience is a cause of belief in a natural law.

Mineralogical Society, January 16.—Mr. W. Barlow, president, in the chair.—A. **Holmes** and Dr. H. F. **Harwood**: The basalts of Iceland, Färoe Islands, and Jan Mayen. The basalts described fall into four well-marked types based on the presence or absence of olivine and the porphyritic or non-porphyritic character of the structure. They resemble the Greenland basalts previously described by the authors, and the whole series is closely matched by the basalts of Skye and Co. Antrim. Chemically the most striking feature of the lavas is their high content of titanium dioxide, which in the seven analyses made varies from 2·36 to 5·68 per cent. The olivine-free rocks are remarkable for their abundance of titaniferous magnetite. In the olivine basalts this mineral is less abundant, and much of the titanium is presumably in the pyroxene, which in the olivine varieties only is of a purple-brown tint. A peculiarity of the olivine basalts is their comparative richness in alkalies, a feature that brings them into relationship with the titaniferous-olivine basalts of the western Mediterranean described and analysed by Washington. The Arctic province, however, is distinguished by the abundance of alkali-poor basalts, which, in spite of the fact that their silica percentages are low, are thoroughly over-saturated rocks.—Prof. H. **Hilton**: The use of the orthographic projection in crystallography. The method of preparing a projection and its use in the drawing of crystals were explained, and the advantages of this projection of the sphere were pointed out.—J. V. **Samojloff**: Palæophysiology, the organic origin of some minerals occurring in sedimentary rocks. In connection with the exploration of the phosphate deposits of Russia, the occurrence of barytes has been noted over a wide area in the Governments of Kostroma, Kazan, and Simbirsk, and also farther to the north-east in the basin of the Pechora River. The mineral occurs as nodules in the clays and marls of the Upper Jurassic, and is confined to the Oxfordian-Sequanian horizon, though extending up to the Kimmeridgian in some of the districts. Nodules of barytes have been dredged from the sea-floor off the coast of Ceylon, and granules of barium sulphate have been detected in the bodies of certain marine organisms, namely, the Xenophyophora. If, therefore, during the Upper Jurassic period such organisms, capable of extracting barium salts from sea-water, were more abundant, they would account for the accumulation of barium in these strata, where the barytes occurs as a primary mineral. Similarly, the mineral celestite has been found over a very wide area in Turkestan in the beds of Upper Cretaceous age. The presence of strontium sulphate has been detected in the skeletons of the Acantharia, a group of the Radiolaria. It is conceivable that similar organisms were relatively more abundant during the Cretaceous period, and that their remains gave rise to the deposits of celestite. Although the iron compound hæmoglobin plays an important function in the blood of present-day animals, yet cases are known amongst the Crustacea and Mollusca in which the copper compound hæmocyanin performs the same function, and vanadium has been detected in the blood of the Ascidia. During former periods of the earth's history these, and perhaps some other, metals may have been predominant in the blood of animals then living. In this connection the persistent occurrence in the Permian strata of copper minerals and ores associated with abundant animal remains is significant. Similarly, there may have been at different periods variations in the chemical composition of the ash of plants. The recurring presence of minerals of primary origin in certain sedimentary strata therefore suggests that there may have been varying physiological processes during past periods, and for this new branch of palæontology the name "palæophysiology" is suggested.—E. S. **Simpson**: Tapiolite in the Pilbara Goldfield, Western Australia. The mineral, which was discovered at Tabba-Tabba Creek and Greens Well, lying in a large area of granite intersected by pegmatite veins and greenstone dykes and bosses, occurs in fairly well-defined crystals, which analysis proved to contain little niobium. At the first locality the crystals displayed the forms 100, 001, 111, 101, 320, and were twinned as usual on 101, and often distorted; while at the second they displayed the forms 100, 111, 101, 320, and showed twinning about 106 and 301, as well as 101. A curve was prepared showing the specific gravity obtaining in the tetragonal isomorphous series of meta-tantalates and metaniobates of iron, manganese, and calcium.

Mathematical Society, January 18.—Prof. H. M. Macdonald, president, in the chair.—G. H. **Hardy** and S. **Ramanujan**: Asymptotic formulæ in combinatory analysis.—Prof. M. J. M. **Hill**: The singular solutions of ordinary differential equations of the first order.—H. **Bateman**: The nature of a moving electric charge and its lines of electric force.—Prof. L. J. **Rogers**: The expansion of the variables of a hypergeometric equation in terms of the ratio of two solutions.—Prof. H. J. **Priestley**: A problem in the theory of diffraction.

PARIS.

Academy of Sciences, December 26, 1916.—M. Camille Jordan in the chair.—G. **Bigourdan**: The first scientific societies of Paris in the seventeenth century. The meetings at the Bureau d'Adresse.—E. **Branly**: The electrical conductivities of air and mica.—H. Le **Chatelier**: Cristobalite. In a previous paper the author has shown the existence of a form of silica, X, characterised by a point of transformation at 215° C., and probably identical with cristobalite. Further work has proved the correctness of this view, and crystals of this form of silica have been detected in various artificial products. The paper is illustrated with eight photomicrographs.—C. **Richet** and H. **Cardot**: The influence of small rises of temperature for short periods of time on the course of fermentation. A study of the effect of short periods of heating on the lactic fermentation.—M. de **Sparre**: Water hammer in a main formed of two sections of different diameters.—E. **Ariès**: A form of the temperature function in the Clausius equation of state. A discussion of the best means of determining n in the equation

$$p=\frac{RT}{v-a}-\frac{K}{T^n(v+\beta)^2},$$

from experimental data.—C. E. **Guillaume**: The homogeneity and expansion of invar. In spite of the many causes affecting the expansion of invar, it has been proved possible to make ingots so homogeneous as to make certain that the specimen tested and the specimen utilised have identical coefficients of expansion.—J. P. **Morat** and M. **Petzetakis**: The experimental production of retrograde ventricular extrasystoles and of inverse rhythm by inversion of the conduction of stimulations in the heart.—S. **Mangeot**:

A construction of the osculating sphere and of the radius of torsion at a point of the curve of intersection of two given surfaces.—W. H. **Young**: The conditions of convergence of Fourier's series.—M. **Baticle**: The application of the theory of integral equations to certain calculations relating to the stability of constructions.—J. **Repelin**: New species of Rhinocerotidæ of the Oligocene of France. The Laugnac deposit discovered by Vasseur contains the remains of at least three new forms of rhinoceros. The best represented is the oldest European Teleoceras known. It appears towards the end of the Oligocene period in the middle of a fauna undoubtedly Oligocene, and may perhaps be considered as the direct ancestor of *T. aurelianense.*—J. **Georgévitch**: The evolutive cycle of *Ceratomyxa herouardi.*—J. **Danysz**: The causes of anaphylaxy: the nature and formation of the antibodies. The antigens are substances which cannot be directly assimilated, the antibodies the substances which transform the antigens into assimilable products, and which each organism can produce specially for each antigen. This change can be compared with a digestion, and consists of two successive reactions, the formation of a precipitate, and the resolution of this precipitate. When, after a special preparation, the blood of an animal contains a sufficient quantity of this digestive reagent, the digestion is effected in the interior of the blood-vessels, and the formation of a precipitate under these conditions causes the troubles described under the name of "crisis," or anaphylactic shock. The intravascular digestion may give rise, in certain cases, to toxic by-products.—H. **Judet**: An attempt to reconstitute losses of substance of the long bones resulting from war wounds.

BOOKS RECEIVED.

Catalogue of the Collection of Skulls and Teeth in the Odontological Museum of the University of Birmingham. Pp. 64. (Birmingham: Cornish Bros., Ltd.)

British Agriculture: The Nation's Opportunity. By the Hon. E. G. Strutt, L. Scott, and G. H. Roberts, and a Preface and Appendix on the Reclamation of Land, by A. D. Hall. Pp. xi+168. (London: J. Murray.) 3*s.* 6*d.* net.

The Flying Machine from an Engineering Standpoint. By F. W. Lanchester. Pp. viii+135. (London: Constable and Co., Ltd.) 4*s.* 6*d.* net.

Food and Fitness, or Diet in relation to Health. By Prof. J. Long. Pp. ix+208. (London: Chapman and Hall, Ltd.) 5*s.* net.

The Problems of Physiological and Pathological Chemistry of Metabolism for Students, Physicians, Biologists, and Chemists. By Dr. O. von Fürth. Translated by Prof. A. J. Smith. Pp. xv+667. (Philadelphia and London: J. B. Lippincott Co.) 25*s.* net.

The Reality of Psychic Phenomena, Raps, Levitations, etc. By Dr. W. J. Crawford. Pp. vii+246. (London: J. M. Watkins.) 4*s.* 6*d.*

The Lack of Science in Modern Education, with Some Hints of What Might Be. By Sir Napier Shaw. Pp. 42. (London: Lamley and Co.) 1*s.* net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 25.

ROYAL SOCIETY, at 4.30.—The Dynamics of Revolving Fluid: Lord Rayleigh.—Spectroscopic Observations on the Active Modification of Nitrogen. V.: Hon. R. J. Strutt.—Magnetic Induction and its Reversal in Spherical Iron Shells: Profs. J. W. Nicholson and E. Wilson.—The Two dimensional Motion of a Plane Lamina in a Resisting Medium: S. Brodetsky.

FRIDAY, JANUARY 26.

ROYAL INSTITUTION, at 5.30.—Epicurean Philosophy: Prof. G. Murray.

PHYSICAL SOCIETY, at 5.—A Clock of Precision: C. O. Bartrum.—The Effect of the Water Vapour in the Atmosphere on the Propagation of Electromagnetic Waves: Dr. F. Schwers.

SATURDAY, JANUARY 27.

ROYAL INSTITUTION, at 3.—The Lakes and Mountains of Central Africa: A. R. Hinks.

MONDAY, JANUARY 29.

ROYAL SOCIETY OF ARTS, at 4.30.—Town Planning and Civic Architecture: Prof. A. Beresford Pite.

TUESDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—The Old Brain and the New Brain, and their Meaning: Prof. C. S. Sherrington.

ROYAL SOCIETY OF ARTS, at 4.30.—Imperial Industries after the War: O. C. Beale.

WEDNESDAY, JANUARY 31.

ROYAL SOCIETY OF ARTS, at 4.30.—The Work of the Y.M.C.A. in France: Miss Ella C. Sykes.

ROYAL SANITARY INSTITUTE, at 4.30.—*Discussion*: The Physical Welfare of Children after Infancy from the National, Social, and Public Health Standpoints, to be opened by Dr. W. Leslie Mackenzie.

THURSDAY, FEBRUARY 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: An Application of the Theory of Probabilities to the Study of *a priori* Pathometry. Part II.: Sir Ronald Ross and Miss H. P. Hudson.—An Investigation into the Periodicity of Measles Epidemics in London from 1703 to the present day by the Method of the Periodogram: Dr. J. Brownlee.—The Causes responsible for the Developmental Progress of the Mammary Glands in the Rabbit during the latter part of Pregnancy: Capt. J. Hammond.—The Post-œstrous Changes occurring in the Generative Organs and Mammary Glands of the Non-pregnant Dog: F. H. A. Marshall and E. T. Halnan.

ROYAL INSTITUTION, at 3.—The Mechanism of Chemical Change: Prof. F. G. Donnan.

CHEMICAL SOCIETY, at 8.—Chromium Phosphate: A. F. Joseph and W. N. Rae.—The Detection of Traces of Mercury Salts in Toxicological Work: K. C. Browning.—"Stepped" Ignition: R. V. Wheeler.—The Catalytic Bleaching of Oils, Fats, and Waxes: H. Rai.—Alkaloidal Derivatives of Mercuric Nitrite: P. C. Rây.—Synthesis of a Derivative of the Lowermost Homologue of Thiophene: P. C. Rây and M. L. Dey.—The Detergent Action of Soap: S. U. Pickering.—The Occlusion of Iron by the Phospho-molybdate Precipitate: E. H. Archibald and H. B. Keegan.

MATHEMATICAL SOCIETY, at 5.30.

FRIDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 5.30.—The Supply of Gaseous Energy: Dr. C. Carpenter.

SATURDAY, FEBRUARY 3.

GEOLOGISTS' ASSOCIATION, at 3.—President's address: The Study of the Archæan Rocks, with Special Reference to Scotland: G. Barrow.

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NATURE

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

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THURSDAY, FEBRUARY 1, 1917.

OIL-FIELD TECHNOLOGY.

Oil-Field Development and Petroleum Mining. By A. Beeby Thompson. Pp. xix+648. (London: Crosby Lockwood and Son, 1916.) Price 25*s.* net.

THIS is practically a second edition of the author's previous volume on the same subject, with transposition of the leading divisions of the title. It is, however, by no means a mere reprint, extensive alterations having been effected by correction, addition, and excision. Readers interested in some only of the many branches of the subject will doubtless consider that both the last two processes might well have been carried further, but an impartial survey of the work will show that the author is gifted with a judicious sense of proportion in the allotment of attention to the several sections of his complex topic, only stopping at the door of the refinery, the operations within which are beyond the scope of the volume, and are merely summarised in some half-dozen pages.

Somewhat more than half the work is concerned with the technology of exploitation and transport, but a fair degree of consideration is accorded to the geological questions of the original formation of petroleum, its mode of accumulation, and the effect of tectonic movements. The author naturally deals at greater length with the more important factors of composition and structure of strata, as affecting the concentration of oil, than with the more purely academic problems of the primary formation of the hydrocarbons from their parent organic matter, animal or vegetable. Ample space is, nevertheless, occupied by a careful balancing of the more or less contradictory evidence on this point, with a general deduction in favour of catalytic action by anaerobic enzymes shortly after inclusion in sediment. This provisional hypothesis obviates at least many of the objections which have been advanced against the more vaguely enunciated theory of organic origin, now generally accepted. That this was ever controverted is attributable to the absence of co-operation between geologists and chemists, so that wholly untenable hypotheses have been advocated or supported by leading chemists; not that there was any doubt whatever that petroleums had been produced synthetically in the laboratory, but that geological considerations precluded the acceptance of this as a natural method of formation. The converse error, through geologists proposing chemical impossibilities, is probably rarer, though not wholly unknown.

Apart from the question of origin, the texture and tectonic structure of the rocks of an oil-bearing region are shown to have a most important bearing on the productivity of the field. Not only do oil-bearing rocks, like all the coarser mechanical deposits, occur in lenticular masses, often of very abrupt angles of attenuation, but even in continuous sandstones the porosity (and consequent passage of fluids) may be largely reduced by calcitic or siliceous cementation, irrespective of the coarseness or fineness of the grains or pebbles composing the bulk of the rock. Some very coarse conglomerates have been rendered wholly impervious by such cementation, occurring sporadically, and thus removing those portions of the rock from the category of productive "sands."

The migration of oil under pressure, generally with the aid of flexures, faulting, or other tectonic disturbance, is dealt with at length, as its importance merits, and is illustrated by heavy yields of oil from horizons wholly devoid of it except where forced into contact with productive members of the geological series. As the author remarks, erroneous deductions may easily be drawn from imperfectly studied phenomena. Our knowledge of the physics of the subterranean flow of oils is yet little more than the empirical record of observed details not permitting the formulation of anything beyond tentative proposition of working hypotheses. The chief difficulty lies in the weight to be assigned to unknown quantities in the many relevant factors—pressure, gravity, capillarity, surface-tension, solution of gas in oils, effect of underground temperature on viscosity, original structure of the rocks, with its modification by tectonic action, by the disturbance of equilibrium in exploitation through the rapid removal of vast bulks of oil and sand, and to some extent by the vibration due to abrupt stoppages of the flow by temporary choking of the boreholes.

Caution in the interpretation of surface indications is enjoined rather as regards forecast of quantity and quality than as depreciating their value as guides to probable supplies, but oil-films on streams may be some distance from their source, or may arise from certain vegetable compounds. Films of iron peroxide, although instantly distinguishable by their incoherence, have often misled careless observers.

The author purposely refrains from entering upon the exceedingly intricate chemistry of petroleum beyond a very brief summary of the physical characters of a few typical oils. He shows that the supposed difference in original source between asphaltic and paraffinoid oils is based upon inaccurate data, many fields yielding both classes, and frequently in admixture.

The whole constitutes a useful treatise on the branches to which the author has devoted special attention, and the localities cited in illustration are mostly those of his personal investigation.

The orthography of Russian and other place-names is often open to individual choice, and there are few real misprints, such as "menelite." Prof. Mrazec's term "diapir" (for masses of older rock forced up through softer strata) should not be spelt "diaper." "Commendable criticism" (p. 125) is clearly a slip for "commendatory criticism." In the footnote on p. 116, XII. should be LXI. In the index are several unimportant errors, not affecting position, but Ackverdoff for Akhverdoff may be noted, and Quayaguayare would be more serious were not Guayaguayare given in its right place.

Z

ARBOREAL HABITS AND THE EVOLUTION OF MAN.

Arboreal Man. By Prof. F. Wood Jones. Pp. x + 230. (London: Edward Arnold, 1916.) Price 8*s.* 6*d.* net.

EVER since anatomy became separated from physiology and practical medicine it has run the risk of being assimilated with the material with which it deals and itself becoming a "dead subject." By a curious paradox this tendency became specially pronounced when the publication of "The Origin of Species" gave a great impetus to research in morphology, although Charles Darwin himself never failed to take into consideration the physiological and psychological factors which directly or indirectly affected the evolution of animal structure. But when the study of morphology led certain anatomists to regard their subject as what they were pleased to call a "pure science," worthy of being cultivated "for its own sake," and not merely as the geography of the territory the medical student would exploit when he became a physician or surgeon, an unfortunate tendency developed to disregard any treatment of the subject which might expose it unduly to the latter interpretation. As a result it suffered from the lack of those vitalising influences which the study of the functions naturally exerts upon attempts to explain structure.

The outstanding merit of the book which Prof. Wood Jones has given us is that it impresses upon the mind of the student the importance of studying *living* animals and human beings as the indispensable method for really understanding the meaning of their anatomy.

The somewhat ambiguous title emphasises the fact that his main theme is the examination of the far-reaching and determining influence of arboreal habits in the evolution of man's structure, distinctive abilities, and outlook. The general idea is not new, but it needed restating and expounding in the light of our current knowledge. Prof. Wood Jones had added much new information as the result of his own investigations, and has presented the whole argument with all the lucidity and brilliance of the conspicuously successful teacher he has proved himself to be. The book represents the Arris and Gale lectures as they were actually given at the Royal College of Surgeons. If he had been expounding the subject in another way, no doubt the author would have given fuller bibliographical references and discussion of the evidence. But in its present form the work can be confidently recommended to students as an exceptionally clear and sober exposition of certain of the factors in human evolution which have in the past not received the amount of attention their importance merits. The book is illustrated with characteristic samples of the author's clever draughtsmanship.

G. ELLIOT SMITH.

PHILOSOPHY.

(1) *The Contingency of the Laws of Nature.* By Emile Boutroux. Authorised translation by Fred Rothwell. Pp. ix + 196. (Chicago and London: The Open Court Publishing Co., 1916.) Price 5*s.* net.

(2) *The Dreams of Orlow.* By A. M. Irvine, with an Introduction by J. Arthur Hill. Pp. 256. (London: George Allen and Unwin, Ltd., 1916.) Price 5*s.* net.

(3) *A Modern Job: an Essay on the Problem of Evil.* By Etienne Giron, with Introduction by Archdeacon Lilley. Authorised translation by Fred Rothwell. Pp. 92. (Chicago and London: The Open Court Publishing Co., 1916.) Price 2*s.* 6*d.* net.

(1) M. EMILE BOUTROUX'S essay was originally presented as a thesis to the Sorbonne in 1874. Its aim was to find a new vindication of the freedom of the human will. The great difficulty which is always supposed to beset the libertarian is to reconcile free-will in man with the strict determination of natural objects which are governed by immutable laws. The author undertakes to show that there are no such laws. What really exist are uniformities which are similar to the uniformities in behaviour of a man who has formed very regular habits. "Contingency" in the title of the essay means "non-necessity," and the laws of Nature are not necessary, though they are regular. So long as we regard the laws of Nature as necessary we render illusory all life and liberty. And so the author claims that he has "restored to man that reality and effective influence over the course of things which common sense attributes to them, but which purely intellectualist or voluntarist philosophies, like those of Germany for the most part, declare to be inconceivable and illusory."

It is evident that the aim which M. Boutroux has set before himself is one which will command widespread sympathy, but the method by which he endeavours to realise his aim is too abstract and formal to be satisfactory. For the greater part of his book he is arguing against presuppositions and is attacking conceptions which, though widely current forty-two years ago, are not accepted to-day by any considerable body of philosophic opinion. The highly abstract (and therefore unsatisfying) character of the author's argument is seen most plainly, perhaps, in his second chapter, on Being. "On the lowest rung of the ladder of things given we find *being* or *fact* pure and simple, as yet indeterminate. Can we say that it exists necessarily?" The author's answer is, of course, that we cannot say so. On this whole question, however, our comment must be that the conception of pure indeterminate being is empty and futile. It stands in the forefront of Hegel's system, but since the date when this essay first appeared the Hegelian system has fallen out of favour, and men have turned to more concrete and fruitful inquiries. Altogether we are inclined to doubt whether the Open Court Publishing Company and Mr. Rothwell have done much service to philosophic thought by bringing forward this early thesis, or whether its republication will add much to the author's very considerable reputation in England.

(2) Miss Irvine's book is curious and interesting, and many people will read it through to the end who will be unconvinced of its value as a contribution either to science or to religion. It records under a thin veil of fiction the experiences of a young lady who could dream what she called True Dreams—that is, dreams which were recognised as different from waking reality, but were regarded by the dreamer as incursions into some supernatural—or shall we say "astral"?—plane of existence. A work of this character has no clear scientific value, but it has the merit of stimulating inquiry and directing attention to an important and little-explored field of human experience.

(3) M. Etienne Giron's essay on the problem of evil follows very closely upon the model of its prototype. His "modern Job" is a Dutch descendant of the patriarch, distinguished by the possession of great wealth and the practice of every virtue. Suffering the severest bereavements and financial misfortunes, he is comforted by three friends and by his faithful servant. The book belongs to the literature of Christian exhortation rather than to that of philosophy.

ARBORICULTURAL PATHOLOGY.

Tree Wounds and Diseases: Their Prevention and Treatment, with a special chapter on Fruit Trees. By A. D. Webster. Pp. xx+215. (London: Williams and Norgate, 1916.) Price 7*s*. 6*d*. net.

"TREE Wounds and Diseases" is a popular account of the nature and treatment of the ailments and injuries to which trees are liable, and may serve as an introduction to more scientific treatises like Hartig's "Diseases of Trees" and Gillanders's "Forest Entomology." To one branch of the subject, practical tree-surgery, Mr. Webster pays more attention than these authors, who wrote from the sylviculturist's point of view. The forester handling large masses of woodland aims at the retention of only healthy and well-formed trees, from which sound timber will be ultimately harvested, and accordingly removes in his thinning operations all decaying, deformed, and injured trees. The arboriculturist is concerned with the preservation of trees for shade and ornament rather than for future use as timber, and is often called upon to repair decay and ward off impending dangers from historic and ornamental trees in parks and towns. Mr. Webster, as a practical man with considerable experience, discusses in three short chapters such problems as the filling of hollow trunks, the support of heavy branches by iron bands and connecting rods, the guying of limbs to prevent splitting, and the pruning of diseased trees. He cites examples of old and decaying trees to which careful treatment has given a new lease of life, such as the elms in Regent's Park, the chestnuts in Greenwich Park, and the Wilberforce oak in Holwood Park, Kent. His remarks upon the numerous injurious influences to which trees are exposed in towns deserve attention, some of these not being generally known, as the escape of gas, which often causes the sudden and mysterious death of previously healthy trees. Piling earth round the stem, as is sometimes done in street improvements, may also prove fatal.

The chapters dealing with fungus and insect attacks are slight and sketchy, and do not contain sufficient descriptive details to render identification easy, though some of the figures may be helpful in this respect. The chapter enumerating the special enemies of each species of tree is very incomplete, and will be of little value to the forester or park superintendent, who must resort to the larger works already mentioned. This book, however, is useful as directing the attention of landowners and other non-professional readers to the many preventable causes which spoil the appearance and ultimately cause the death of much ornamental timber in Britain.

OUR BOOKSHELF.

Insect Enemies. By C. A. Ealand. Pp. xiii+223. (London: Grant Richards, Ltd., 1916.) Price 6*s*. net.

MR. EALAND has done good service in publishing his book on insect enemies. The work is cast in popular form, which fact may in the eyes of some detract from its merits; but, as the author justly observes, "unless and until those who have no scientific training are told of the activities of insects in language which they can understand, they can hardly be expected to be other than phlegmatic concerning the work of entomologists. The best methods of dealing with these enemies of mankind may be revealed by the comparatively few economic entomologists, but the great work of eradication can, in many cases, only be accomplished by the active co-operation of the general population." In accordance with the views here expressed, the insect pests of forest, orchard, flower and vegetable garden, farm crops, domestic animals, household, and warehouse are briefly but not inadequately dealt with, a final chapter being devoted to insects that are directly injurious to man. The treatment is naturally not exhaustive, and it may be doubted whether the remedial measures proposed are in all cases set forth in sufficient detail to be of much practical service unless the directions for use are supplemented from other sources. An appendix gives useful information as to the preparation of insecticides, though not as to the precise method of employing them. A few errors have escaped the author's notice; "*Trochilium apiformis*" is an awkward collocation, and in Fig. 7 the representations of male and female sawfly are reversed.

Large-scale Map of the Salonika Battle Front. (London: J. W. Bacon and Co., Ltd.) Price 1s. net on paper, 1s. 6d. net on cloth.

THIS map, on a scale of 5 miles to 1 in., shows the country to the north of Salonika as far as lat. 42° 10′ N., and east to Kavalla and west to Monastir. It is layer coloured, and the contour interval is 1000 ft. International boundaries are clearly shown, and a red line indicates the approximate position of the Allies' front. Railways and main roads are shown, as well as swamps. The map is carefully executed and contains plenty of names. No doubt it could be improved by the addition of a 500-ft. contour line, but it is the best cheap war map of this region which has yet appeared.

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.]*

Talbot's Observations on Fused Nitre.

AMONG the little remembered writings of that remarkable man, H. F. Talbot, there is an optical note in which he describes the behaviour of fused nitre (nitrate of potash) as observed under the polarising microscope. The experiments are interesting and easily repeated by anyone who has access to a suitable instrument, by preference one in which the Nicols can be made to revolve together so as to maintain a dark field in the absence of any interposed crystal.

"Put a drop of a solution of nitre on a small plate of glass, and evaporate it to dryness over a spirit-lamp; then invert the glass, and hold it with the salt downwards and in contact with the flame. By this means the nitre may be brought into a state of fusion, and it will spread itself in a thin transparent film over the surface of the glass.

"Removed from the lamp it immediately solidifies, and the film in cooling cracks irregularly. As soon as the glass is cool enough, let it be placed beneath the microscope (the polarisers being crossed, and the field of view consequently dark)."

I have found it better to use several drops spread over a part of the glass. And instead of inverting the plate in order to melt the nitre, I prefer to employ the flame from a mouth blow-pipe, caused to play upon the already heated salt. The blow-pipe may also be used to *clean* the glass in the first instance, after a preliminary heating over the flame to diminish the risk of fracture. Further security is afforded by keeping down the width of the strip, for which half an inch suffices.

Talbot describes how, under the microscope, there appear crystalline plates of irregular shape, often fitted together like a tesselated pavement, each plate forming a single crystal. If one plate is darkened by rotation of the Nicols, the others remain visible in varying degrees of brightness. If the plates are thin, the light is white; but with more salt they display colour, and the colour is not always uniform over the whole plate, indicating a variable thickness. But this condition of things is not permanent. After perhaps a quarter of an hour the plates break up in a surprising fashion, and the general appearance is totally changed.

Moreover, the transformation may be accelerated. "Let a film of fused nitre be obtained in the manner already mentioned, and let it be allowed to cool during three or four minutes. The plate of glass should be turned round upon the stage of the microscope until the crystalline film is darkened as accurately as possible. Things being thus adjusted, let the observer touch the film with the point of a needle while he is observing it in the microscope. He will perceive that the touch immediately produces a luminous spot on the dark surface, and this spot will slowly expand itself in all directions like a luminous wave. This is a very curious object, but difficult to describe." And further on:—"If, however, we touch it prematurely, as, for instance, during the first minute after it has become solid, this change does not take place."

I have made a few trials to ascertain whether the life of the plates can be prolonged. Protection from atmospheric moisture did little good. Another plate, kept for five hours at a temperature not much short of that of boiling water, was found to have undergone transformation. But, as might be expected, a higher temperature over a diminutive gas flame acted as a safeguard, and the plate after removal behaved like one newly formed.

I have found that nitre may be replaced by *chlorate* of potash, with the advantage that the plates will keep (at any rate in an artificially warmed room) for weeks, and perhaps indefinitely. The appearances are similar, but less beautiful, as colour is not so often developed. The chlorate is more fusible than nitre, and the heat should not be pushed beyond what is needed for fusion.

Other salts—for example, silver nitrate—which fuse in the anhydrous state without decomposition may also be employed, as is probably known to those who prepare objects for the microscope. But Talbot's early observations on nitre are rather special, and deserve recall as they seem to be but little known.

RAYLEIGH.

"Plants in Health and Disease."

ON p. 331 of NATURE of December 28, 1916, the writer of the review of the book entitled "Plants in Health and Disease" remarks:—"The accounts of such pests as the cabbage-root fly and the onion fly, which have been very active this year, are particularly clear. We could only wish that the measures whereby these pests are to be combated were half as good." With reference to the cabbage-root fly, I am glad now to be able to report that an efficient measure for dealing with that widespread pest has been tested under my direction during the past season.

Mr. J. T. Wadsworth, research assistant in this department, has conducted a series of experiments with American tarred felt paper discs, and a full account of the work will appear in the next issue of the *Annals of Applied Biology*. The tarred felt discs each measure $2\frac{1}{2}$ in. square, and are provided with a slit which enables them to be slipped round the stems of young cabbages and cauliflowers so soon as the latter are planted out in the field. Each disc is pressed flat upon the surface of the soil round the plant, and no further attention as a rule is needed. Its primary function is to act as a mechanical obstacle, preventing the flies from laying their eggs on the soil in the usual position, close around the plant. Out of 816 cabbages used in these experiments, half of them were provided with the discs, and the remainder left unprotected. Only one plant was lost out of the 408 protected examples, while fifty-four unprotected cabbages were severely attacked. With regard to cauliflowers, the results were even more striking. Altogether 932 of these plants were utilised, and, similarly, half were provided with the discs and the rest left unprotected. From among the protected cauliflowers twenty-four were lost, as compared with 294 plants out of a similar number of unprotected ones. One of the advantages of this method over the more familiar use of paraffin and sand or soot is that a single application is sufficient, whereas the other remedies have to be reviewed periodically.

In addition to Mr. Wadsworth's experiments, I supplied three growers with the American discs, giving full instructions as to their manipulation. One grower at Chorlton (near Manchester), who was supplied with 100 discs, reported that no single case of root-maggot attack was noted where they were used. Another grower, at Prestwich (Cheshire), wrote to say that he had fifty cabbages with the discs on, and only two of them were attacked. Out of the fifty control plants most of them were infested. The third observer (at Nottingham) used 100 discs, and reported that out of eighty-four protected cauliflowers only five were apparently attacked. and none were lost. From among twenty unprotected plants only twelve survived.

It is remarkable that a simple and effective measure should have attracted so little attention in this country or elsewhere in Europe. It appears to have been overlooked that its value has frequently been demonstrated in Canada and the United States. I may add that we hope to be able to have a supply of tarred felt paper discs available for use in this country during the forthcoming spring, when every effort will be needed to conserve the food supply of the nation.

A. D. IMMS.

Department of Agricultural Entomology,
Manchester University.

The Decimal System and Summer Time in France.

THE frequent references to the necessity of introducing the decimal system which one reads in the public Press at present suggest some considerations which an experience of more than two years with the B.E.F. has confirmed. It is surprising with what facility the average soldier becomes accustomed to French money. Everything out here is bought and paid for on the decimal system. The men and officers receive their pay in French money. I have seen bills made out and paid by officers' orderlies which show they are quite at home in the French system. It is, of course, perfectly evident that the time gained in schools and colleges, if we were to replace many confusing weights and measures now in use by the decimal system, would be of great importance. Here in France half a kilo is called a pound; a sou is called a halfpenny. There would be no need for us to change familiar names if we are lucky enough to adopt the decimal system. It may be said that everybody out here has become familiar with decimal money, weights, and lengths, and knows roughly the ratios between them and corresponding British measure. The present opportunity is one which ought not to be missed. The stern teacher—war—has taught us to give up so many of our out-of-date ways that the imposition of the decimal system would soon be an accomplished fact if our rulers would only listen to those who really know.

This naturally suggests some facts connected with the introduction of "summer time." Whatever advantages that measure may have had from the point of view of those living in large towns, and of those whose time is their own (and they are many), it must certainly be confessed that in the case of the farming class in France it has been a complete failure. In fact, it exists only in name. I have spoken with the farmers on the subject, and they all assured me that it was no good to them. The hottest time of the day is about 2.0 p.m. Now, according to the summer-time programme, the greatest heat corresponds to 3.0 p.m. If, then, the farmer dines at noon (which is universal) he must do his afternoon's work during the hottest hours of the day. As a matter of fact, the farmers make no change in their habits. Many of them do not change their clocks, and dine at 1.0 p.m. according to summer time. But see the result. The schools must follow the legal time, the children get home for their dinners an hour before the family has begun to dine, with the result that there is the greatest confusion in a household, especially where the mother has to work in the fields. Again, there is the disadvantage that those occupied with cattle, as in Ireland, have an extra hour of darkness for their most important industry.

The case of Ireland is especially hard. Since the abolition of "Irish time" there is already an extra half-hour of darkness in the mornings; if the clock in Ireland is put back another hour it will mean that in many places the extra darkness in the mornings will be more than an hour and a half. It seems to the writer that the greatest care should be taken before the present system of summer time is made perpetual. It would be much better and much more scientific and more straightforward if the opening hour of all public offices, etc., was advanced an hour, and their time of closing treated in the same way. In conclusion, I may add, as a proof of the confusion which exists in some parts of France, the list of services in the parish church had to be written in two columns, the legal time being in ordinary figures, the summer time in Roman numerals. C. F.

France, January 22.

Meldola Memorial.

A MOVEMENT has recently been initiated to institute, at the Finsbury Technical College, a reference library of chemical books in memory of the late Prof. Raphael Meldola, F.R.S., who formerly presided over this school of applied chemistry.

We beg to bring under your notice this appeal, which has met with generous support from many former students of Prof. Meldola, because we believe that his other friends outside the college circle would welcome the opportunity of helping to make this memorial a fitting tribute to a strenuous life spent in the pursuit of science in many varied aspects.

The proposed chemical library would be of the utmost utility to past and present students of this college, and, in all probability, suitable arrangements could be made to render it available to the scientific public for purposes of special references. It would be situated in a part of London where such facilities are at present non-existent.

Donations towards the memorial fund would be greatly appreciated by the undersigned committee and by all who have at heart the development of applied chemistry, a branch of science which the war has shown to be of national importance.

J. L. BAKER (*Hon. Treasurer*).
J. H. COSTE.
M. O. FORSTER.
H. F. KNIGHT.
G. T. MORGAN.
F. W. STREATFEILD.
C. H. BUTCHER } (*Hon.*
A. W. H. UPTON } *Secretaries*).

Finsbury Technical College, Leonard Street,
City Road, London, E.C.

CHANGES IN THE RHONE GLACIER.[1]

WE are indebted to Swiss naturalists for initiating a careful study of glaciers, and this has been extended, as we learn from the *Zeitschrift für Gletscherkunde*, to many of the most important regions on the earth's surface. In the majority of these their history, prior to the last few years, is a blank. That their glaciers have advanced and retreated is obvious, but when and at what rate is unknown. In the Alps, however, traditions exist which preserve a fairly trustworthy account of the more notable movements for at least two centuries, and the volume now issued by the Swiss Natural History Society, to which M. P. L. Mercanton is the principal contributor, gives, with some mention of these, the results of careful observations of the Rhone Glacier since 1874.

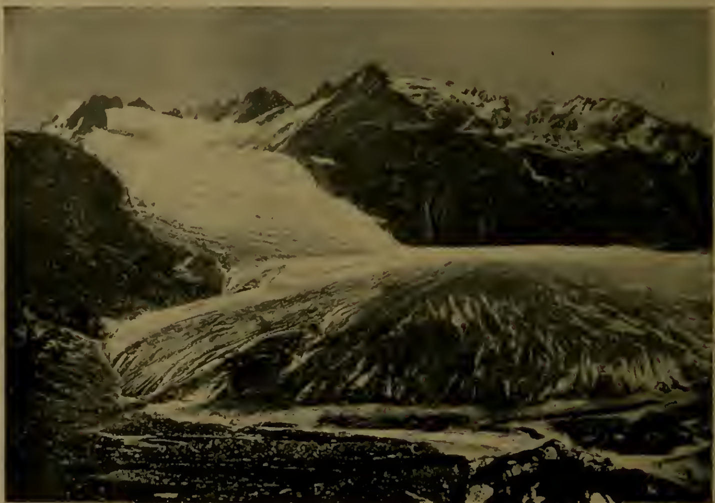

Fig. 1. The Rhone Glacier in August, 1849. From a daguerreotype.

As two well-known passes, the Furka and the Grimsel, command magnificent views of this glacier, it has for long been noticed by travellers, and is represented in illustrations to books before the days of photography, the earliest which has any value dating from 1777. Besson says that the glacier was then advancing, and had four distinct terminal moraines, one at 216 ft., another at 269 ft., a third at 551 ft., and the last at 771 ft. Shepherds told him it had been retreating for twenty years. In September, 1826, there were about four well-marked terminals, besides two or three others less distinct. But it must have advanced rapidly between this date and 1834, for in that year its end was near a newly built auberge, and the swollen aspect of the lower part of the glacier suggests that it was still moving forwards. In 1848 this tongue covered half the Gletsch valley, but there were still four distinct terminal moraines in front of it, which in the next year had been reduced to two.

A more complete record exists, as might be expected, for the two well-known glaciers at Grindelwald, and as they are only about twenty-five miles distant in a straight line from the Rhone Glacier, their phases are likely to correspond. In 1540 these had greatly shrunk, but they made an equally marked advance from 1575 to 1600, and attained, during the next two years, the greatest extension on record. A retreat then began, which became important between 1661 and 1686, but the glaciers advanced again in 1703 and retired in 1720. From 1743 to 1779 was a period of marked advance, which culminated in the latter year, and was followed by a retreat, which, if the shepherds of the district can be trusted, had already set in with the Rhone Glacier. But in 1819 the Grindelwald glaciers had again become large, though they had not reached the limit of 1602. Then came a period of retreat, but between 1840 and 1855 they again moved forward, like the other glaciers of the Alps, though not to their former limit; then, in the latter year, the recession began, which lasted, with slight oscillations, not always in correspondence, until 1912, when both glaciers moved forward. But this retreat was at first very slow, for in 1858 the torrent from the Lower Glacier issued from an ice-cave on the bed of the main valley, and the deep gorge, now made accessible, was wholly hidden by the ice. In that year also the Rhone Glacier had a swollen end, and in the following one the writer saw the Gorner Glacier at Zermatt ploughing up the turf in front. But two or three years later the retreat became rapid, so that by 1870 the gorge and the old marble quarry at Grindelwald had been exposed.

It is difficult to account for these variations in the size of glaciers. The information collected during recent years indicates that, as a rule,

[1] "Vermessungen am Rhonegletscher, 1874–1915." Geleitet und herausgegeben von den Gletscher-Kommission der Schweizerischen Naturforschenden Gesellschaft (Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft). Band lii. Pp. 190 + maps and illustrations. (Bâle, Geneva, and Lyons: Georg and Co., 1916.)

diminution has affected a wide area, and thus suggests a cause operating on a large part, if not the whole, of the earth's surface; while, as the supply basin is limited in valley glaciers, it would require a considerable rise or fall in the mean temperature materially to affect the volume of them, neither of which has been observed. Still, an increased or diminished precipitation of snow on the *névé* of the ice-stream would affect the latter, besides altering the surface ablation of the stream itself. But as the amount of precipitation increases in ascending a mountain range from the lowlands, and then diminishes, much may depend upon the position of the zone on which it is at a maximum. As that zone probably does not exceed, at any rate in the Alps, a thousand feet

FIG. 2.—The Rhone Glacier on August 30, 1912.

vertical, rather small variations in the mean temperature or snowfall of a region may produce somewhat marked effects. The last period of diminution, now more than half a century, seems to bear no relation to either the eleven-year sunspot period or Brückner's thirty-five-year one, and thus suggests a complication of causes. Be that as it may, in this memoir on the Rhone Glacier the variations in its length, area, volume, and level, the snowfall and ablation, the movement of its several parts, and the relation between the velocity of the surface and the thickness of the ice, are all placed on record, so that students of glaciers owe a debt of gratitude to the authors of this volume and the Swiss Natural History Society. T. G. BONNEY.

SOURCES OF NITROGEN COMPOUNDS IN THE UNITED STATES.[1]

THE problem of how to turn the vast store of uncombined nitrogen which exists in the atmosphere into useful products may be said to have been only seriously attacked within the lifetime of the present generation. It had its origin in the growing demand for forms of combined nitrogen suitable for use in the arts, and more particularly in agriculture, the oldest of all the arts. But circumstances arising out of the present world-wide struggle, affecting in greater or less degree every nation, but more particularly those engaged in the war, have forced the problem into still greater prominence by demonstrating how intimately it is bound up with the question of national defence. Indeed, as regards the Central Powers, their very existence is dependent upon it, as they now painfully realise.

Accordingly nearly every highly developed nation is considering it, and its urgency is shown by the circumstance that its solution is no longer left wholly to individual effort or private enterprise. Even our own Government, hitherto not very prompt to initiate action in such matters, has been moved to recognise its national importance, and has got so far as to appoint at least two committees associated with public departments to consider and report upon it.

In this connection it is of interest to note how the question strikes American expert opinion. This is revealed in the publication before us by Dr. C. G. Gilbert, recently issued by the Smithsonian Institution.

As the author points out, in the extension of chemical needs, as in the development of cyaniding in industry, of refrigeration in the preservation of foodstuffs, and more especially in the increased use of fertilisers, nitrogen compounds are now necessary not only to the welfare, but to the very existence of a people living under modern conditions of economic development. Until within a few years past, the yields from India, from Continental sewage-farms, together with the natural supplies from South America, have met the demand for nitrates. Ammoniacal compounds have been produced in rapidly increasing quantities, as by-products, in the various methods of the destructive distillation of coal, peat, and oil-shale; in producer and blast-furnace gas; in bone carbonising, in sewage and garbage disposal, and in a variety of other methods; and the sulphate of ammonia thus obtained bids fair to overtake, if not largely to supplant, Chile saltpetre as a fertiliser. But even these combined sources are now proving inadequate to meet the world's demands, and the increasing necessity has stimulated efforts to effect the synthetic production of ammonia and nitric acid from atmospheric nitrogen.

Of the several methods of accomplishing this synthesis there are at present, so far as is known, only three which are commercially practicable,

[1] "Sources of Nitrogen Compounds in the United States." By Dr. C. G. Gilbert. (Smithsonian Institution, Washington, 1916.)

viz. the arc method, the cyanamide process, and the Haber process. It is with the working and the results of these processes that Dr. Gilbert's report is particularly concerned. In what follows we purpose to summarise, as briefly as possible, the main conclusions to which his critical examination leads him.

The arc method in its present state of efficiency requires from 2·75 to 3 h.p.-year of electric power per ton of nitric acid yield. Having regard to conditions in the United States, the 2·75 h.p. needed for the fixation of the nitrogen in one ton of nitric acid costs in power-expense alone more than 40 dollars per ton of product. Inasmuch as the fertiliser equivalent in Chile saltpetre is already available at about the same price, the arc method is not commercially feasible under present conditions in America. Notwithstanding this, the U.S. Government is said to be contemplating a twenty million dollar project for atmospheric nitrogen fixation as a military measure. If this sum were put into power-site development it would furnish about 150,000 h.p., capable of yielding about 50,000 tons of nitric acid, or only about a quarter of that needed in military emergency. To satisfy Government requirements a power generation of about 600,000 h.p. would be needed, or some 50,000 h.p. more than the total Niagara power development. As a commercial proposition for peace-time working the arc method offers not a single advantage, and is of very doubtful benefit even as a measure of military preparedness.

The cyanamide process yields three main products, viz. cyanamide, ammonia, and nitric acid, the nitric acid being the end product instead of the first, as in the arc method. Up to the nitric acid stage the power consumption is approximately ½ h.p.-year per ton of nitric acid, or about one-sixth to one-fifth of that of the arc method, and the normal peace-time first product is at once applicable to agricultural purposes. A consideration of all the circumstances makes it abundantly evident that the cyanamide process far outweighs in applicability, convenience, and economy the arc method. When all is reckoned it requires only from three-fifths to two-thirds of the total power involved in the arc method manufacture, in addition to the value of a product normally in demand as against one for which there is relatively very little constant requirement.

The Haber process is exclusively worked in Germany. It is a catalytic process involving many technical difficulties which have hitherto prevented its extension even under present exigencies. Its production of ammonium sulphate is said to amount to 200,000 tons a year. Nothing is known as to comparative costs, but inasmuch as the process would seem not to have greatly extended, its permanent position is still open to doubt.

The general conclusions at which Dr. Gilbert arrives are: (1) That the arc method has not thus far demonstrated its capacity to meet agricultural requirements at all, and defence requirements only very imperfectly. (2) Such knowledge as there is of the Haber process seems to show that its record of achievement is against it, and in any case it is unsuited to American conditions, at least in its present stage of development. (3) The cyanamide process is readily capable of a development which at once meets the requirements for a cheapened nitrogenous fertiliser, of which the nitrogen content can be converted into nitric acid. But whatever may be the relative value of these different synthetic processes, and whatever the future may have in store for them, Dr. Gilbert is evidently disposed to believe that it is by the systematic extension of the coking industry, and by the more rational treatment of our coal, so as to increase the yield of by-products, that the main increase in our supply of nitrogenous fertilisers is to be looked for immediately. He calculates that in America a total of about 700,000 tons of sulphate of ammonia would be possible if all coking were of a by-product nature, and he confidently predicts that not far short of this amount will be reached when the ovens now in course of erection in the States are in full working order. In the meantime are we doing all that we can in this direction?

T. E. THORPE.

LITERATURE AND SCIENCE IN EDUCATION.

WHEN Dr. Johnson kept school at Lichfield in 1736 he drew up a "Scheme for the Classes of a Grammar School," which his biographer, Boswell, inserted in the pages of the famous "Life" with the remark that "Johnson well knew the most proper course to be pursued in the instruction of youth." The scheme consisted of Latin accidence, translation, and syntax in the lower classes, with the addition of Greek in the third class. No other subject was mentioned. For a hundred years or more this was broadly the basis of the system adopted throughout English grammar schools, with the addition of a little arithmetic, geography, and history.

Dr. Sleath, High Master of St. Paul's School down to 1847, is reported to have said once to an inquiring parent: "Madam, at St. Paul's we teach only Latin and Greek. We give three half-holidays a week that boys may learn mathematics."

In the early fifties of the nineteenth century a little experimental science crept in almost shamefacedly, introduced by the peripatetic teacher with his box of tricks. But probably the first instance of a systematic teaching of science by resident teachers was at the well-known school at Queenwood, Hants, with Frankland and Tyndall as the masters. This was in 1847, but it was not until twenty years later that this example was followed in other schools. Then Clifton took the lead in 1867, and was followed immediately by the Manchester Grammar School. Since that day matters have improved so substantially that there are few schools of any pretensions which do not possess a good laboratory and competent teachers.

Such facts might seem to justify the question by representatives of the older subjects: "What more do you want, then, and what do you mean by the neglect of science?" The fact is that there has not been, and in some quarters there is not at the present time, that straightforward dealing with the question to which the advocates of more science think they are entitled. The reluctance of the literary people to yield up a fair proportion of the time-table to the modern studies lies at the root of the matter. It is now a question of curriculum, and even in the schools which boast laboratories and appliances the controversy will never end until this barrier is overcome. It is, therefore, particularly gratifying to observe the attitude of the Headmasters' Conference as represented by the resolutions printed in NATURE of January 4 (p. 359). Among the resolutions passed the following is conspicuous:—

(*a*) That it is essential to a boy's general education that he should have some knowledge of the natural laws underlying the phenomena of daily life, and some training in their experimental investigation. (*b*) That, in the opinion of this Conference, this can best be ensured by giving to all boys adequate courses of generalised science work, which would normally be completed for the ordinary boy at the age of sixteen. (*c*) That, after this stage, boys who require it should take up science work of a more specialised type.

Nothing can be better as a statement of a generalised opinion, and we may hope that headmasters will see that it is put into practical effect. There is some ground for belief that this hope will not be in every case disappointed. The address delivered on Tuesday, January 9, by the Rev. J. R. Wynne-Edwards as president of the Inporated Association of Headmasters (see NATURE, January 11, p. 380) does not appear to be the utterance of a man who is toying with the question, and the distribution of hours at the Leeds Grammar School, of which he is headmaster, would doubtless be found more satisfactory than in some other places. There is not great divergence of opinion in respect to fundamental principles, if we except a comparatively few extreme partisans on both sides. But a satisfactory position is not allotted to the natural sciences in those schools in which an engineering or military side composed of specialists has been established, while the majority of the boys in the school—namely, those to be found on the classical side, which includes many of the best—are put off with two hours a week or less in a time-table which covers thirty hours for other subjects. It is not the function of the schools to provide a body of scientific specialists, but every boy and girl in the kingdom should have time and opportunity for the acquisition of some degree of familiarity with the chief methods and conclusions of the observational and experimental sciences. Concentration on special or technical matters should not be encouraged before the age of sixteen or seventeen, and should not be sought in the curriculum of a general education. The testimony of a business man on this point ought to serve to correct the views of many parents, and it is worthy of notice that Mr. W. L. Hichens (chairman of Messrs. Cammell Laird and Co.), in an important paper contributed to the same meeting, expressed the opinion that "specialised education at school was of no practical value."

On the second day of the meeting (January 10) a paper was read by Mr. A. D. Hall, F.R.S., a Development Commissioner and formerly director of the Rothamsted Experimental Station, on "A General Course of Science for the Secondary School." Mr. Hall made no claim for any kind of training directly applicable to industry. He desired to see a broad and liberal treatment of science, and in the outline he proceeded to sketch he included a larger share than is customary of studies in the domain of biology. In doing this he was not afraid of the charge of smattering. It would be interesting indeed to look into the details of his scheme of work, remembering that this is the outcome of the mature experience of a former schoolmaster. Mr. Hall was at one time chief science master in King Edward's School, Birmingham.

A paper by Mr. A. C. Benson, Master of Magdalene College, Cambridge, read before the Royal Society of Arts on December 20 on the subject of "Literature and Science in Education," will be welcomed by all teachers of science and others interested in progress towards the compromise which must be arrived at if peace is to be secured. Mr. Benson is a well-known literary man with full experience as a teacher, having been for twenty years a master at Eton. It is all the more gratifying, therefore, to find the conciliatory spirit, the liberality of view, and the freedom from prejudice which pervade his paper. It is impossible adequately to summarise it, and it should be read especially by headmasters. One point on which he lays emphasis is the importance of securing good and enthusiastic teachers, and this implies the necessity for rendering the teaching profession more attractive than it has been in the past. With regard to subjects he says: "I do not believe in intellectual progress being possible without intellectual interest"—a view which will be generally acceptable to the present generation, even among those who are not old enough to look back to the time when Latin grammar with plenty of cane was looked upon as the one effectual and economical basis of education.

LORD CROMER, O.M., F.R.S.

NOT only those who have worked in Egypt, but all who are interested in that country, will have learned with deep regret of the death of Lord Cromer on Monday last, January 29.

On returning to Egypt in 1883, six years after his first appointment there as a Commissioner of the Debt, Lord Cromer found the country in a state of administrative chaos after the suppression of Arabi's rebellion, while bankruptcy appeared imminent. In the Sudan, troubles were already assuming a threatening aspect, and the dervish revolt was shortly to take place. Under such conditions the most urgent needs were to reorganise the administration of the country, and to re-establish its financial position by developing the great agricultural resources of the Nile Valley and Delta. The provision at the International

Convention at London in 1885 of a million sterling to be devoted to irrigation was the first step towards the regeneration of Egypt, which has since gone on with scarcely a check on the lines which he then laid down. Those first six or seven years were years of rigid economy, when all expenditure had to be strictly curtailed and every source of revenue carefully husbanded, but by 1890 the race against bankruptcy was won, and it became possible to deal more generously with various branches of the Administration.

Lord Cromer was always keenly sympathetic towards education, and year by year as means became more ample the grants for it were increased. Schools for elementary vernacular education and secondary and technical schools were established in constantly increasing numbers throughout the country, while the training of teachers to staff them was likewise taken in hand. In a Mohammedan country the education of the female population always presents especial difficulties, but an ever-increasing number of girls' schools have gradually been established throughout Egypt.

Efficient irrigation of the cultivable land being the prime necessity of Egypt's existence, the first grant which made the restoration of the Delta Barrage practicable was followed by many others, and Lord Cromer supported unceasingly the demands of the irrigation engineers until the present system of dams, barrages, and distributing canals had been, if not completed, at least largely achieved. Closely related to irrigation is the agriculture of the country, and the investigations necessary to improve the principal crops had always his warm support.

"The principal function of Government," said Lord Cromer in his report for the year 1903, "is the prevention of epidemic diseases," and to provide adequately for the sanitation of the country was increasingly his care as resources became greater. Recent visitations of cholera and bubonic plague have shown how much success has been obtained in this direction; while the hospitals and medical schools which now exist have made many forget the appalling conditions which prevailed in that country forty years ago.

The geological survey and the cadastral survey of Egypt, from which developed the recent geodetic work in the Nile Valley, are further instances of the way in which Lord Cromer encouraged the more scientific aspects of work of practical importance.

In Egypt archæology has a vast and important field of activity, and while his own interests were most closely connected with the classical period, Lord Cromer supported all projects for the better conservation of ancient buildings and the investigation of the past history and the ancient civilisation of the country. To his advocacy we owe the systematic study of the Nile Valley in Nubia, which, besides the archæological results, has yielded in the hands of Prof. Elliot Smith such important evidence relating to the Egyptian race.

After his retirement from Egypt his interest in science led him, by becoming president of the Research Defence Society, to aid the opposition to the ignorant outcry against vivisection, since he recognised its importance in furthering the advancement of medicine and surgery. In 1911 he was elected a fellow of the Royal Society as one who had rendered service to science.

Laden with heavy responsibilities of administration, and fully occupied by the many problems which Egypt presented, he still found time to take interest in all new investigations which were being undertaken; his kindly advice and powerful aid were always available to those who were playing their part in the reconstruction of Egypt, and to them he was one on whose support they could always confidently depend. H. G. L.

NOTES.

AMONG the list of honours conferred by the King on officers of the Army, the Royal Army Medical Service has reason to be gratified by the number bestowed upon its members. Sir Alfred Keogh, the Director-General, is promoted to be G.C.B., sharing this distinction with Sir William Robertson. Sir Alfred Keogh was a former Director-General of the Army Medical Service, and subsequent to his retirement became rector of the Imperial College of Science and Technology, but soon after the outbreak of war was recalled to his former post. He found the Royal Army Medical Service confronted with a task of the first magnitude, and its staff numerically wholly inadequate to cope with the work before it. Within a few months he made a new force of it; numbers of the younger medical practitioners were enrolled in its ranks, and senior members of the medical profession—physicians, surgeons, hygienists, and specialists in all branches—were attached to it in a consultative capacity. For two years this virtually new force has worked harmoniously and efficiently. Never before have the wounded been so promptly and so adequately cared for, while the prevention of the numerous diseases which are so liable to follow on war and the train of an army has never been more successfully accomplished.

THE KING has been pleased to confer the Companionship of the Order of the Bath, for services rendered in connection with the war, upon Lieut.-Col. G. H. Barling, vice-chancellor of the University of Birmingham, who is now serving as a consulting surgeon to the British Army in France. The honour of Companionship of the Order of St. Michael and St. George has also been conferred for war services upon Major Bertram Hopkinson, F.R.S., professor of mechanism and applied mechanics, Cambridge University.

WE regret to see in the *Morning Post* of January 30 the announcement of the death, at eighty-two years of age, of Mr. John Tebbutt, of Windsor, New South Wales, where he had an observatory and carried on very valuable astronomical work for many years.

SURGEON-GENL. SIR G. H. MAKINS will deliver the Hunterian oration before the Royal College of Surgeons of England on Wednesday, February 14. The subject will be the influence exerted by the military experience of John Hunter on himself and on the military surgeon of to-day.

IT is announced in the *Times* of January 29 that summer time will be reintroduced in Germany and Austria-Hungary on April 1, and will last until the end of September. Apparently, therefore, the reported rejection of the proposal by a committee of the Prussian Diet, referred to last week (p. 414), was either incorrect or will be disregarded.

WE note with regret that the *Engineer* for January 26 records the death of Mr. James Stirling at the age of eighty-one years. Mr. Stirling was locomotive engineer to the South-Eastern Railway from 1878 to 1898, and introduced many improvements, including the steam reversing gear. He was a member of the Institution of Civil Engineers and also of the Institution of Mechanical Engineers.

THE President of the Board of Agriculture and Fisheries has appointed a committee of representative agriculturists to advise him on questions arising in connection with the increased production of food. The committee is constituted as follows:—The Right Hon. R. E. Prothero (chairman), the Right Hon. Sir Ailwyn E. Fellowes (vice-chairman), the Right Hon. F. D. Acland, the Right Hon. Henry Hobhouse, the Hon. Edward G. Strutt, Sir Sydney Olivier (Board of Agriculture), Mr. W. W. Berry (Development Commissioner), Mr. S. W. Farmer, Mr. F. L. C. Floud (Board of Agriculture), Mr. A. D. Hall (Development Commissioner), Mr. S. Kidner, Mr. T. H. Middleton (Board of Agriculture), Mr. A. Moscrop, Mr. H. Padwick (National Farmers' Union), Mr. R. G. Paterson, Mr. G. G. Rea, Mr. E. Savill, Mr. Leslie Scott, and Prof. W. Somerville. Mr. E. M. Konstam (who has joined the department for the duration of the war) is the secretary of the committee.

ACCORDING to a telegram (*Daily Mail*, January 26) Dr. T. B. Robertson, professor of biochemistry in the University of California, has succeeded in isolating from an extract of the pituitary gland a substance which has the power to influence and regulate the growth of the body. That the secretion of the pituitary gland does take a part in regulating the growth of the body has been known since 1886, when that remarkable growth disturbance which Marie named acromegaly was discovered to be directly related to a diseased condition of the pituitary gland. In 1895 Oliver and Schäfer surprised medical men by isolating from the pituitary gland a substance which has a powerful influence on unstriped muscle fibres and on the walls of blood-vessels. The effects produced by extracts from the pituitary gland are so complex and diverse that it is highly probable it may produce several different substances which act as hormones on the tissues of the body. Hitherto the element which acts as a growth-sensitiser or regulator has not been identified.

A NUMBER of influential persons interested in the development of the resources of the Empire have formed themselves into a committee, of which Sir Starr Jameson is for the present acting as chairman, Mr. Almeric Paget, M.P., as honorary treasurer, and Mr. Wilson Fox as honorary secretary. The committee, which represents every party in the State, has for its ultimate object the appointment of a board to develop the Empire's resources; but in the meantime it has been inquiring into various questions in order to present a *prima facie* case for the consideration of the Government. The committee has the following purposes:—(1) To advocate (*a*) the conservation for the benefit of the Empire of such natural resources as are, or may come, under the ownership or control of the Imperial, Dominion, or Indian Governments; (*b*) the development of selected resources of the Empire under such conditions as will give to the State an adequate share of the proceeds; (*c*) the appointment in due time of a Board for the Conservation and Development of the Resources of the Empire, so that Imperial effort may be concentrated on assets ripe for development for the common good of the Empire. (2) To take such action as may from time to time appear to be desirable in order to disseminate information in regard to the objects of the committee, to arouse and maintain public interest, to enlist public sympathy and support, and to co-operate with other committees and associations having similar objects.

DR. H. R. MILL, director of the British Rainfall Organisation, contributes a special article to the *Times* of January 25 on the rainfall of 1916. Detailed results are given for 131 stations. Last year is shown to have been generally a wet year; the rainfall was far in excess of the average at most stations, and slightly below it at only a few. A map shows the distribution of rainfall, and forestalls the fuller results, from about 5000 stations, which will appear later in "British Rainfall, 1916." A deficiency of rainfall for 1916 is shown in the extreme south-west of Wales and the north-west of Devon and Cornwall, and in two areas in the centre of England, one stretching east and south from the north of Anglesey and the estuary of the Mersey, the other in the south-east of Yorkshire. The area over which the year was relatively dry was much less than in any other of the last twelve years, except perhaps 1912. The excess of rain was most pronounced in the south of England, the centre of Scotland, and the south-west, north-west, and east of Ireland. The wettest part of England was in the district of East Grinstead, where the excess was about 40 per cent. In Scotland the excess of rainfall was 20 per cent. over nearly one-half of the country, while in parts there was an excess of more than 40 per cent. The whole of Ireland was wet; the greatest excess of more than 30 per cent. stretched inland from Dublin Bay. No year since 1903 has been wetter than last year in Scotland and Ireland, while the British Isles as a whole have only been wetter than 1916, during the last fifty years, in 1903, 1882, 1877, and 1872. In London the total measurement for the year was 34·01 in., which is 35 per cent. above the average for fifty years. In 1903, the wettest year on record, the rainfall was 38·10 in., and the only other year since 1858 with as much rain as 1916 was 1878, with 34·08 in.

MR. A. W. CARDINALL, in the January issue of *Man*, describes a collection of stone implements from Ashanti. Most of them are of normal types, but one specimen is peculiar from its remarkable size—14·5 cm. in length, and maximum breadth 5·5 cm. In its coarse flaking it resembles specimens collected by M. Xavier Stainer from the Congo, but in the Ashanti weapon its rounded cutting edge is perfectly distinct, and there is no doubt that this has been produced by grinding.

WE have received the list of seeds of hardy herbaceous plants, trees, and shrubs available for exchange from the Royal Botanic Gardens, Kew, forming Appendix I. of the Kew Bulletin for 1917. We are glad to notice that the list is a full one, and shows that this important side of the work of a botanic garden has been fully maintained during the past year, despite the large number of men who are absent on military duties.

WART disease of potatoes, which has caused such serious loss in the north of England, is difficult to eradicate from a district owing to the length of time the soil may remain infected with the fungus, *Synchytrium endobioticum*, which is its cause. Owing to the thick coats which cover the sporangia no method of killing them has been discovered, so that soil treatment as a remedy is of no practical use. Experiments recently carried out at the pathological laboratory of the Royal Botanic Gardens, Kew, by Mr. A. D. Cotton (see Kew Bulletin, 1916, No. 10) have proved that, in addition to the potato, our common English weeds, *Solanum nigrum* and *S. dulcamara*, can be infected with wart disease, and a few small warts containing the characteristic sporangia of the fungus have been produced on the roots of these two plants. Though these plants may not be active sources of soil infection, it is clear that they should be removed from a wart-disease area.

IN reference to our recent note (NATURE, vol. xcviii., p. 395) as to the replacement of materials in sedimentary rocks by iron pyrites, Mr. C. Carus-Wilson writes that he has described a case from the base of the Cainozoic strata in Bournemouth Bay, where a lignitic vegetable mud in the interstices of a sandstone has been thus changed into a pyritic cement.

A HANDSOME addition has been made to the representation of regional geology by the publication of a colour-printed geological map of Mysore on the scale of 1 in. to 8 miles (approximately 1 : 500,000). The whole of the rocks are assigned to the Archæan era, with the exception of the "sheet laterite" of the north, which is probably in the main of Cainozoic age. The map, compiled under Dr. Smeeth's direction by the Department of Mines and Geology of Mysore, gives a clear and harmonious picture of the great folded masses of crystalline rocks, striking N.N.W. from southern India, until they are concealed by the enormous Cretaceous lava-flows of the Bombay Presidency and Haidrabad. Dr. Smeeth's general description of the country was noticed in NATURE, vol. xcvii., p. 505.

Naturen for October, 1916, contains an appreciative review of the geological work of Prof. Amund Helland, of the University of Christiania, written by Hr. P. A. Oyen in connection with the seventieth birthday of this veteran observer. An attractive portrait accompanies the memoir. The author usefully reminds us that Helland stands as one of the great pioneers in glacial studies, and that before he was thirty years of age he undertook a journey to Greenland in order to satisfy himself of Ramsay's views on the relation of fjords and cirques to ice-action. This notice makes us turn with pleasure to Helland's paper published in the Quarterly Journal of the Geological Society of London in 1877 (vol. xxxiii.), where the origin of cirques in alternations of frost and thaw, combined with the presence of a transporting glacier, is very clearly stated. Hr. Oyen remarks that even the famous discussion on glacial erosion in Stockholm in 1910 added little to what had been put forward many years before by Ramsay, Lorange, and Helland.

THE Weekly Bulletin of the Hawaiian Volcano Observatory is in reality a monthly paper of some twelve pages, and is supplied to the members of the Hawaiian Volcano Research Association. Movements and changes in the Kilauea crater are reported under weekly headings, and, beginning with the bulletin for August, 1916, photographic plates of the surface of the lava-lake of Halemaumau are issued by Mr. T. A. Jaggar, jun., so as to form a continuous record. The importance of such observations lies in the fact that the stages leading up to a disturbance of unusual magnitude cannot be missed, as is commonly the case where active volcanoes attract spasmodic attention. The Hawaiian Observatory may aid in explaining the circular plugs of lava, with radial structure, described as "craterlets" in the Deccan Trap (L. L. Fermor and C. S. Fox, Records Geol. Surv. India, vol. xlvii., p. 81, 1916). These occur in a limited region of the Chhindwara district of the Central Provinces, and are now well illustrated, so that we may hope for their recognition elsewhere as the basal portions of spiracles and lava-bubbles.

THE difficulty in the spelling and transliteration of place-names arises out of the insufficient number of characters for separate sounds which our alphabet contains. This has been partly overcome by geographical authorities in different countries using an alphabet devised for the purpose, but all present difficulties in the way of phonetic representation. In the Memorial volume of the Transcontinental excursion of 1912 of the American Geographical Society, Mr. G. G. Chisholm suggests an international alphabet as a standard of reference. By comparison with this alphabet geographical authorities of different countries might decide the signs to be used for particular sounds in their own alphabet. Mr. Chisholm would like the sounds of this alphabet recorded on gramophone records, a copy of which could be kept by every important geographical society.

IN the *Geographical Review* for December (vol. ii., No. 6) some account is given of the new Museum of the American Indian, the foundation-stone of which was laid in New York in November, 1915. The museum, which will occupy part of the same block as the American Geographical Society, is the outcome of the collections of Mr. George G. Heye, and will contain everything of value to the student of the American Indian, from Fuegia to the Arctic regions. Up to the present all the funds for the furtherance of the work, including many expeditions, publications, and the purchase of collections, have been furnished by Mr. Heye and his mother. Mr. Heye has now turned over all his collections to a board of trustees, of which he has been elected chairman. Mr. Heye retains the directorship. The new building will probably be completed in the spring.

ELECTROSTATIC methods have sometimes been tried with doubtful success for separating minerals of nearly the same specific gravity. Writing in the *Rendiconti del R. Istituto Lombardo* (xlix., 15), Dr. Pietro Riboni now proposes a new arrangement consisting of a horizontal plane conductor at zero potential, and a cylindrical charged conductor fixed above it with its axis parallel to the plane. The conducting particles fly to and fro between the two conductors, becoming alternatively positively and negatively charged, and owing to the curvature of the lines of force which are arcs of circles, coupled with the effects of gravity and possibly elasticity, they gradually make their way outwards. The dielectric particles, on the other hand, tend to travel towards the places where the intensity of the field is greatest, and are found in the centre of the field. Although this method is described mainly with a view to the separation of metallic particles, it might be interesting to try whether it could be used to eliminate coal-dust from shore gatherings of foraminifera.

THE proximity to the field of Italian military operations of portions of the remarkable formation known as the Karst adds interest to a paper in *Scientia* (xx., 8), by Luigi De Marchi, on "The Waters of the Carso" (in Italian, with French translation by Dr. S. Jankelevitch). The tableland between Trieste and Abbazia is simply honeycombed with craters, some no larger than a room, some hundreds of yards in diameter, the hollows of which are cultivated with potatoes, while at Abbazia springs of cold fresh water come welling out from beneath the sea and from rocks on the shore in most of the bathing-places and elsewhere. Some difference of opinion exists as to the condition of the underground waters in such districts, in particular as to the existence of subterranean basins filled with water up to a certain level as distinct from underground rivers, and Dr. De Marchi discusses Grund's views in this connection. There is in southern Italy another Karst region in the arid portions of Puglia, but in this case the fissures are much smaller, and the author here finds conditions under which the bed of water is not much above the sea-level.

MR. A. GRANGER, the chief inspector of weights and measures for Birmingham, has written a pamphlet entitled "Our Weights and Measures" (published by Messrs. Eyre and Spottiswoode, price 6*d*.), suggesting certain modifications of the imperial system of weights and measures with a view to its simplification. He appears to be of opinion that such a radical change as the displacement of our weights and measures by the metric system is not practicable, and his plan is to modify the present system so as to make it as convenient and rational as possible. His proposal involves the introduction of a new pound weight equal to half a kilogram, which for all ordinary purposes means an increase of the present pound by 10 per cent., and a new gallon, also 10 per cent. greater than the present one, practically equivalent to 5 litres, or ½ dekalitre. This would not disturb the plan of the imperial system; for example, the legal definition of the gallon as containing ten imperial pounds of distilled water would still hold good. His idea is ingenious, but it seems probable that if any change is effected in our weights and measures it will be in the direction of adopting the metric system in its entirety, rather than modifying the present imperial units.

THE investigation which M. Guillaume, of the Bureau International des Poids et Mesures, Paris, has been conducting into the changes undergone by steels used as length standards has shown results of interest to engineers and scientific workers (*La Nature*, January 6). Briefly summarised, his conclusions are as follows:—The most important point in connection with the use of steels in the tempered state for the preparation of standards of length is that of the "stabilisation" of the steel. It may be said generally that between 0° and 100° C. the transitory variation in length (like that in glass or in the nickel-steels) is proportional to the square of the temperature. With stoving carried to a high limit of duration, the total variation between 0° and 100° C. is about 5 microns. At ordinary temperatures this variation is only of the order of a small fraction of a micron per metre length. For tempered steels stoved for only a short time, the transitory variation is much greater. To conclude: as regards tempered carbon-steels, the variations of all kinds before stoving are appreciable and rapid, but can be so minimised as to cease to be prejudicial to the use of such steels for industrial end standards.

THE *Times Engineering Supplement* for January 26 is the annual review number, and contains much interesting matter relating to the progress of engineering in 1916. Experience has accumulated during the past year regarding the features of ship-construction which are calculated to enable a ship to remain afloat after torpedo or gunfire attack. Longitudinal subdivision, while practicable in warships at great cost, is impracticable in an ordinary cargo vessel, and it is considered doubtful whether transverse water-tight subdivision would enable a cargo ship to resist torpedo attack. While merchant vessels can be greatly improved to protect them from torpedo attack, considerations of design, economy of construction, and carrying and earning power make it preferable to arm the ship. This is the course which will probably be adopted in the new tonnage now building. In America, owing to the enormous demands on the steel industry, it has been found impossible to keep abreast with the demand for shipbuilding material. This has led to a revival of wooden shipbuilding, and a number of wooden hulls are now being constructed in the Seattle district and at various points on the Pacific Coast.

THE *South African Journal of Science* for October, 1916, contains a report of the address to Section B (Chemistry, Geology, Metallurgy, Mineralogy, and Geography) of the South African Association for the Advancement of Science by the president of the section, Prof. J. A. Wilkinson. The address deals with two general questions: first, the organisation of the South African Union for the fuller development of its industries and resources, and, secondly, the necessity of research in order to develop existing industries and establish new ones. Dealing with the first question, Prof. Wilkinson points out that hitherto South Africa has existed on its raw materials, which are exported whilst articles manufactured from them are imported He gives a long list of imported articles, the most important being coal products, earthenware, glass, cement, condensed milk, paper, sugar products, oils, fats, and waxes, and medicinal preparations which could be manufactured from the natural resources of the colony. Some of these are, in fact, manufactured there, but the quality is not so good as that of the imported articles, and this is stated to be due to the lack of effective chemical control in the industries. It is urged that South Africa is not sufficiently self-contained, and that the necessity of establishing chemical industries with *chemists*, not merely engineers and business men, in control is vital. With regard to the second question, the position of the tannin bark industry of Natal now (tannin was synthesised by E. Fischer and K. Freudenberg in 1913) is compared with that of the natural indigo industry in 1880, when indigo had been synthesised in the laboratory, but the long period of development which made it a commercial success was only beginning. It is argued that had as much time and money been spent on the scientific investigation of natural indigo as were spent on the synthetic dye, the vegetable product would have been placed beyond competition. The lesson afforded by indigo should be applied to the case of tannin. Prof. Wilkinson considers that the prime mover in research must be the State, and submits a comprehensive scheme for its inception and organisation.

OUR ASTRONOMICAL COLUMN.

COMET 1916*b* (WOLF).—The following ephemeris of this comet, for Greenwich midnight, is given by Dr. Berberich in *Astronomische Nachrichten*, No. 4870:—

		R.A.			Decl.		Log Δ	Brightness
		h.	m.	s.	°	′		
Feb. 2	...	17	9	0	−5	1·4	0·4406	10·5
10	...		26	5	4	19·9	0·4182	12·3
18	...	17	43	36	3	27·0	0·3951	14·5
26	...	18	1	31	2	22·1	0·3716	17·0
Mar. 6	...		19	48	−1	5·3	0·3476	20·1
14	...		38	26	+0	23·5	0·3235	23·8
22	...	18	57	22	2	4·0	0·2995	28·1
30	...	19	16	34	+3	55·1	0·2758	33·1

The brightness is expressed in terms of the brightness at the time of discovery, 1916, April 3. It is probable that the comet will become a naked-eye object during the summer.

INVESTIGATIONS OF STAR CLUSTERS.—Further results of an extensive investigation of the magnitudes and colours of stars in clusters, which is in progress at Mt. Wilson, have been given by Dr. Harlow Shapley (Contributions from the Mt. Wilson Solar Observatory, Nos. 115, 116, and 117). The problems presented by clusters are stated in the first paper, while the second and third deal respectively with the globular cluster in Hercules, and the open cluster M37.

In the case of the Hercules cluster, a catalogue of 1300 stars has been prepared, involving more than 10,000 estimates and measurements of magnitude. The colour-indices suggest that there is no appreciable selective scattering of light in space in the direction of the Hercules cluster, but the apparent increase of redness towards the centre would seem to imply an absorption within the cluster itself. There is an almost linear decrease of colour-index with decreasing brightness in all regions of the cluster, and this feature will probably have great significance in regard to the evolution of giant stars. A conclusion of special interest is that the parallax of the Hercules cluster must be less than 0·0001″, and is probably greater than 0·00001″. At the provisionally adopted distance of 100,000 light years, the cluster would be more than 1000 light years in diameter. As viewed from the cluster, our sun would appear fainter than the 22nd magnitude, and our entire galactic system would have an angular diameter of about 5°, perhaps comparing closely in general appearance with the Greater Magellanic Cloud as seen from the earth. It is probable that no star so faint as the sun has yet been photographed in this cluster, and that a large number are more than 200 times the solar brightness. Dr. Shapley considers it reasonably clear that the Hercules and other similar clusters are very distant systems, distinct from our galaxy, and perhaps not greatly unlike it in size and form. The open clusters, on the other hand, seem to be relatively small parts of the local system.

It is interesting to note further that five new variables have been discovered in the Hercules cluster, making a total of seven now known. It is probable that all of them are of the Cepheid type.

THE ALMANAC OF THE MADRID OBSERVATORY.—The issue of this publication for 1917 contains the customary astronomical information, ephemerides, and tables, with the necessary explanatory matter. In addition, there is a useful article on the spectroscopic classification of stars, by Prof. Iniguez, with photographic illustrations, and a very full account of the methods of determining latitude. Details of the meteorological observations and of the observations of sun-spots, faculæ, and solar prominences made at the Madrid Observatory occupy nearly 300 pages of the volume.

SOUND-AREAS OF GREAT EXPLOSIONS.

IT is not often that a great explosion occurs near the centre of a populous area, and the recent disaster in East London thus offers an opportunity of adding to our knowledge on the transmission of sound-waves by the atmosphere. A brief summary may first be given here of the results obtained in recent investigations. The most remarkable result is the recognition of the fact that there exists sometimes, not always, a zone of silence which separates two detached sound-areas. This zone has been traced in twenty recent explosions (excluding that of Friday, January 19), two being due to gun-firing, four to explosions of dynamite or gunpowder, and the remainder to volcanic explosions in Japan.

The source of sound is always unsymmetrically placed within the inner sound-area, and nearly always lies on the side facing the outer sound-area. On this side the boundary of the inner area may be as near as 2½ miles, or as distant as thirty-nine miles, from the source. The most important dimension, however, is the radius, or mean radius, of the curve which forms the outer boundary of the zone of silence. It is far from being constant. It may be as low as fifty miles, as with the minute-guns fired at Spithead on February 1, 1901, or as high as ninety-nine miles, as with the Wiener-Neustadt explosion of 1912.

During the four years 1909–13 eleven explosions of the volcano Asamayama, in central Japan, have given rise to double sound-areas, in most of which the outer area is the larger. The inner area is arranged with a rough approach to symmetry about the ash-precipitation zone. This is usually a long narrow band, the direction of which is determined by that of the higher air-currents into which the smoke-cloud from the volcano rises. The direction of the band is usually towards the east, but varies between north-east and south-east, and it is a significant fact that, as Prof. Omori has pointed out, the centre of the outer sound-area is usually on or close to the continuation westwards of the ash-precipitation zone. Of twenty-two important explosions of the Asamayama from December, 1909, to the end of 1913, Prof. Omori notices that single sound-areas occur just as frequently as double sound-areas. Nine of the former occurred in the six winter months, and ten of the latter in the six summer months. On the theory that the zone of silence is due to the refraction of the sound-rays by winds varying in velocity, and sometimes also in direction, with the altitude, Mr. S. Fujiwhara has shown that, with the normal type of winter weather in Japan, the sound-areas would be single, and with that of summer weather, double.

With regard to the distance to which explosions may be heard, it would be well to separate those in which the sound-areas were single from those in which they were double. Of the first class, the explosion at Avigliana (northern Italy) in 1900 was heard at Lugano, ninety-nine miles distant. The explosion in the same year at Kobe (southern Japan), which probably belongs to this class, was heard at ninety-seven miles. Of explosions with double sound-areas, the distances are ninety miles for the Hayle (Cornwall) explosion of 1904, about 112 miles for the Förde (Westphalia) explosion of 1903 and the Jungfrau railway explosion of 1908, and 186 miles for the great explosion at Wiener Neustadt in 1912.

Though later accounts may modify some of the dimensions given below, a first analysis of the reports already received shows that the explosion in East London on January 19 belongs to the class with double sound-areas. The inner area is of unusual form, being L-shaped, with the angle near Godalming, the east-and-west limb reaching to Canterbury, and the north-and-south limb to the neighbourhood of Northampton. The least distance of the boundary of the inner area from the source of sound is about twelve miles, and the greatest distance sixty-five miles.

The outer sound-area lies to the north of the other, with its centre a few miles west of King's Lynn. Its longer axis (131 miles in length) reaches from the neighbourhood of Nottingham to that of Lowestoft, its width being about fifty-five miles. The zone of silence varies in width from sixteen miles (near Northampton) to fifty-four miles, and the distance of its outer boundary from the source is about sixty miles. So far as is known at present, it includes the greater part of Essex and Suffolk, the southern half of the counties of Cambridge and Huntingdon, and the central portion of Northamptonshire. Even if observations should be received afterwards from this area, it is significant that, from the inner sound-area of about

3500 square miles, I have so far received 250 records in which the time is given, from the outer sound-area of about 5700 square miles 223 records (including 122 from Norfolk and fifty-six from Lincolnshire), and from the zone of silence of about 4500 square miles only one, and that one close to the sea. The greatest distance to which the sound-waves penetrated is about 121 miles.

A remarkable feature about these records is that, though all of them have been sent in reply to my newspaper letters (and therefore sent as it were at random), they are almost as thickly grouped near the boundaries as near the centres of the two areas. There is none of that increasing sparseness of records near the boundary which is so characteristic of earthquake investigations. It would seem as if the boundary were determined, not by the sound-vibrations becoming inaudible, but by the absence of sound-vibrations from the area beyond. It may be of interest to add that, at a large number of places, pheasants showed signs of alarm, as they did during the North Sea battle of January 24, 1915.

May I, in conclusion, state how glad I should be to receive (address: 16 Manor Road, Edgbaston, Birmingham) further accounts of the explosion, and especially *negative* records? Observations on the direction of the surface and upper winds would be of great value. CHARLES DAVISON.

RECENT PAPERS ON PARASITES.

ONE of the most notorious of protozoan parasites at the present time is the microsporidian *Nosema apis*, which, since the well-known researches of Drs. H. B. Fantham and Annie Porter in 1912, has been generally regarded as the cause of "Isle of Wight disease" in hive-bees. In the Proceedings of the Royal Physical Society of Edinburgh (vol. xx., part 1) two papers have lately appeared in which this conclusion is called in question—one by John Anderson, the other by the same author in collaboration with Dr. John Rennie. Stress is laid on the possibility of bees heavily infested with Nosema showing no symptoms of the disease; this condition was recognised by Fantham and Porter, who attributed it to immunity in certain strains, and directed attention to the danger caused to other bees by such "carriers." On the other hand, an epidemic of disease among bees on Deeside with all the characteristic "Isle of Wight" symptoms appeared to be unaccompanied by any trace of Nosema in the affected insects. It may, of course, be retorted that the parasites were present in inconspicuous stages and in relatively small numbers, as Fantham and Porter concluded to be the case in similar instances observed by them. Anderson and Rennie, however, "are unable to recognise any causal relation between the presence of this parasite and the disease," though it "may be a contributing weakening factor favouring in certain cases the development of the disease." It may be doubted if the authors sufficiently recognise the possibly deadly effects, on certain strains of bees, of parasites so few in number as to escape observation.

Students of the Sporozoa will read with more than usual interest Dr. Howard Crawley's paper entitled "The Sexual Evolution of *Sarcocystis muris*" (Proc. Acad. Nat. Sci., Philadelphia, lxviii., part 1), in which the early development of the parasites in the intestinal cells of the mouse is described with numerous figures. The spores swallowed by the mouse reach the hinder-end of the small intestine within an hour and invade the epithelial cells. Some spores then undergo a great enlargement of the nucleus and degeneration of the cytoplasm, while others remain much as when they entered the cell, becoming, however, relatively shorter and broader than the original spores; the author regards the former as male and the latter as female gametes. From six to fifteen hours after penetration chromatin granules separate from the nucleus and are absorbed by the protoplasm; this process is interpreted as maturation. "Finally, in the eighteen-hour stage, macrogametes may be found which in some cases show minute, thread-like bodies upon their surfaces, and in others contain within their substances small, solid chromatic bodies, one in each case. These appearances are regarded as warranting the interpretation that fertilisation takes place." Dr. Crawley's work goes far to establish the existence of a sexual phase in the sarcosporidian life-cycle, but it appears to fall short of demonstration.

In the Proceedings of the U.S. National Museum (vol. l., No. 2131) an important systematic paper on "Nematode Parasites of the Rodentia and Hyracoidea" has been published by Maurice C. Hall. Most of the species described are illustrated by clear structural figures, and there are diagnoses of the various classificatory groups, so that the paper will be of much value to students. In the class-diagnosis of the Nematoda it is rather surprising to find no stress laid on the entirely epithelial nature of the intestinal wall or on the anomalous character of the body-cavity.

Several papers on parasites are to be found in the lately issued third and fourth reports of the director of veterinary research for the South African Union Department of Agriculture (Pretoria, 1916). Sir A. Theiler and W. Robertson describe the life-history of *Trichostrongylus douglasi*, a nematode parasite of the ostrich, somewhat unfortunately called a "wireworm." The four larval stages are carefully distinguished, and it is shown that the young worm can survive and become mature in the bird's stomach only when swallowed in its late second stage. No evidence that the worms ever enter through the skin could be obtained. Dr. F. Veglia contributes an exhaustive paper on "The Anatomy and Life-history of *Haemonchus contortus*," a well-known strongylid parasite of the stomach in ruminants; in this memoir a number of structural and bionomic details are recorded. The photographs and careful drawings illustrating these reports are reproduced in excellent style; it is all the more disappointing to find that for the letterpress of these valuable zoological papers a cheap contract method has apparently been adopted by the South African Government which recalls the worst traditions of our Home Stationery Office.

THE LOUTREUIL FUND.

GRANTS FOR SCIENTIFIC WORK.

IN the *Comptes rendus* of the Paris Academy of Sciences for November 27 is given the report of the council of the Loutreuil Foundation. The grants allotted are divided into three groups, as follows:—

I. ESTABLISHMENTS MENTIONED BY THE TESTATOR.—(1) Museum of Natural History. 2000 francs to Prof. Louis Roule for the continuation of his researches on the migratory fishes of French marine and fresh waters, the Salmonideæ in particular. 10,000 francs for refitting the maritime laboratory of the Island of Tatihou at Saint-Vaast-La-Hougue. This laboratory has been used as a concentration camp since the outbreak of war, and considerable damage has been done. (2) The Collège de France. 700 francs to E. Gley to complete the frigorific installation for which an allocation was made last year. 4350 francs to Prof. Nageotte for the purchase of apparatus for pursuing his studies on the regeneration of nerves. 4000 francs to M. l'Abbé Rousselot for continuing and developing the experiments commenced by him on locating artillery by sound. (3) Conseil Central des Observatoires. 15,000 francs to the Observatory of Paris for the improvement of astronomical instruments applied to the determination of time. 1500 francs to the Observatory of Marseilles for ensuring the publication of the *Journal des Observateurs.* (4) Ecole Nationale Vétérinaire d'Alfort. 7000 francs to this school for the purchase of an apparatus for kinematographic registration and projection; this will be of great service in the study and demonstration of various movements in the normal or pathological state. (5) Ecole Nationale Vétérinaire de Lyon. 850 francs to Charles Porcher for the purchase of instruments to be used in his researches on milk. 800 francs to François Maignon for the purchase of a balance and a small hydraulic press, to be used in his researches on nutrition. (6) Ecole Nationale Vétérinaire de Toulouse. 5000 francs to this school for a radiological installation to be used in the diagnosis of diseases of animals.

II. ESTABLISHMENTS NOMINATED TO THE COMMITTEE BY THE PRESIDENT OF THE ACADEMY.—(1) Conservatoire des Arts et Métiers. 4000 francs to Louis Blaringhem for the creation of a typical collection for the determination and classification of the woods used in the aeronautic industry. 5000 francs conditionally to James Dantzer for the creation of a laboratory for the testing of textiles, fibres, and tissues under the express condition that the Union des Syndicats Patronaux de l'Industrie Textile contributes the same amount. (2) Ecole Nationale Supérieure des Mines. 10,000 francs to this school for completing the laboratory installation, especially as regards motive power. (3) Institut Catholique de Paris. 2000 francs to Henri Colin for the purchase of apparatus not usually found in botanical laboratories, to be used in his researches on the conditions of destruction of various bacilli. 2000 francs to Jules Hamonet for purchasing apparatus for determining the physical constants, particularly refractive indices, of the new substances he has discovered in the glycol group.

III. VARIOUS DIRECT REQUESTS FOR GRANTS.—10,000 francs to Jules Garçon for the preparation of a bibliography of bibliographers, a part to be used in making an inventory of the scientific periodicals contained in the libraries of Paris. 3000 francs to Guillaume Bigourdan for the construction of an angle comparator for measuring the variation which the angular distance of two stars may show in a short interval of time. 3000 francs to Henri Bourget for his researches on astronomical photometry. 2000 francs to A. Colson for continuing his researches on solutions. 7000 francs to Augustin Mesnager for improving the equipment of the laboratory for testing materials under his direction at the Ecole des Ponts et Chaussées. 2000 francs to Jules Glover for continuing his researches on telephony. 7000 francs to Louis Jobin to complete the publication of his studies relating to the material collected in the second Antarctic voyage of Jean Charcot. 5000 francs to the Société de Documentation Paléontologique. 2000 francs to J. M. R. Surcouf for assisting the publication of his work on horse-flies.

The total amount in grants is 115,200 francs.

THE U.S. NATIONAL RESEARCH COUNCIL.

THE December, 1916, issue of the Proceedings of the U.S. National Academy of Sciences contains reports of meetings of the council on November 13 and 14 last, and of the meetings of the Executive Committee of the council held during October and November. At these meetings several committees were appointed to deal with specific questions. Among these may be mentioned that to confer with representatives of the National Canners' Association in the conduct of investigations on toxic elements in canned foods; that to co-operate with the Government Committee on Ocean Surveys and Ice Patrol; that on the utilisation of industrial research facilities for the national defence; that to consider the organisation of research in anthropological and sociological sciences; and general committees (in addition to that on chemistry previously established) on mathematics, astronomy, physics, geology and palæontology, geography, botany, zoology and animal morphology, physiology, medicine, hygiene, agriculture, psychology, and anthropology.

At the meetings of the council in November several members gave addresses, one of which, on scientific research for national defence as illustrated by the problems of aeronautics, was by Lieut.-Col. G. O. Squier, and of this we print an abstract from the Proceedings of the National Academy.

SCIENTIFIC RESEARCH FOR NATIONAL DEFENCE AS ILLUSTRATED BY THE PROBLEMS OF AERONAUTICS.

The following are some present problems connected with the development of military aviation and aerostation.

1. *Aerodynamics.*—(*a*) Continue the development of the mathematical theory to explain the aerodynamic phenomena recorded in the aerodynamical laboratories, and to forecast further results.

(*b*) Obtain solutions for the speed and direction of flow of air about geometric and aerotechnic forms and develop experimental means to visualise or map the speed and direction of flow.

(*c*) Map the currents of the upper atmosphere which may be of most use in aerial navigation, and evolve simple practical rules for the guidance of pilots.

(*d*) Give fuller explanation of the phenomena of soaring, *i.e.* airplaning indefinitely without motive power.

(*e*) Develop equations and laws of comparison by which the behaviour of large aircraft may be more accurately foretold from tests of models. Apply further the principle of dynamical similarity.

(*f*) Investigate more direct and effective methods of securing a lift or thrust in the air from the consumption of fuel.

(*g*) Complete theory of the air-screw.

2. *Engine Problems Requiring Research.*—(*a*) Fuel. Possibly the most far-reaching problem is fuel. A fuel that will carry more power into an engine per unit volume will be a direct gain.

Attempts have been made to combine alcohol, gasolene, acetylene, picric acid, ether, and other hydrocarbons with the above object in view. Questionable results have followed. There has been an increase of power, but nothing so far commercially or practically useful.

This question must be studied with the greatest of care and from a truly research point of view.

(*b*) Solid fuel. Solid fuels that can be converted into liquid in small quantities just prior to use are desirable for military aviation. In case of accident from shot or shock, leakage of liquid fuel is a danger. Solid fuel could be carried in quantity with less danger.

(*c*) Engine cooling. The problem of radiation is important. If some substance could be found that would circulate through the cooling system, at higher temperatures than water, it is probable that greater engine efficiencies would result. Oils, salt waters, and other materials have been tried with indifferent success.

(*d*) Liquid-fuel pipes. Tubing that will resist vibration (causing rupture) is desired. An oil and gasolene proof rubber tubing is reported as used in Europe. This development is highly important, not only for tubing, but for containers in which to carry liquid fuel. Some sort of fabric and rubber tank that would really resist the action of gasolene would be of the highest benefit.

A difficulty lies in the fact that the tanks are large (say 20 to 100 gallon capacity). The structural problems would be serious. The tanks now used are large and of metal. Vibration causes much difficulty and leakage.

(*e*) Metal coating. The protecting of the metal parts of an airplane, especially the fittings and cables, is a serious problem. A material is desired that would really prevent dangerous corrosion. Nickel-plating over copper is very good, but will not suffice. Rust strikes through very rapidly. Baked enamel is the best coating. It is impossible to apply in many cases.

(*f*) Sound. The question of eliminating the noises involved in the operation of aircraft is one of importance. The peculiar note of the propeller of a Zeppelin can be heard for several miles, and is usually the first warning of its approach at night.

3. *Miscellaneous.*—(*a*) Physiological. Study the physiological and psychological effects of low-density air at high altitudes on the performance of pilots.

(*b*) Transparent wing covering for airplanes. A wing covering which would answer the following general requirements would be of great value to military aviation:—

Weight not more than 5 oz. per square yard.

It should present reasonably great resistance to flame.

It should be reasonably proof against action of salt water, moist air, extreme dryness, and quick temperature changes.

It should not stretch in any direction. Its ability to retain its original form as placed on the airplane is very important.

It should have tensile strength of at least 75 lb. per inch width in any direction.

Its tendency to tear and split because of tack holes through it, or because of bullet holes, should be as small as possible.

(*c*) Development of light alloys for airplane construction. Pure aluminium or aluminium alloys. It is believed that a great deal can be done in this direction. So far no alloy has been developed, except possibly in Germany, which can compare with average Alaskan spruce in its "specific tenacity."

(*d*) The structure of gusts. It is believed that this is of sufficient importance to aviation to warrant considerable expense in its study.

Painstaking investigation of the character of eddy formations caused when wind strikes trees, hollows, cliffs, etc., and the character of disturbances created by canyons, swamps, deserts, etc., would be of great value to aviators.

This can be done not only by smoke and toy balloon work in the vicinity of obstructions such as the above, but also by photographic work in wind channels.

A set of simple rules laying down just what the aviator may expect on one side or another of canyons, cities, trees, lakes, and swamps would be very helpful in aviation.

(*e*) Radio-apparatus for aircraft. The subject of radio-intercommunication between aircraft in flight, and between aircraft and the earth, requires for its solution the highest possible efficiency and trustworthiness combined with minimum weight.

A present tendency is to separate entirely the power plant from the main engine of an aircraft. The generator body in this case has a stream-line figure, and a separate small air-screw is provided. Among other methods the oscillion is being tried as the actual source of continuous electromagnetic waves.

(*f*) Bullet-proof gasolene tanks. Development of a material with which to line or construct tanks to contain the gasolene in an airplane in which a bullet hole will quickly close, entirely or at least partly. This would enable many a flyer to get back to his own lines after having been fired upon.

(*g*) Development of a fabric as good as, or better than, Irish linen for the covering of airplanes. There has not been manufactured in the United States a fabric suitable for use in covering airplanes.

The fabric should answer all requirements laid down under *transparent wing covering*, and be, in addition, such as to shrink the proper amount without harm when cellulose solution is applied.

It is possible that long-fibre cotton might be developed that would answer the purpose.

We must become independent in all lines affecting our military aviation. To-day we depend entirely upon Ireland and England for our linen, and the supply is becoming very low in the United States.

(*h*) Aviator's clothing. Much has still to be done in devising non-inflammable and protective clothing for aviators. This question is intimately connected with personal armour and safety in case of fall.

(*i*) Ground-speed indicator. An instrument which would measure the actual speed of an aircraft over the ground would be useful in the operation of military machines.

4. *Physics of the Air.*—A number of physical properties of air, important in the problems of aviation, were also discussed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—Miss Helen Caddick has presented to the University a valuable collection of examples of the art of primitive peoples. The collection, which has been made by Miss Caddick in numerous travels, includes specimens from Central Africa, Tonga and Fiji Islands, New Zealand, and Peru. It is hoped that the gift may form the nucleus of an ethnological museum for the University.

London.—At a meeting of the Senate held on January 24, the Vice-Chancellor (Sir Alfred Pearce Gould) being in the chair, Mr. J. J. Guest, of Trinity College, Cambridge, was appointed as from February 12 next to the University readership in graphics and structural engineering tenable at University College, in succession to Dr. W. H. Eccles, reader in graphics, who has been appointed professor of applied physics and electrical engineering at Finsbury Technical College.

The following doctorates have been conferred by the Senate:—*In Chemistry*: Mr. Guy Barr, an external student, for a thesis entitled "Researches in Relation to the Tensile Strength of Fabric, and the Effects of Experimental Variations on the Result of Tensile Tests," and other papers. *In Botany*: Mr. R. C. McLean, an external student, for a thesis entitled "Studies in the Ecology of Tropical Rain Forests," and other papers.

Oxford.—On January 30 the preamble of the Statute creating the status of "advanced student" and prescribing the conditions on which advanced students may obtain certain degrees came before Congregation. An able speech in favour of the Statute was delivered by the Rev. E. M. Walker (Queen's), who was supported by Prof. Perkin, Waynflete professor of chemistry, and as to the principle of the Statute by Mr. S. Ball (St. John's), Dr. Macan, Master of University College, and Dr. F. C. Schiller (Corpus). The last three speakers argued in favour of the degree of doctor of philosophy being offered under the Statute, instead of that of D.Sc. or D.Litt. as was at present contemplated. Notice was given of an amendment to be proposed in this sense. The only speaker in opposition was Prof. J. E. Holland (All Souls), who thought that council should have proceeded by resolution rather than by Statute. On a division the preamble was carried by 69 to 7.

The King has consented to open the School of Oriental Studies, London Institution, on Friday morning, February 23.

Dr. C. E. Moss, Botany School, Cambridge, has been appointed professor of botany in the South African School of Mines and Technology, Johannesburg.

At the request of Mr. Fisher, Prof. Gilbert Murray, professor of Greek, Oxford University, is undertaking temporary work at the Board of Education, taking the place of Mr. H. F. Heath, C.B., now Secretary of the Department of Scientific and Industrial Research. Mr. Heath was head of the Universities Branch of the Board, and also Director of Special Inquiries and Reports.

One of the sections of the report to the Prime Minister of the Speaker's conference on electoral reform, which was issued on Tuesday, deals with university representation. The following recommendations are made:—(a) The Universities of Oxford and Cambridge shall continue to return two members each; the electorate shall be widened, and, in order to secure a proper representation of minorities, each voter shall be allowed to vote for one candidate only. (b) The Universities of Durham, Manchester, Birmingham, Liverpool, Leeds, Sheffield, Bristol, and the University of Wales shall receive representation; these universities shall be grouped with the University of London so as to form a single constituency returning three members elected on the system of a single transferable vote. (c) The combined Universities of Edinburgh and St. Andrews and of Glasgow and Aberdeen shall also be grouped so as to form a single constituency returning three members under the system of a single transferable vote. (d) As regards all universities, the obtaining of a degree shall be the basis for electoral qualification.

The following resolutions were passed at the annual meeting of the Association of Science Teachers, held at the University of London on January 6:—(1) That the science teaching in the schools should aim at developing in the pupils (a) the power to observe accurately, to reason logically from observed facts, to frame hypotheses and to test these hypotheses by means of their own experiments; (b) a spirit of interest and inquiry with regard to the world around them and the universe at large, an interest in the growth of knowledge in the past, and an appreciation of some of the wider problems with which science deals at present and which influence modern thought and modern activities. (2) That in order to accomplish the first of these aims a thorough course of experimental work in the laboratory is absolutely necessary, that such a course should be continuous, or nearly so, from the ages of twelve to sixteen, and that in this course the pupils should, so far as possible, be encouraged to attack problems for themselves. (3) That as such a course by itself would necessarily cover a very narrow field, the work should be supplemented by teaching or by activities on the part of the pupils themselves, designed to bring them into contact with the wider issues indicated in (1. b). (4) That if science is to play its due part in the curriculum as indicated in the foregoing resolutions lessons encouraging the children to observe the phenomena of Nature should be given from the earliest ages, while between the ages of twelve and sixteen not less than an average of one-seventh of the teaching hours of the school should be given to science.

SOCIETIES AND ACADEMIES.

London.

Geological Society, January 10.—Dr. A. Harker, president, in the chair.—H. A. **Baker**: The Palæozoic platform beneath the London Basin and adjoining areas, and the disposition of the Mesozoic strata upon it. With an appendix by Dr. A. M. Davies. The author carries on the work of tracing the contours of the Palæozoic platform of S.E. England. By comparing these with the contours of the base of the Gault, the probable boundaries of the areas of the platform that were only submerged finally under the Gault sea are determined. The effects of post-Cretaceous tilting and warping are analysed. The successive Mesozoic overlaps on the platform, their probable areas, and the tectonics of the platform are discussed. Evidence is given for a second Charnian axis, proceeding south-eastwards through Norfolk and Suffolk, east of Kent, to the North of France.—Dr. C. **Lapworth**: Balston Expedition to Peru: report on graptolites collected by Capt. J. A. Douglas, R.E. The graptolites were collected from the rocks of the Inambari district. The specimens are recorded as all occurring in the same locality, but it is not known whether they were obtained from a single zone. The lithology of the containing rocks and the mode of preservation of the graptolites are similar to those obtaining in the richest of graptolite-bearing strata of Britain, Europe, and North America. Taken as a whole, this graptolite fauna may best be compared with that of the Upper Arenig formation of Britain and its North American equivalents. The assemblage of graptolites discovered in Bolivia a few years ago by Dr. J. W. Evans corresponds closely with this Peruvian fauna, and was probably derived from the southward continuation of the same Andean graptolite-band. The Douglas collection of Peruvian graptolites greatly strengthens the inference that in Arenig-Llandeilo times there was open-sea communication admitting of the circulation of sea-currents along some as yet undetermined line or lines, connecting these widely separated regions, which must have extended across the equator and apparently throughout a length nearly equal to that of half the circumference of the globe.

Linnean Society, January 18.—Sir David Prain, president, in the chair.—Prof. F. O. **Bower**: The morphology of the sorus of ferns. The isolated sporangium (monangial sorus of Prantl) is frequent among primitive Filicales. The distal or marginal position of the sorus is prevalent in primitive types. The transition from a marginal to a superficial position has frequently occurred. Interpolation of sporangia has led to increased complexity of the sorus. In simple, gradate, and mixed sori thus constituted the receptacle varies: it is not a stable entity, but a result of elaboration of the vein-ending on which the sporangia are seated. Superficial extension of sori occurs. Duplication of sori also occurs. Fusion of sori occurs progressively in various phyla. The fusion-sorus may disintegrate, but not necessarily along the original lines of fusion. The identity of the sorus may be lost by acrostichoid development, which has occurred along numerous lines of phyletic advance. The more complex sori of ferns, as they are now seen, are referable along such lines of comparison to marginal or distal monangial sori. Such a position of isolated or few sporangia is found to prevail in plants of the Lower Devonian period. The marginal placentation of seed-plants is probably more than a mere analogy.

Aristotelian Society, January 22.—Dr. H. Wildon Carr, president, in the chair.—C. E. M. **Joad**: Monism in the light of recent developments in philosophy. A monistic theory confuses two distinct propositions. A thing is what it is, not only because it has a place in the universe, and because of its relations to other things, but also because those relations are not the thing. To assert that a thing is its relations involves a second and quite different proposition. A thing indeed presupposes reality and its connections with it, just as our apprehension of a truth presupposes reality. But when we assert that a thing is what it is because of its connections with reality, we do not mean that the thing is its connections. They condition it, but it is separate from them. The other main monistic argument is to the effect that the ultimate Real being one and indivisible, all analysis by means of which we arrive at a world composed of things and relations is a false abstraction of thought, which leads us away from Reality. It is true that a whole, although created by its parts, is more than their sum. A whole, as opposed to an aggregate, is a unity—a new entity which has come into being by their synthesis. But such a whole clearly has parts which it cannot be a fiction to distinguish from one another. The fact that analysis of a whole into parts destroys the whole does not mean that it also destroys the parts, or that the parts are not really its parts, or that they cannot exist as distinguished from one another.

PARIS.

Academy of Sciences, January 2.—M. C. Jordan (later M. A. d'Arsonval) in the chair.—G. **Bigourdan**: The principle of a new zenithal telescope.—Ch. **Depéret** and L. **Gentil**: An upper Miocene marine fauna in the R'arb, western Morocco.—C. **Guichard**: The K networks of general quadrics.—W. **Kilian** and J. **Révil**: The Pleistocene formations and the morphology of the Arc valley, Savoy.—G. **Julia**: The reduction of binary forms with real coefficients of any degree whatever.—G. H. **Hardy** and S. **Ramanujan**: An asymptotic formula for the number of partitions of n.—E. **Belot**: The theory of spiral nebulæ and the true sense of their rotation.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1916. Observations were possible on eighty-nine days, and the results are given in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—C. K. **Reiman**: The absolute density of hydrobromic acid. The gas was prepared by three independent methods, the final purification being by liquefaction and fractional distillation in a vacuum. The mean of thirty-one determinations is 3·6442 grams per litre.—P. **Gaubert**: The indices of refraction of the rhombohedral carbonates. Figures are given for gioberite, siderite, dialogite, smithsonite, dolomite, ankerite, and mesitite. The value of the indices of refraction of various dolomites, ankerites, etc., agrees with that obtained by calculation on applying the laws governing the relations between the indices of an isomorphous mixture and those of its components, but the agreement is only approximate.—V. **Commont**: The Pre-Quaternary Somme-Oise.—E. **Harlé** and J. **Harlé**: The maritime dunes of the coast of Gascony.—A. **Nodon**: Observations of the atmospheric disturbances during the months of October and November, 1916. Confirming earlier researches, there is found to be a close relation between the solar perturbations, electromagnetic disturbances, and disturbances of the terrestrial atmosphere.—Ph. **Flajolet**: Disturbances of the magnetic declination at Lyons (Saint-Genis-Laval) during the third quarter of 1916.—P. de **Beauchamp**: New researches on sexuality in Dinophilus.—L. **Lindet**: Waste in alcoholic fermentation.—F. **Garrigou**: Special examination of urines for the rapid and correct choice of a thermal station.—O. **Laurent**: The realisation of siamoisism in animals. Experiments on grafting together two different animals.—P. Lecomte du **Noüy**: The relative *rôle* of surface and perimeter in the phenomenon of cicatrisation of wounds at the surface and the formula which interprets them.

January 8.—M. A. d'Arsonval in the chair.—The president announced the death of Prof. Chauveau, in his ninetieth year.—M. **Hamy**: The approximate value of a definite integral. P. **Appell**: An extension of the equations of the theory of vortices and of the equations of Weber.—M. de **Sparre**: Calculation of the hammer in a water-main formed of two sections of different diameters.—M. **Depage**: The secondary transformation of open into closed fractures. A detailed description of a new application of Carrel's method for irrigating fractures.—W. H. **Young**: A new set of conditions for the convergence of Fourier's series.—M. **Petrovitch**: The limit of extensibility of an arc of certain curves. The curves, the deformation of which is examined, are such that on going from one extremity to the other none of the x co-ordinates changes the sense of its variation, each of them increasing or decreasing along the arc.—M. **Souslin**: A definition of measurable B ensembles without transfinite numbers.—N. **Lusin**: The classification of M. Baire. Some consequences of the results of M. Souslin in the preceding paper.—L. **Hartmann**: The systematic variation of the value of the kinetic energy in the elastic rebound of bodies. According to experiment, in the elastic shock of bodies the sum $mV^2+m'V'^2$ is not constant and independent of V and V', contrary to the proposition of Leibnitz.—J. **Olive**: The mechanical trace of the ballistic hodograph.—E. **Esclangon**: The reflection and refraction of isolated waves at the surface of separation of two fluids in repose or in motion.—A. **Pereira-Forjaz**: Spectrographic studies of Portuguese minerals of uranium and zirconium. Results are given for chalcolites from Sabugal and Nellas, autunite from Nellas, and zircon from Alter Pedroso. Radium was present in the chalcolites.—P. **Fallot**: The geology of the island of Ibiza.—F. **Grandjean**: The orientation of anisotropic liquids on the cleavages of the crystals. An account of the examination of anisaldazine, p-azoxyanisol, and p-azoxyanisolphenetol. It is concluded that the property of orientation of an anisotropic liquid on a determined cleavage is not a reticular property.—J. **Deprat**: The geological exploration of the part of Yun-nan comprised between the Tonkin frontier, the Kwang-si, and the Kwei-tcheou.—Ph. **Glangeaud**: The substratum of the volcanic massif of Mont Dore.—E. **Belot**: Provisional trace of the curve described by the magnetic north pole since 1541.—Mlle. Y. **Dehorne**: A new Stromatopore from the Lusitanian of Cezimbra (Portugal).—P. **Lesage**: The germination of the seeds of *Lepidium sativum* in solutions of electrolytes.—C. **Galaine** and C. **Houlbert**: A new arrangement for the rapid filtration of potable waters after their purification by the Lambert-Laurent process. After treatment with potassium permanganate, the removal of the precipitated oxide of manganese presents practical difficulties. It is proposed to modify the apparatus so that the purification and filtration take place in the same vessel, without transference and possible re-contamination.—F. **Dienert** and G. **Mathieu**: Search for typhoid and paratyphoid bacilli.

BOOKS RECEIVED.

Recherches sur les Mouvements Propres des Etoiles dans la Zone Photographique de Helsingfors. By R. Furuhjelm. Pp. 190. (Helsingfors: Société de Littérature Finnoise.)

Compressed Air Practice in Mining. By D. Penman. Pp. vii+221. (London: C. Griffin and Co., Ltd.) 5*s*. net.

A Handbook of Briquetting. By Prof. G. Franke. Translated by F. C. A. H. Lantsberry. Vol. i. Pp. xxviii+631. (London: C. Griffin and Co., Ltd.) 30s. net.

Diderot's Early Philosophical Works. Translated and edited by M. Jourdain. Pp. v+246. (Chicago and London: The Open Court Publishing Co.) 4s. 6d. net.

The Geometrical Lectures of Isaac Barrow. Translated, with Notes and Proofs, by J. M. Child. Pp. xiv+218. (Chicago and London: The Open Court Publishing Co.) 4s. 6d. net.

New Essays concerning Human Understanding. By G. W. Leibniz. Together with an Appendix consisting of some of his Shorter Pieces. Translated by A. G. Langley. Second edition. Pp. xix+861. (Chicago and London: The Open Court Publishing Co.) 12s. net.

Contributions from the Jefferson Physical Laboratory and from the Cruft High-Tension Electrical Laboratory of Harvard University for the Year 1915. Vol. xii. (Cambridge, Mass.)

Chemical Discovery and Invention in the Twentieth Century. By Sir W. A. Tilden. Pp. xvi+487. (London: G. Routledge and Sons, Ltd.) 7s. 6d. net.

Le Traitement des Plaies Infectées. By A. Carrel and G. Dehelly. Pp. 177. (Paris: Masson et Cie.) 4 francs.

Les Dysenteries, le Choléra Asiatique, le Typhus exanthématique. By H. Vincent and L. Muratet. Pp. 184. (Paris: Masson et Cie.) 4 francs.

Registration of Business Names. By H. W. Jordan. Pp. 32. (London: Jordan and Sons, Ltd.) 6d. net.

Elementary Dynamics of the Particle and Rigid Body. By Prof R. J. Barnard. Pp. vii+374. (London: Macmillan and Co., Ltd.) 6s.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 1.

ROYAL SOCIETY, at 4.30.—An Application of the Theory of Probabilities to the Study of *a priori* Pathometry. Part II.: Sir Ronald Ross and Miss H. P. Hudson.—An Investigation into the Periodicity of Measles Epidemics in London from 1703 to the present day by the Method of the Periodogram: Dr. J. Brownlee.—The Causes responsible for the Developmental Progress of the Mammary Glands in the Rabbit during the Latter Part of Pregnancy: Capt. J. Hammond.—The Post-œstrous Changes occurring in the Generative Organs and Mammary Glands of the Non-pregnant Dog: F. H. A. Marshall and E. T. Halnan.

ROYAL INSTITUTION, at 3.—The Mechanism of Chemical Change: Prof. F. G. Donnan.

CHEMICAL SOCIETY, at 8.—Chromium Phosphate: A. F. Joseph and W. N. Rae.—The Detection of Traces of Mercury Salts in Toxicological Work: K. C. Browning.—"Stepped" Ignition: R. V. Wheeler.—The Catalytic Bleaching of Oils, Fats, and Waxes: H. Rai.—Alkaloidal Derivatives of Mercuric Nitrite: P. C. Rây.—Synthesis of a Derivative of the Lowermost Homologue of Thiophene: P. C. Rây and M. L. Dey.—The Detergent Action of Soap: S. U. Pickering.—The Occlusion of Iron by the Phospho-molybdate Precipitate: F. H. Archibald and H. B. Keegan.

MATHEMATICAL SOCIETY, at 5.30.

LINNEAN SOCIETY, at 5.—Some Plants that might occur in Britain: C. E. Salmon.—Recent Exploration of the Abrolhos Islands: Prof. W. A. Herdman.—*Mentha exigua*, Mill: J. Britten.—The Structure of the Leaves of Hybrid Orchids: J. Charlesworth and J. Ramsbottom.

FRIDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 5.30.—Recent Physiology and the War: Prof. C. S. Sherrington.

SATURDAY, FEBRUARY 3.

GEOLOGISTS' ASSOCIATION, at 3.—President's address: The Study of the Archæan Rocks, with Special Reference to Scotland: G. Barrow.

MONDAY, FEBRUARY 5.

ROYAL SOCIETY OF ARTS, at 4.30.—Town Planning and Civic Architecture: Prof. A. Beresford Pite.

ARISTOTELIAN SOCIETY, at 8.—Valuation and Existence: F. C. Bartlett.

VICTORIA INSTITUTE, at 4.30.—Islam and Animism: Rev. Dr. S. M. Zwemer.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Thirty Years' Work of the Royal Geographical Society: Dr. J. Scott Keltie.

TUESDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 3.—The Old Brain and the New Brain, and their Meaning: Prof. C. S. Sherrington.

ZOOLOGICAL SOCIETY, at 5.30.—Structure and Functions of the Mouth-parts of the Palæmonid Prawns: L. A. Borradaile.—Scolex in the Cestode Genus Duthiersia, and on the Species of that Genus: Dr. F. E. Beddard.—Report on the Deaths which occurred in the Zoological Gardens during 1916: Prof. H. G. Plimmer.

RÖNTGEN SOCIETY, at 8.15.—Some Properties and Applications of Selenium: Dr. E. E. Fournier d'Albe.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The Main Drainage System of London: G. W. Humphreys.

WEDNESDAY, FEBRUARY 7.

ROYAL SOCIETY OF ARTS, at 4.30.—The Future of British Spas: Dr. R. F. Fox.

GEOLOGICAL SOCIETY, at 5.30.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Quantitative Estimation of Mercury in Organic Compounds: J. E. Marsh and O. G. Lye.—The Shrewsbury and Knapp Process for the Detection of Coconut Oil: G. D. Elsdon.—The Detection of Rose Petals in Blue Pill: W. Partridge.

THURSDAY, FEBRUARY 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Dynamics of Revolving Fluid: Lord Rayleigh.—Deflection of the Vertical by Tidal Loading of the Earth's Surface: Prof. H. Lamb.—Spontaneous Generation of Heat in Recently Hardened Steel: C. F. Brush and Sir R. Hadfield.

ROYAL INSTITUTION, at 3.—The Mechanism of Chemical Change: Prof. F. G. Donnan.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Frequency Changers: R. Townend.

OPTICAL SOCIETY, at 7.30.—Annual Meeting.—More Notes on Glass Grinding and Polishing: J. W. French.

FRIDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 5.30.—Experimental Phonetics and its Utility to the Linguist: D. Jones.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

MALACOLOGICAL SOCIETY, at 7.—Annual Meeting. Presidential Address: Systematic List of the Marginellidæ: J. R. le B. Tomlin.

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NATURE

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

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THURSDAY, FEBRUARY 8, 1917.

SEA-TROUT.

The Sea-Trout: a Study in Natural History. By H. Lamond. Pp. xi+219. (London and Manchester: Sherratt and Hughes, 1916.) Price 21s. net.

IN a handsome and well-illustrated volume Mr. Lamond gives us the results of his studies on the life-history and habits of the sea-trout of Loch Lomond and the Clyde estuary—a subject on which he writes with first-hand knowledge.

Most authorities are agreed that our migratory and non-migratory trout are the same species, and it is interesting to find that this view is confirmed by Mr. Lamond's observations. He writes that in the spring it is a practical impossibility to distinguish young trout two or three years old from sea-trout parr of equal age, and that in the later months sea-trout that have been in the loch for a few weeks and have lost their silvery sheen approximate in appearance so closely to the native non-migratory trout that it is difficult to distinguish between them.

According to Mr. Lamond, non-migratory Loch Lomond trout may descend to the Clyde estuary and even return with sea-lice—from which one might infer that a trout is only migratory and a sea-trout when it actually reaches the sea; but later we are told that the sea-trout is essentially an estuarine fish, and may be found at all stages in the Clyde estuary. In fact, in structure, appearance, or in habits there does not seem to be any real distinction between trout and sea-trout.

The salmon, of course, is quite another species, and in the eastern Atlantic, where salmon and trout occur together, they differ both in structure and in habits. The salmon goes farther out to sea, grows faster, and attains a larger size than the trout; it does not form non-migratory colonies except in lakes such as Wenern and Ladoga, which are sufficiently large to excuse it for thinking it has reached the sea; it spends at least one winter in the sea before returning to its parent river, whereas a large proportion of the sea-trout return as "whitling," after only a few months in the sea, to spend the winter in fresh water; finally, the salmon breeds only once or twice, rarely more often, in its life, whereas trout are annual spawners.

Mr. Lamond rightly insists that legislation must be based upon reason and a full understanding of the life-history and habits of the species, and he raises the question whether the fishery laws dealing with salmon and trout are not in need of revision. Legally, it appears, a sea-trout is a salmon, and a trout is something quite different.

When dealing with subjects outside his own particular province, the natural history of the trout of the Clyde area, Mr. Lamond's grip is less firm. For example, he mixes up two perfectly distinct questions: (1) Whether it is worth while to recognise the trout of our eastern and western coasts as separate races on account of certain slight and inconstant differences between them; and (2) whether the "bull trout" of the Tweed, Coquet, etc., is merely a large sea-trout or a distinct species. He thinks the bull trout will prove to be a separate species, but his grounds for this belief are quite insufficient, being mainly that growth is more rapid than is usual in sea-trout.

A curious slip is the description of the axillary process of the pelvic fin as "a little rudimentary or, it may be, an aborted fin." But mistakes of this kind do not lessen the merit of the book, which contains a lot of information about a species that has not been sufficiently studied, and is a work of considerable interest and of real value.

C. T. R.

PHOTOGRAPHIC RECORDING.

The Camera as Historian: a Handbook to Photographic Record Work for those who use a Camera and for Survey or Record Societies. By H. D. Gower, L. Stanley Jast, and W. W. Topley. Pp. xv+259. (London: Sampson Low, Marston and Co., Ltd., 1916.) Price 6s. net.

MUCH may be said in favour of the opinion that there is no more desirable work to which photography can be applied than that which is generally understood by the terms "photographic record" or "photographic survey" work. And yet, so far as we are aware, the authors of this volume are correct in stating that this is the first attempt to produce a manual on the subject. The authors are well fitted for the task that they have undertaken, having had considerable experience as officers of the Photographic Survey and Record of Surrey, and two of them in connection with public libraries. In a quite true sense every photograph is a record, and although a very large proportion of the photographs taken have only a trivial, temporary, or it may be a purely personal interest, others are of the greatest value, and will increase in value as time passes and the objects represented change or disappear. But the practical value of such photographs is exceedingly small, or even nothing, so long as they remain hidden away in private collections or lumber-rooms. The duty of record societies is to systematise the work so that it may proceed along definite lines, and to classify, arrange, and index the photographs. They then become available for reference like books in a public library. It is not only the archæologist and historian who are interested in such collections, but questions that relate to ancient lights, rights of way, etc., may sometimes, by reference to them, be answered with a certainty that will obviate disputes and expensive litigation.

The value of photography for such work as compared with hand-drawn records scarcely needs emphasis, but an excellent example that ought to convince the most sceptical is given by the authors in reproductions of a photograph and an architect's drawing of a wrought-iron lock in Beddington Manor House. Both were made for the purpose of record; the differences are surprising, and the superiority of the photograph is obvious at a glance, and still more so on a detailed examination.

Those who have not considered the matter would be surprised at the variety of subjects that are dealt with. The following is a table of the "main classes" given, each of which is to be interpreted very broadly:—Topography, art, literature, geology, palæontology, zoology, botany, horticulture and agriculture, architecture, antiquities, meteorology, passing events; and space is left for other classes.

Although the work is as yet only in its early stages, about fifty thousand photographs have been deposited and catalogued for reference in various public libraries and museums. The authors give as complete details as they have been able to obtain of the extent of the work which has already been done and is now going forward, with the methods adopted in various places for classifying and storing the records, and many valuable suggestions as to ways of popularising the work (for so far it has been done almost entirely by amateurs as a labour of love). They treat also of those little differences in manipulation that add much to the value of the record and little, if anything, to the trouble of making it, such as the indication of the scale of the photograph, the time of day, etc.

We recommend a study of the volume not only to those who are already interested in record work, but to photographers in general, whether professional or amateur. C. J.

OUR BOOKSHELF.

Fertilizers. By the late Prof. E. B. Voorhees. Revised edition by Prof. J. H. Voorhees. Pp. xv+365. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 6*s.* 6*d.* net.

THE first edition of this book was issued in 1898; since then it has been reprinted no fewer than sixteen times, and now it is revised by Prof. J. H. Voorhees and re-issued. The second edition is rather larger than the first, but not much, the subject-matter having been left very much as it was before, with a few additions to bring the book up to date. Thus, some illustrations have been added which increase the interest of the book, and a new chapter has been put in on farmyard manure and green manuring.

The treatment is general rather than special, and only few references to original papers or bulletins are given. We think this ought to be remedied; even an elementary student ought to be put into touch with the sources from which the information presented to him is derived. Modern books show an increasing tendency in this direction, which, of course, is wholly good.

Some of the newer work is not dealt with as one would like, the treatment of the new synthetic nitrogenous fertilisers, calcium cyanamide and calcium nitrate, being very brief. Further, the only mineral phosphates described are those of the United States; no mention is made of such important substances as Gafsa phosphate or Algerian phosphate. In the chapter on farmyard manure, also, we note that gypsum, rock phosphate, kainit, and acid phosphate are all recommended as conserving agents, although many experiments have shown that their action is very small.

One other point ought to be remedied: the factors for converting nitrogen into ammonia, etc., are given to four places of decimals; two are usually sufficient, and more than three are never wanted.

The book retains its distinguishing features and will no doubt prove helpful to the type of student who used the previous edition.

Australia. By Prof. J. W. Gregory. Pp. 156. (Cambridge: At the University Press, 1916.) Price 1*s.* 3*d.* net.

AUSTRALIA is sometimes represented as a fringe of inhabitable land round a useless desert, with a stagnant population, an easily exhausted soil, a national debt of more than 60*l.* a head—in sum, as a country tending to inevitable bankruptcy under the incompetent rule of envious demagogues. Such is the view of Australia which Prof. J. W. Gregory has found little difficulty in proving untenable in this small book. Within its limited compass he has provided considerable information; for example, in the case of Western Australia he shows that the rainier half of that State has already been settled by pastoralists, and contains a rich cattle-breeding country; again, in a convincing chapter on the Government of Australia, he shows that the Labour Party in Australia is misunderstood in Britain, and is led by capable statesmen. With reference to the policy of "White Australia," it is demonstrated that the employment of white labour to displace the Kanakas—one of the most daring of all Australian industrial experiments—has resulted in considerable progress in the cultivation of sugar-canes in Queensland.

LETTERS TO THE EDITOR.

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

The Aurora, Magnetic Storm, and Sun-spot of January 4.

THE Aurora Borealis of January 4, 1917, described by Mr. Denning and Dr. Rambaut in NATURE of January 18, was also observed by Mr. Alfrel Noël Neate, at Carlisle. He has kindly sent me the following description of the display:—"I observed a very great display of aurora on Thursday evening, January 4. The principal display was observed by me at about 10.45 p.m., but I had seen a lesser one at 5.45 p.m. Notwithstanding the advanced phase of the moon, the whole northern half of the hemisphere was affected by it, and had the moon been absent the sight would have been truly magnificent. As it was, great beams shot up vertically and horizontally, the latter forming great arches, and the former appearing like searchlights. Frequently an immense area of the sky would become illuminated as if by a great cloud of mist, and the light would pass up to the zenith with lightning rapidity, appearing like clouds of light being wafted upwards from the N. horizon. The clouds were mostly greenish, like a gas-mantle, but the background of the sky was pale ruby."

The magnetic storm of considerable violence which accompanied this auroral display affected the magnets between the hours January 4, 3.36 p.m., and January 5, 2.48 a.m., G.M.T. The greatest range in declination was 57′, in horizontal force 50′, and in vertical force 52′, where in force $1'=4 \cdot 6\ \gamma$ ($\gamma=10^{-5}$ C.G.S. unit). Mr. Neate mentions 5.45 p.m. as the hour of a lesser display, and Mr. Denning 8.30 p.m. as the time of the appearance of an auroral streamer. Both these times approximately were marked by rapid oscillations in all three elements. The ranges were, in the first instance, declination 40·4′, horizontal force 40·2′, and vertical force 19·6′, and, in the second instance, 40·0′, 29·7′, and 10·5′ respectively. Dr. Rambaut gives the hour 10.15 p.m. for the finest display of streamers, and Mr. Neate the hour 10.45 p.m. This period was also marked by a series of oscillations on the three curves, but not so rapid or of such large amplitude as the former ones.

On December 30, 1916, a very large round spot of regular outline was glimpsed through clouds near the E. limb of the sun. On January 4, when it was about 13° to the west of the central meridian, it had the appearance of an elongated spot with considerable penumbra and two nuclei, followed by two smaller spots. Another group of two large spots about the same distance east of the central meridian followed it on almost the same parallel of latitude. A small round spot was also near the W. limb. These spots, in the northern hemisphere, were all the spots visible on that date. The area of the large spot was 9 units, in terms of the 1/5000 of the visible disc, and its position was: latitude +14°, and longitude 136°, heliographic. It was a new outburst, though contiguous to a region which had been disturbed as late as October 19, 1916. By January 6 the main spot had split into two, and the surrounding area showed much activity. On January 9, when it was near the W. limb of the sun, there was a whole series of groups of small spots, almost on the same parallel of latitude, stretching from the W. to the E. limb of the sun. In addition to the large group, which, though born on the invisible hemisphere of the sun, was active between January 4 and 6, the subsequent appearance of no fewer than five groups of small spots, three of which were new formations, was further evidence of a disturbed condition of the solar surface. On January 24 extensive and bright faculæ marked the position of the large spot on the sun's E. limb.

A. L. CORTIE, S.J.

Stonyhurst College Observatory,
January 25.

Forms of Weathering in Magnesian Limestone.

SEVERAL distinct forms of weathering are met with in the Sunderland Magnesian Limestone, two of which I will describe, leaving two others for another occasion. In one of them the prevailing rod, or the retiform, structure has been altered into one closely resembling a coral, *e.g. Lithostrotion basaltiforme*. Many of the short columns, consisting chiefly of calcium carbonate, have now numerous thin bands across their long axis (shown by arrow), producing the coral-like appearance, due, I suppose, to rearrangement in a periodic series of the carbonate of lime molecules. They have a fairly uniform thickness of about 1/30 of an inch, with slightly less interspaces. Thus far I have only met with this structure in this unique concretionary limestone, where it has been exposed several years.

The specimen shown in Fig. 1 was cut off a pinnacle

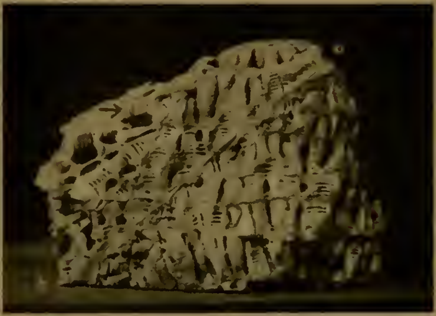

FIG. 1.—Weathered Magnesian Limestone, Carley Hill (natural size).

6 in. long and 2 in. thick, which was removed from the top of a "wall" of rock, this, at the base, is about 10 ft. thick, with a section, on the north side, of about 10 ft., and on the other side 20 ft., from the respective ground-levels. It is situated on the northern boundary of Old Southwick Quarry on Carley Hill, a part of Fulwell Hill.

Thicker bands are seen in this figure; the

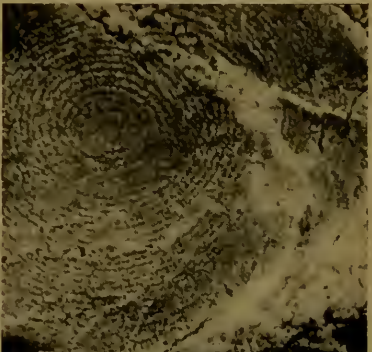

FIG. 2.—Segregation banding in Cannon-ball Bed, Roker, 1901 (× 1·5).

diagonal one, *b.o*, is what I term a "band of origin," from which the rods grew. Others, at right angles to the rods, are part of the original "honeycomb" structure. Apparently a few rods remain unaltered, but closer observation reveals the same zones, although not distinguishable in the photograph.

Fig. 2 represents part of a vertical surface on a southern face of the Cannon-ball Bed, where it juts from the Roker Cliffs at Sunderland. Most of this surface is above the tide-mark. Many of the calcareous balls exposed in any part of this bed exhibit similar narrow concentric zones, which also are a rearrangement of the carbonate of lime in an orderly fashion after the formation of the spheres. A few years ago in Fulwell Hill Quarry I saw, on about the same horizon as the top of Carley Hill, already mentioned, a bed of such balls 2 in. to 3 in. in diameter, from which a few feet of Boulder Clay had been removed six years earlier. These also had the same concentric lines, but as yet I have had no opportunity of fixing a time-scale for the formation of zones shown in Fig. 1. I ought to state that a few microscopical examinations of unweathered specimens revealed no such lines across the rod structure. The two forms of weathering are probably due to the same physical change. The second one, when I saw it in 1901, I supposed was due to segregation, and therefore I have since then called it segregation banding, but a better title is possible. Similar zonings of carbonate of lime have been produced by osmotic action by Prof. S. Leduc, of Nantes, and are shown on p. 84 of his "La Biologie Synthétique" (A. Poinet, Paris). Much the same thing is now known as Liesegang's rings, but who can claim priority I do not know. Except for a considerable difference in width of the interspaces they closely resemble the zones in weathered mortar due to rearrangement of carbonate of lime.

GEORGE ABBOTT.

2 Rusthall Park, Tunbridge Wells,
December 30, 1916.

Tertiary Igneous Rocks of the Pyrenees.

THE review of the treatise of Beyschlag, Vogt, and Krusch in NATURE of August 3, 1916, gives prominence to their mention of supposed absence of Tertiary igneous rocks. Yet even their pages figure grey-copper veins of Los Arcos cutting Tertiary beside ophite and granite intrusions. The latest official map of a Pyrenean district (Orthez) figures the ophite veins cutting uppermost Cretaceous, which I have insisted on during thirty years. In that time I have succeeded in securing by fossil evidence the recognition of the Cambrian of the map of 1890 as Hippurite Cretaceous, the "Silurian" slates of Lourdes as Middle Cretaceous, and the Scolithia beds of San Sebastian as Nummulitic Eocene. The erroneous classification led to the conception of the entire Pyrenees as rolled from the Sierra Nevada in such confusion and reversal as forbid attention to local and detailed observation, in the progressive correction of the map of Dufrénoy.

Yet even in Cornwall the excellent version of French methods supplied by an eminently practical miner has promoted accurate observation, and even Suess has returned, in his latest pages, to the principle of direction. As a hopeful science, apart from literary speculation, geology must aim at verifiable measurements and fossil confirmation. As example, I may quote my latest revision of the cluster of interior basins between Pamplona and Bayonne, which present floors of the plain Cretaceous border, now cited as exposures of that plain beneath a shovelled Palæozoic mass. With accurate mining plans, I trace their Cretaceous filling, in places, to the highest surrounding summits, and its successive beds as distinctly synclinal in disposition. Exceptional points of dislocation and reversal prove to accompany those local faults attested in mining work, abounding specially on the depressions followed by the high roads of the tourist's automobile. The Tertiary age of much of the ophite and granite of the Pyrenees has been my main contention since my first map of 1881, confirmed in both France and Spain, and affording a fresh clue from the most neglected portion of the chain. The latest observations in both Alps and Andes led Suess himself to rehabilitate the importance of igneous intrusion, and its recognition in connection with mining and orogenics has seemed to me of supreme utility in practical geology.

P. W. STUART-MENTEATH.

Ciboure, January 20

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE sixty-ninth regular annual meeting of the American Association for the Advancement of Science was held in New York City on December 26–30, 1916, under the presidency of Dr. C. R. Van Hise, of the University of Wisconsin.

The headquarters of the meeting was Columbia University, but, with the twelve sections of the association and the fifty-two national societies of restricted scope affiliated with the association at this meeting, the large lecture-rooms of Columbia University were insufficient, and meetings were also held in the American Museum of Natural History, in Barnard College, in the College of the City of New York, in the Cornell Medical College, in the College of Physicians and Surgeons, and in the Union Theological Seminary. The association, while holding annual meetings, is making especial effort to have every fourth meeting unite all the scientific societies of the United States, and this meeting at New York was the first of these four-year meetings. The second will probably be held at Chicago in 1920.

The attendance was larger than it has ever been in the history of the association. More than two thousand registered at the association headquarters, and it is estimated that above a thousand more were in attendance at the meetings held in other parts of the city.

The address of the retiring president, Dr. W. W. Campbell, of the Lick Observatory, University of California, on "The Nebulæ," was delivered on December 27 in the large lecture-hall of the American Museum of Natural History. The address was followed by a reception given by the trustees of the museum, and the guests were received by Mrs. H. F. Osborn and by Mr. J. H. Choate, former United States Ambassador to London.

During the week presidential addresses before the different sections were given as follows:—

Prof. W. A. Setchell, of the University of California, before Section G, on "The Geographic Distribution of Marine Algæ." This address was followed by a symposium on the relations of chemistry to botany.

Prof. E. Davenport, dean of the College of Agriculture of the University of Illinois, before Section M, on "The Outlook for Agricultural Science." The address was followed by a discussion on "The Adjustment of Science to Practice in Agriculture."

Dr. G. F. Kunz, before Section I, on "Scientific Efficiency and Industrial Museums: Our Safeguard in Peace and War."

Prof. W. McPherson, of the Ohio State University, before Section C, on "Asymmetric Syntheses and their Bearing upon the Doctrine of Vitalism."

Prof. E. P. Cubberly, of Stanford University, before Section L, on "Some Obstacles in Educational Programme."

Prof. Lillian J. Martin, of Stanford University, on "Personality as Revealed by the Content of Images."

Mr. B. J. Arnold, of Chicago, before Section E, on "The Inter-relationship of Engineering and Pure Science."

During the week two public lectures, complimentary to the citizens of New York, were held. The first was by Dr. Simon Flexner, director of the scientific laboratories of the Rockefeller Institute for Medical Research, on "Infantile Paralysis and the Public Health." The second was given by Prof. A. A. Noyes, of the Massachusetts Institute of Technology, on "Nitrogen and Preparedness."

A number of important symposia were held in addition to those mentioned in connection with two of the vice-presidential addresses. Section K (physiology and experimental medicine) and the American Society of Bacteriologists held a symposium on "Cancer and its Control." The papers presented at this symposium were as follows:—

Prof. G. N. Calkins, of Columbia University, on "The Stimulating Effects of Protoplasmic Substances on Cell Division."

Prof. Leo Loeb, of the Washington University Medical School, on "Tissue Growth and Tumour Growth."

Dr. J. C. Bloodgood, of Johns Hopkins University, on "Cancer in the Human Being."

Prof. James Ewing, of the Cornell Medical School, on "Radium and Cancer."

Mr. C. E. Lakeman, of the American Society for the Control of Cancer, on "Past and Present Efforts to Control Cancer through the Education of the Public."

A conference on the metric system was held under the auspices of Section I, at which delegates from the National Wholesale Grocers' Association, the American Institute of Mining Engineers, the American Pharmaceutical Association, the American Institute of Electrical Engineers, the American Chemical Society, the National Wholesale Druggists' Association, the National Association of Retail Druggists, the Philadelphia Bourse, the Philadelphia Commercial Museum, and the American Institute of Chemical Engineers were in attendance. The council of the American Association for the Advancement of Science, at its final session on December 29, passed a resolution urging the general adoption of the metric system in the United States. The association has always favoured this move, and has passed similar resolutions at previous meetings.

A symposium on "The Structure of Matter" was held at a joint meeting of Sections B and C, the American Physical Society, and the American Chemical Society, in which Prof. R. A. Millikan, of the University of Chicago, Prof. G. N. Lewis, of the University of Chicago, Prof. R. W. Wood, of Johns Hopkins University, and Prof. W. B. Harkins, of the University of Chicago, were the principal speakers.

A symposium on "Biology and the National Existence" was held by Section F and the American Society of Naturalists, the principal speakers being Dr. S. Paton, of Princeton University, Mr. W. J. Spillman, of the U.S. Department of Agriculture, Prof. J. Loeb, of Columbia University, and Prof. E. G. Conklin, of Princeton University.

The American Genetic Association held meetings throughout the week, joining the American Association for the Advancement of Science for the first time; as also did the newly organised Ecological Society of America.

Another important series of meetings was held by the newly founded Federation of American Societies for Experimental Biology, formed by the Physiological Society, the Society of Biological Chemists, the Society for Pharmacology and Experimental Therapeutics, and the Society for Experimental Pathology.

The principal social events of the week, apart from the opening reception at the American Museum of Natural History, included a smoker at the Aquarium, given by the New York Zoological Society, and a reception by the United Engineering Societies in their beautiful clubhouse. There were many dinners, including an especially interesting one given in honour of Prof. E. B. Wilson, of Columbia University, by his former students.

The Committee of One Hundred on Scientific Research held an important meeting on the first afternoon, at which reports from a large number of sub-committees having charge of special aspects of scientific research questions were presented.

The most important action taken by the council of the association was to authorise a thorough revision of the constitution of the association, in the hope of increasing the efficiency of the association and to permit possibly more intimate relationships with the national scientific societies of specific scope.

The general committee, at its meeting on the final evening, accepted an invitation to meet at Pittsburgh in the winter of 1917–18, and elected the following officers:—

President: Prof. T. W. Richards, of Harvard University. *Presidents of Sections:* B, Dr. W. J. Humphreys, U.S. Weather Bureau; C, Prof. W. A. Noyes, University of Illinois; E, Prof. G. H. Perkins, University of Vermont; F, Prof. Herbert Osborn, Ohio State University; G, Dr. B. E. Livingston, Johns Hopkins University; H, Prof. E. B. Titchener, Cornell University; I, Mr. G. W. Perkins, New York City; K, Dr. C. E. A. Winslow, Yale University; L, Prof. E. F. Buchner, Baltimore; M, Prof. H. J. Waters, University of Kansas. *Secretary of Council:* Prof. W. V. Bingham, University of Pittsburgh. *General Secretary:* Prof. J. McK. Cattell, Columbia University. *Secretaries of Sections:* B, Prof. George W. Stewart, State University of Iowa; C, Prof. J. Kendall, Columbia University; E, Prof. R. T. Chamberlin, Chicago; K, Dr. A. J. Goldfarb, New York.

RESEARCH IN TIMBER.

IN an address[1] to the Timber Trade Federation, delivered in October last, Prof. Percy Groom showed that the lack of co-operation in the past between technical science and the timber trade of this country had resulted in the timber resources of the Colonies and India not being efficiently utilised. The British Empire includes within its bounds a larger number and wider range of timbers than any other State; but many of these are imperfectly known, and on that account not in commercial use. Prof. Groom instanced many examples of the need for scientific research in timber. Wood-pulp, the import of which into the United Kingdom was valued at 5,500,000*l.* in 1913, is obtained at present mainly from spruce growing in foreign countries. In all probability it could be manufactured as cheaply from the soft woods, valueless as timber, which grow abundantly in the forests of our tropical possessions; and an investigation into this problem is most desirable. The hard woods of the tropics, owing to the loose nomenclature and wrong naming of many species, are less sought for than they deserve by architects, railway companies, and other large consumers of strong durable wood. The African mahoganies, for example, comprise a large series of different woods, varying widely in colour, hardness, and other qualities; and the identification and standardisation of these and other tropical woods should be the subject of prolonged scientific investigation. Some woods of great merit show defects in ordinary use which might be remedied by experiments in the laboratory, an interesting example being the Indo-Malayan Yang wood[2] (Dipterocarpus sp.), which had been introduced into England as a substitute for teak, but was found to warp badly and exude a resin, injuring its utility and appearance. Experiments carried out at the Imperial Institute resulted in the discovery of a simple cure for these defects, and the wood has been reinstated into favour.

Prof. Groom referred to a promising line of investigation, the economic utilisation of waste products which, in the form of slabs, shavings, and sawdust, are produced in great quantity in all conversion of wood. Every particle of wood is either a source of power, as when used for fuel, or can be transformed into a variety of valuable substances, as in the manufacture of explosives like cordite and acetone; of antiseptics, as creosote and carbolic acid; of alcohol, acetic acid, celluloid, collodion, artificial silk, etc. The chemical utilisation of wood lends itself especially to co-operative efforts in large towns; and some improved method of distillation may solve the problems of dealing profitably with coppice-woods in England, and with forests in the tropics which consist mainly of trees producing unmarketable timbers.

Another important problem, not yet attacked in this country, is the economical application of preservatives and antiseptics to mining timber, the life of which in the pits might in many cases be prolonged from three to thirteen years, if recent experiments in the United States are to be trusted. In any case, there is a possibility of a large saving in the cost of raising coal by improved sanitation and appropriate treatment of wood in mines.[3]

As a practical scheme for linking up technical science with the timber trade and its dependent industries in this country, Prof. Groom advocates the establishment of an Imperial Timber Bureau in London, which would be in close touch with the Colonies and Dominions. It would supply technical advice, conduct investigations, and diffuse information amongst the trades and professions that handle wood. To the bureau would be attached an institute with timber, chemical, physical, engineering, and fuel laboratories, as well as workshops. Though not mentioned by Prof. Groom, it is almost precisely on these lines that investigation in timber on a large scale has been successfully carried on for some time by the Products Branch of the United States Forest Service.[4] Some account of the working of this department will be of interest. It consists of two sections, the Office of Wood Utilisation at Chicago, and the Forest Products Laboratory at Madison.

The Chicago office serves mainly as a bureau for the collection of information and statistics of production, consumption, utilisation, etc.; but it also deals with problems not requiring the aid of a laboratory; for example, by inducing manufacturers to undertake experiments of various kinds. This office publishes reports on the wood-using industries in each State, which are compiled with the aid of owners of timber, merchants, manufacturers, railway companies, and other consumers of wood, including certain Government departments. Much has also been done to eliminate waste by this office suggesting possible uses for material that had formerly been burnt to get it out of the way. Mr. Burdon states that the economic value of co-operation between the wood-using industries in the United States and the Forest Service Utilisation Office cannot be over-estimated, as the confidence reposed in the latter by the timber trade is remarkable.

The Forest Products Laboratory at Madison is staffed and equipped by the Forest Service in co-operation with the University of Wisconsin, which provided the buildings at a cost of 55,000 dollars in 1910. It is planned for research work on a semi-commercial scale, and has a large

[1] *Timber Trades Journal*, October 7, pp. 565–71.
[2] Percy Groom, "Shrinkage, Swelling, and Warping of Cross-grained Woods." Ann. Applied Biology, vol. iii., No. 1, June, 1916.
[3] Percy Groom, "Pit Timber and its Preservation," Trans. Inst. Mining Engineers, vol. li., part ii., pp. 190–203.
[4] See U.S. Dept. Agric. "Review of Forest Service Investigations," vol. i., pp. 17–28 (1913); and E. R. Burdon in Journ. R. Soc. Arts, vol. lxi., pp. 438–446 (1913).

storage yard connected with the main railway by a switch line. There are sheds and buildings for natural and artificial seasoning of timber, a saw-mill, a carpenter's shop, and eight laboratories, devised for technical research in timber-testing, the physical properties of wood, pathology, wood-preservation, wood-distillation, paper and pulp manufacture, and engineering and chemistry problems connected with timber. The research work undertaken is all carefully planned with the express object of obtaining results which will directly benefit the timber merchant and consumer. The field covered in the general scheme laid down for research accordingly includes every important industry which derives its raw material from the forest.

The Forest Products Branch in the United States furnishes a model which might readily be adapted to our needs. The interests, however, of the timber trade, of the home consumer, and of British owners of woodlands must all be carefully considered, if a satisfactory general scheme is to be evolved. The Bureau of Information and Statistics would necessarily be in London. The laboratories and workshops could perhaps be established in connection with the university which took the greatest interest in the project.

NOTES.

LORD DEVONPORT, the Food Controller, has issued a statement pointing out the urgent need for economy in food, and the necessity for some curtailment of the nation's food consumption. The three most important staples of daily consumption are bread, meat, and sugar, and forethought for the sustenance of the population requires a decision as to whether compulsion is necessary to ensure an equitable distribution and conservation of available supplies. Compulsory rationing to a fixed quantity per head involves a very elaborate machinery, which in itself absorbs labour, and for that reason alone ought to be avoided unless absolutely necessary. Therefore, having carefully weighed the advantages and disadvantages, the Food Controller has come to the conclusion that a voluntary system is preferable until further experience is gained, and meanwhile to trust to the nation's instinct of self-discipline. The following allowance is based on the average weekly consumption of each of the commodities named which should be permitted to each person. After consideration of available stocks and probable means of future supplies, the situation requires that heads of families should endeavour to limit themselves to the weekly purchase for each person comprising the household of the following quantities per head per week:—Bread, 4 lb. (or its equivalent in flour, 3 lb. for bread-making); meat, $2\frac{1}{2}$ lb.; sugar, $\frac{3}{4}$ lb. Although these quantities will form the basis of the dietary scale, they will naturally be supplemented by other food products. The nation is placed upon its honour to observe these conditions. The effect upon consumption will reveal itself through the statistical returns available to the Food Controller. Meanwhile, to meet the contingency that rationing may become necessary, the machinery to bring such a system into operation is being organised, so that if and when required it may be ready. It is hoped that a patriotic endeavour will be made by everyone to limit consumption wherever possible to below the standard indicated, and by so doing render rationing unnecessary.

THE report of a committee of the Royal Society, made at the request of the President of the Board of Trade, on the food supply of the United Kingdom has just been issued. It is divided into three parts, the first dealing with food supply in the period 1909–13, the second with food supply in 1916, and the third with possible methods of economising the available food supply. The recommendations respecting economies are as follow:—(1) The possibility of a better recovery of flour in milling; (2) the possibility of more economical meat production; (3) the possible increase in the national food supply which might result from a general practice of making cheese in place of butter; (4) a consideration of the economy of food which might be effected by the prohibition of brewing.

THE formation of the new Air Board is authorised by an Order in Council published in the *London Gazette* of Tuesday last. The composition of the board is as follows:—President, Viscount Cowdray; Parliamentary Secretary, Major J. L. Baird; Fifth Sea Lord of the Admiralty, Commodore G. Paine; Director-General of Military Aeronautics, Lieut.-General Sir David Henderson; Controller of Aeronautical Supplies, William Weir; Controller of Petrol Engines, Percy Martin; secretary, Sir Paul Harvey; assistant secretary, H. W. W. McAnally; private secretary to the Parliamentary Secretary, C. G. Evans.

AT the scientific meeting of the Royal Dublin Society on January 23, Lord Rathdonnell, president, in the chair, the Boyle medal of the society was presented to Prof. H. H. Dixon in recognition of his distinguished work for botanical science, and particularly his investigations on transpiration and the ascent of sap in plants.

PROF. R. SAUNDBY has been appointed to deliver the Harveian Oration to the Royal College of Physicians of London for the present year. Dr. E. S. Reynolds is to be the Bradshaw Lecturer. Dr. T. M. Legge will be the Milroy Lecturer in 1918.

WE regret to notice the death, on Sunday last, February 4, at the age of seventy-three years, of Mr. C. Owen Waterhouse, formerly assistant keeper of the British Museum (Natural History).

BY the death of Mr. John Tebbutt, of Windsor, N.S.W., briefly announced in our issue of last week, disappears, at the ripe age of eighty-four, one of the few remaining links that connect the astronomy of to-day with the older form that Airy and his school recognised and practised. The late Mr. Tebbutt, as a loyal member of that school, worked hard to record positions, to deduce orbits, and to study planetary markings. Inadequate instruments did not rob him of the delight of industrious occupation in his selected science, but he did a far greater work than discover comets and painfully determine their position by imperfect means. In a nascent colony in which the conditions of life were adverse to scientific study, and where the stimulus of sympathetic companionship was utterly wanting, he worthily upheld the claims of intellectual study, and struggled manfully in the pursuit of research. He was of the highest type of amateur, one who followed his own inclinations with ardour and enjoyment, never tiring and never changing; he had his reward in well-doing. He observed Donati's comet, nearly fifty years ago, and among his latest observations those of comets still found a place. He was the discoverer of the great comet of 1861, following it with a sextant, and though such an instrument was utterly inadequate for the purpose, as the writer of this note can unfortunately testify, for it fell to him to reduce the observations, yet the Observatory at Melbourne was little better off, for the assistant, Mr. White, had no other means. Mr. Tebbutt's example has, no doubt, done much to stimulate progress in the colony, and that his silent, steady work impressed his fellows is shown by the fact that later he was offered the post of Government astronomer. This appointment was refused, and no doubt wisely, for by that time he had improved his equipment, acquiring first a $4\frac{1}{2}$-in. Cooke, and afterwards an 8-in. refractor by Grubb, and could push his researches in the direction that best pleased himself.

THE *Revue Philosophique* for January announces the death, on December 9, of Prof. T. A. Ribot, the well-known psychologist and philosopher. Prof. Ribot was born at Guingamp in 1839, and during his long life did much, both by lecturing and writing, to further the study of psychology. In 1888 he was appointed professor of experimental psychology at the College of France. He made contributions to many psychological problems, but probably his monographs on some mental diseases, namely, "Les Maladies de la mémoire, de la volonté and de la personnalité," have had the widest circulation of all his works. In his "Essai sur les passions" and in "Problèmes de psychologie affective" he directed attention to the importance of the emotions in the life of the individual, and thus helped to modify the exaggerated belief of many writers in the dominance of the intellectual processes. His interest in English thought is shown by his work, "La Psychologie anglaise contemporaine," and by his translation of Herbert Spencer's "Principles of Psychology." He also edited the *Revue Philosophique* from the beginning of that journal.

Engineering for February 2 records the death of Mr. George Andrew Hobson, which occurred on January 25 in his sixty-third year. Mr. Hobson was for many years a partner with Sir Douglas Fox and Sir Francis Fox, and played an important part in the extensive work which the firm carried out, especially in South Africa. Perhaps the best example of his work is the bridge spanning the Zambezi River near the Victoria Falls. The southern part of the constructional work involved in the completion of the Great Central Railway was carried out by his firm, and in this, as well as in connection with the tube railways of London, Mr. Hobson took an active share. He was a member of the Institution of Civil Engineers, and was awarded a gold medal for each of the two papers he contributed to the Transactions. It is of interest to note that his chief enjoyment was found in the depths of the country, alone with Nature, studying bird-life. His widow and daughter have the deep sympathy of a large circle of professional and social friends.

THE death is announced, in his fifty-first year, of Mr. Henry Gordon Stott, a former president of the American Institute of Electrical Engineers. Mr. Stott was a native of the Orkneys, and was educated at the Watson Collegiate School, Edinburgh, and the College of Arts and Sciences, Glasgow. After doing various professional work in England and Spain, he went to America in 1891 to do construction work for the Buffalo Light and Power Co. Since 1901 he had been superintendent of the motive power of the New York street railways. He was the author of many important papers on electrical engineering.

THE new institute at Potsdam for research in genetics, connected with the Landwirthschaftliche Hochschule of Berlin, was opened in April, 1916. Prof. Erwin Baur is in residence as director, combining this duty with medical work under the German Admiralty.

CAPT. AMUNDSEN, the Norwegian explorer, who proposes to endeavour to reach the North Pole by aeroplane, is on his way to Norway from America to complete his plans. The ship in which he will make the first part of the journey is to be launched at Christiania next March, and Capt. Amundsen expects to start his scientific expedition about the summer of next year. He hopes eventually to come into touch with Robert A. Bartlett, another explorer, who is going *via* Bering Strait.

AT the annual meeting of the Royal Microscopical Society, held on January 17, the following officers were elected for the year 1917:—*President*, E. Heron-Allen; *Vice-Presidents*: J. E. Barnard, A. Earland, R. G. Hebb, F. Shillington Scales; *Treasurer*, C. F. Hill; *Secretaries*: J. W. H. Eyre, D. J. Scourfield; *Ordinary Members of Council*: H. F. Angus, A. N. Disney, F. Martin Duncan, T. H. Hiscott, J. Milton Offord, R. Paulson, P. E. Radley, A. W. Sheppard, E. J. Sheppard, C. Singer, C. D. Soar, J. Wilson; *Librarian*, P. E. Radley; *Curator of Instruments*, C. Singer; *Curator of Slides*, E. J. Sheppard; *Editor of Journal*, R. G. Hebb.

IN connection with the Faraday Society there will be a general discussion on "The Training and Work of the Chemical Engineer" on Tuesday, March 6, at 8 p.m., in the rooms of the Chemical Society, Burlington House, W. Sir R. Hadfield, president of the society, will preside over the discussion, which will be opened by Sir G. Beilby. The following papers will be read:—"The Training of the Chemical Student for Work in the Factory," by Prof. F. G. Donnan; "The Training of the Works Chemist in Physics," by C. R. Darling; and "A Plea for the Forgotten Factor in Chemical Training," by W. R. Cooper.

A SPELL of cold weather has occurred over England during the last five weeks, and its principal characteristic has been its persistence. The cold has rarely been severe, and the absence of warmth during the daytime has been much more marked than the degree of cold at night. No temperature so high as 50° has occurred in London since January 3, and between January 13 and February 5 the thermometer did not rise to 40°, whilst after January 19 it had only exceeded 35° on three days. The maximum, or day, temperature has not once risen to the average since January 5. January started with very warm weather, the mean in London for the first three days being 50·5°, which is in precise agreement with the record high temperatures for the corresponding three days of 1916 and 12° above the normal. The mean temperature of the recording station of the Meteorological Office at South Kensington for January was 36·5°, which is 1·9° below the mean at Greenwich during the last sixty years, taken for comparison, as the Kensington records are for too short a period. The mean maximum, or day, temperature was 39·1°, which is 3·8° below the Greenwich average, whilst the mean minimum, or night, temperature was 34°, the same as the average. There has been no mean maximum for January so low since 1897, when it was 38·7° at Greenwich, and in 1895 it was 37·7°: in both these years the mean night temperature for January was below the freezing-point, being 29·5° in 1895, which is 4·5° lower than the present year, although the mean day temperature in 1895 was only 1·4° lower. January is normally the coldest winter month, but in 1916 it was the warmest winter month and February the coldest. January this winter had the mean day temperature 4° lower than December, but the night temperatures were the same. Snow has fallen with considerable frequency, and in places the fall has been somewhat heavy. The ice has already afforded the pastime of skating, but it has not as yet become general, as in the more severe winters of 1890–91 and 1894–95.

The council of the Association of Chambers of Commerce is, we learn from the *Times*, considering draft Bills designed to carry out reforms in our systems of weights and measures and of coinage, and should the council approve of them they will be submitted to the Chambers of Commerce throughout the country. If there proves to be general agreement the association's Bills will be introduced into Parliament. It is probable that a Bill for establishing a decimal coinage will have first attention, the Bill for introducing metric weights and measures not being pressed until the country has grown accustomed to a decimal coinage. It is suggested that the simplest means of making the change would be the adoption of the present florin, which is the tenth part of a sovereign, as the unit. The existing farthing would be replaced by a "cent," equal to the hundredth part of a florin, instead of a ninety-sixth part as now. In this connection it is worthy of note that Sir Edward Holden, at the meeting on January 26 of the London City and Midland Bank, of which he is chairman, expressed himself strongly in favour of the adoption by this country of the metric system. One of the hindrances to the extension of our foreign trade, he said, is the fact that we do not present our catalogues in foreign countries so advantageously as do other countries. If we are seeking to extend our trade to those countries where German influence has hitherto predominated we must at once begin to adopt the systems which are most easily comprehended by purchasers. The metric and decimal systems have been adopted by all European countries except Russia, and in that country they were, before the war, fast coming to the front. These systems are also used in South America and Japan. In fact, there are few countries which do not use them at the present time.

Owing to the special importance at the present time of establishing commercial connections on a firm basis between the Allied countries, the Russo-British Chamber of Commerce at Petrograd requests all British firms wishing to trade with Russia now or after the war to send their catalogues and price-lists (not fewer than ten copies) to the chamber, 4 Gorochovaia, Petrograd, Russia. The catalogues will be placed in the special library of the chamber, and will be distributed to Russian merchants interested in the development of their trade connections with England.

A cave known as the Tecchia d'Equi, in the district known as Lusigiana and situated between Spezia and Carrara, has long been explored for the prehistoric remains which it contained. Of these, an account is given by Dr. Carlo de Stefani in the *Atti dei Lincei*, xxv. (2), 3. Excavations were first made in this cave in 1909 by Mr. Podenzana, curator of the Spezia civic museum, and they have now been continued by the author with the aid of a small grant from the Italian Association for the Advancement of Science. Human remains have been found, but only in a very incomplete state, and these have been referred to about thirty subjects, mostly women and children. On the other hand, the grotto and Tecchia were principally inhabited by *Ursus spelaeus*, and, moreover, the fauna was essentially alpine in character. The Tecchia was a real "abri sous roche" in the Triassic limestones at the foot of a wild region of the Apuan Alps and at an altitude of 352 metres. In it was an opening leading into a spacious cave in which the remains in question have been found. Even in historic times the Tecchia has served as a human habitation.

Neolithic implements have often been found in places remote from the source of origin of the rocks of which they are formed, and it appears definitely agreed that the giadeitic and nephritic minerals used in those implements found in many regions of Italy are of Alpine origin. In a note in the *Rendiconti del R. Istituto Lombardo* (xlix., 15) Rosa Bariola publishes interesting photomicrographs of rock sections made from implements found near Cagliari, in Sardinia. Three specimens were observed, one of giadeitite from Sant' Apparassi, near Cagliari, one a fragment of an axe from Lesbo, consisting of nephritite, and the third of a form of chlorite from Settimo, all these localities being a little to the east of Cagliari. There is good reason for thinking that no rocks of the same character occur in Sardinia, and it is uncertain whether such are found in Corsica.

All facts in regard to the life-history of that most remarkable bird, the Hoatzin (*Opisthocomus cristatus*), are most welcome. Hence we are glad to know that Father C. B. Dawson is making a careful study of this bird in its native haunts. The results so far obtained he gives us in his "Hand-list of the Birds of British Guiana," which has just reached us. Herein he remarks that the mother feeds the young as young pigeons are fed. That is to say, the method is the same, the young abstracting their food by thrusting the head down the mother's throat. But he makes no mention of the nature of the food thus obtained. This he will probably tell us later, as he remarks in this account that the food-plants of the adult are now being investigated. It would also seem that this bird is polygamous. Still further notes on the same theme, and covering different aspects of the life-history, are furnished by Mr. G. K. Cherrie in his "Contribution to the Ornithology of the Orinoco Region," published in the *Science Bulletin*, vol. ii., No. 6, of the Museum of the Brooklyn Institute of the Arts and Sciences. From this source we gather that the young Hoatzin is almost naked at birth and of a shiny jet-black colour, tinged with olive. Within a day or two the eyes are opened, and from that time forward it can only be approached with the most extreme caution, as it drops from the nest into the water on the slightest alarm. He also gives some valuable facts in regard to its nest-building and the extended period over which the breeding is carried.

A new species of digging-wasp, captured in the Forest of Dean so far back as 1897, is described by Mr. R. C. Perkins in the *Entomologists' Monthly Magazine* for January. Though long puzzled by his capture, Mr. Perkins only recently set himself seriously to the task of its identification. On bringing it to the British Museum he found that Mr. K. G. Blair had also taken this insect in 1912 at Stanmore, Middlesex. His examples, a male and female, were bred from cocoons taken from a dead thistle-stem in the previous year, but though he preserved his specimens he did not attempt to identify them. The description of the insect is given now by Mr. Perkins, who names it *Pompilus cardui*.

In his presidential address before Section C of the South African Association for the Advancement of Science Mr. I. B. Pole Evans, chief of the division of botany in the Department of Agriculture, Pretoria, gave an interesting sketch of the rise, growth, and development of mycology in South Africa. The earlier part of the address is occupied with an account of the contributions of various botanists and travellers from Persoon, "the father of the science of mycology," who collected in 1755, to the present day. A portion of the address is devoted to a brief survey of the cereal rust fungi, a subject to which Mr. Pole Evans has contributed much valuable work in the Transvaal. Wheat, oats, rye, and barley are all attacked by the black rust, *Puccinia graminis*, Pers., and the first three cereals are also each attacked by a second rust fungus. Maize is also subject to two rusts, *P. maydis*, Bereng., and *P. sorghi*, Schw. It will be remembered that Mr. Pole Evans discovered that *Oxalis corniculata* is the alternative host of *P. maydis* in South Africa. For the other Puccinias no alternative host is yet known, and there are no barberry bushes in the country. *P. graminis* therefore exists without its æcidial host, and as the over-wintering of the uredo, or spring spores, does not appear to be entirely responsible for the sudden outbreaks of disease, the history of the telentospores in South Africa is an important problem deserving of careful research.

THE *Archivos do Jardim botanico do Rio de Janeiro*, vol. i., fac. i., which has recently reached us, contains an account of new or little-known Amazonian plants by A. Ducke, illustrated by nineteen plates. The volume also contains a well-illustrated account of the remarkable genus of Cactaceæ, Rhipsalis, by A. Löfgren. Among the new plants figured by Ducke are two new species of the Cycadean genus Zamia; one, *Z. Lecointei*, was found near Obidos, and is the first Cycad to be found in the province of Para. Another, from the south-east of Colombia, may be the same species as that found by Spruce many years ago in Uaupes. Ducke concludes his paper with descriptions and notes of species of the Solonaceous genera Ectozoma and Marckea, the habitats of which are the nests of ants, either of the genus Azteca or Camponotus.

A CAREFUL account of the different trees which have passed under the name of Brazil wood, and afford the valuable red dye, is given in Kew Bulletin No. 9. The Brazil wood of the fourteenth and fifteenth centuries came from the East, and was no doubt derived from *Caesalpinia sappan*. It has recently been replaced largely by the West African camwood, *Baphia nitida*. Some eight trees have at different times been known under the names Brazil or Braziletto, and in addition to those mentioned, namely, *C. echinata* from Brazil, *C. brasiliensis*, *C. bahamensis*, and *C. bicolor* from Peru and Colombia. Then there are *Peltophorum brasiliense* from Jamaica and Cuba, a very useful timber tree, and *Haematoxylon Brasiletto*, which is a native of Colombia, Venezuela, and Central America, and may prove to be a valuable article of commerce in Colombia. Finally, there is the well-known logwood, *Haematoxylon campechianum*, a native of Yucatan and British Honduras, which has been largely planted in the West Indian islands and elsewhere. A long account of the early traffic in this wood is given, and the article is illustrated with figures of the pods of all these valuable leguminous trees.

IN *American Forestry* for December a warning note is uttered as to the grave danger which threatens the extremely valuable white and five-leaved pines of New England and Canada from the spread of the "pine blister disease," which is making alarming headway, being spread by infected currant and gooseberry bushes, both wild and cultivated. In south-western Maine 85 per cent. of the trees are infected, and of these 50 per cent. are either dead or doomed. Profiting by the devastation caused by the chestnut blight, which was neglected on its first appearance, legislation of a drastic character is being framed to cope with the menace. In the same issue the Hon. David Houston justifies the decision of Congress to take and keep control of all forest land for the regulation of timber production and watershed protection, and to this end large areas of forested land are now being purchased by the Government.

DR. F. DU CANE GODMAN has presented to the British Museum (Nat. Hist.) some fragments of a second skull of *Eoanthropus dawsoni*, which were found by the late Mr. Charles Dawson in 1915 in the Piltdown gravel of a new locality. The specimens will be described by Dr. Smith Woodward in his fourth paper on Piltdown Man, which is to be read at the next ordinary meeting of the Geological Society on February 28.

DR. CHARLES D. WALCOTT has published a third part of his valuable and exhaustive work on Cambrian Trilobites, chiefly from North America and China (Smithsonian Miscellaneous Collections, vol. lxiv., No. 5). It is illustrated in the usual excellent manner with twenty-three plates, and a glance over the figures enables one to realise the extraordinary diversity of the Trilobites in the very early fauna to which the species represented belong. The genus Corynexochus is of special interest to the geologist in Canada, as affording a means of correlating the Lower Cambrian rocks in the St. Lawrence-Newfoundland area with those of Mount Whyte, in the Canadian Rocky Mountains.

THE need for extreme caution in generalisations in geography, especially in human geography, may well be insisted on, and forms the subject of a paper by Mr. G. G. Chisholm in the *Scottish Geographical Magazine*, November, 1916 (vol. xxxii., p. 507). Mr. Chisholm's paper is a closely reasoned argument illustrated by generalisations, which he feels merit criticism, quoted from Ratzel or other more modern geographical writers. He draws an important distinction between influences which act independently of man's will, and others which do not. The latter are affected by so many unknowable circumstances that they can never be stated except in approximate terms. The failure to distinguish these two classes of laws has been a most fruitful source of confusion in geography. Secondly, Mr. Chisholm reminds his readers that the value of geographical conditions varies with the circumstances of the time, and, thirdly, that statements in human geography, when the human will is concerned, are all the more likely to approach the universality of an absolute law the more imperious is the urgency that leads to the behaviour on the part of man that is taken for granted in the statement. Lastly, he dwells on the danger of laying too great stress on any one cause affecting human development to the neglect of others.

THE abnormal ice conditions around Spitsbergen in 1915 and 1916 are discussed by M. Adolf Hoel, of the University of Christiania, in an article in *La Géographie*, vol. xxxi., No. 3. The question is not only of interest in relation to the weather experienced in north-western Europe in these years, but of great importance in respect of the growing economic development of Spitsbergen. In the summer of 1915 strong easterly winds caused the ice to drift round South Cape and block the west coast until August. Vessels had some difficulty in entering and leaving Icefjord. Late in August more ice arrived by the same route and caused difficulties in September. This is very unusual. On the other hand, the same easterly winds caused the east coast of Spitsbergen to be more open than it has been any year since 1898. In the middle of August a vessel had no difficulty in traversing Hinlopen Strait from the north, and reached the extreme east of North-East Land. Further east, towards Hope Island and Franz Josef Land, the sea was singularly clear of Ice. This shows that a year such as 1915 might hinder economic development in the west, but would most certainly favour it in the east. In the summer of 1916 these abnormal conditions to some extent were repeated, and ice was troublesome on the west coast until early in September. It should, however, be pointed out that, despite this, the coal-mines in Advent Bay exported 30,000 tons of coal in 1916. M. Hoel also directs attention to the advance of the glaciers in North-East Land since 1898.

In a valuable paper which appears in the January number of the Journal of the Franklin Institute, Mr. Ralph Brown, of Cornell University, summarises the results which have been obtained during recent experiments on the magnetic properties of iron and nickel under rapidly alternating magnetic fields. The belief that, at the frequencies in common use in power transmission, the permeability of iron was much less than in steady fields now appears to be unjustified, the apparent diminution being due to the alternating fields never penetrating beneath a thin superficial layer of the iron. When, as in recent observations, this skin effect is allowed for, the permeability is found to retain its steady field value up to a frequency of a thousand per second. At a frequency of 10^5 it is, however, reduced to 500, at 10^7 to 200, at 10^9 to 50, at 10^{10} to 20, while at the frequency of light it is reduced to unity. The behaviour of nickel is like that of iron, except that its initial permeability is only 100.

Many readers of Nature will doubtless be interested to learn that the advertisement which appears in another column of a modern Elizabethan house which is to be let or sold refers to The Camp, Sunningdale, where Sir Joseph Hooker lived for upwards of a quarter of a century.

Messrs. Witherby and Co. have been appointed European agents for the "Journal of the Natural History Society of Siam."

OUR ASTRONOMICAL COLUMN.

The Lake Okechobee Meteorite.—A stony meteorite which has received this title at the U.S. National Museum has been described by G. P. Merrill (Proc. U.S. Nat. Mus., vol. li., p. 525). It is of rather special interest from the unusual circumstances attending its discovery, having been brought up in a fishing-net some three-quarters of a mile from the shore of the lake from which it receives its name. There is no definite record of a fall in this neighbourhood, but the finder recalls a brilliant meteor which passed to the west of Ritta about thirteen years ago, and was accompanied by explosive sounds. The fragments secured weigh about 1100 grams, and appear to have come from a mass originally ten or twelve inches in diameter. Notwithstanding its long immersion, the stone is still firm and shows the characteristic thin lustreless black crust. The chondritic type of the stone is at once evident in thin sections under the microscope.

Cluster Variables.—In the course of an investigation of variable stars in the cluster M5, Prof. S. I. Bailey has found eight stars which have light-curves showing peculiarities not hitherto recognised (Harvard Circular, 193). While the mean period of sixty-one variables of the ordinary cluster type in M5 is 0·547 day, that of the eight stars in question is 0·271 day, or about half the more usual period. Prof. Bailey suggests that such a star may be formed of two variables, each being of the ordinary cluster type, and having the usual period of about half a day, with alternating maxima. This hypothesis is supported by peculiarities in the form of the light-curves, which can be resolved into two curves of the usual type. Spectroscopic observations might provide further tests of this supposition. Prof. Bailey is of opinion that the uniformity of period of cluster variables must have some physical cause, which may separate them from other variables of short period. The mean period in ω Centauri is 0·549d.; in M3, 0·541d.; in M5, 0·547d.; and similar results have been found for other clusters. It is still an open question whether these stars are spectroscopic binaries; if an ordinary cluster variable is a binary, a double variable, on the above hypothesis, must be a system of four components.

United States Naval Observatory.—The annual report of the superintendent of the U.S. Naval Observatory for the year ending June 30, 1916, is notable for the attention directed to the increasing demands on the observatory in connection with the submarine and aircraft services. New and improved methods and instruments for accurate and rapid navigational and plotting work have been devised, and instruction given to the *personnel* of the services. The policy of encouraging suggestions, and of making the necessary trials, is stated to have produced several new methods and instruments of value.

The regular programme of astronomical observations was continued without intermission throughout the year, and included numerous observations of the satellites of Saturn and Uranus. It is interesting to note that the American ephemeris for 1919, which is in the press, will include tables for computing the rising and setting of the sun and moon. A special publication referring to the total eclipse of the sun of June 8, 1918, visible in the United States, is in course of preparation.

INTERNATIONAL AND NATURAL LAW.[1]

THE idea of issuing photographic reproductions of the text of such works as can be said to have contributed either to the origin or to the growth of international law, together with English versions by competent scholars, and with introductions giving biographical details and pointing out the importance of the text and its place in the development of the science, is a most worthy conception, and the commencement of its execution is a timely reassurance to the fears of those who imagined that the Germans had made an end of international law. The photographed text obviates possible mistakes in reprint. At the same time provision is made for the rectification of original misprints: where earlier authors have been ill-served by their printers a revised text will accompany the photographed text. The full bibliographies will be appreciated, and the portraits of the authors are interesting. The volumes form handsome quartos, and the typography might almost satisfy the exacting requirements of an Aldo Manuzio.

(1) The introduction to Vattel, by Prof. Albert de Lapradelle, sketches the life of the author, examines the character of his work and the grounds of its success, and assesses its value. A sustained discussion of Vattel's position was very desirable, and Prof. de Lapradelle has successfully met the need; the only weakness of his monograph is occasional repetition, a fault of form inevitably arising from his division of

[1] "The Classics of International Law." Edited by James Brown Scott, President of the American Institute of International Law. (1) "Le Droit des Gens." By E. Vattel. Text (2 vols.), and Translation by C. G. Fenwick (1 vol.). (2) "De Iure Naturæ et Gentium Dissertationes." By Samuel Rachel, edited by Ludwig von Bar (1 vol.); with Translation by J. Pawley Bate (1 vol.). (Carnegie Institution of Washington, 1916.)

the matter, but readily pardoned. It does seem surprising—and surprise has not infrequently passed into resentment—that Vattel, with a mind on a much lower plane than the master-mind of Grotius, should yet have "certainly won a success equal to that of Grotius, perhaps even greater." Vattel himself would probably be as much surprised as his most caustic critic, for he was very humble indeed in his claims and expectations. Yet Vattel had the merit, and therefore is entitled to the reward, of clear statement and of popular presentment; he was fortunate in being more accessible through his language; if both sides could cite him for their opposing views, the fact stands to the credit of his fairness and candour; and if he translated Wolff's ideas into intelligible form, it was at least a good service to the science. But Prof. de Lapradelle takes pains to demonstrate that Vattel was considerably more than a populariser of Grotius and Wolff—that he broke away from them on important points, and that, even when he followed them, he improved upon them. For example:—"While Grotius and Wolff still held to the patrimonial character of the State, Vattel was the first of the writers on the Law of Nations to have a clear and concise, systematic, and co-ordinated conception of the modern State as a Nation truly free, founded on the adherence of its members, and exempt from tyranny, just as he was among the first, in the realm of municipal law, to conceive of the modern State, not as a maintainer of order, but as a promoter of happiness. This whole section of the work is truly that of a master." Again, on certain aspects of arbitration, on the interpretation of treaties, on the difficult question of diplomatic immunities, the work of Vattel cannot be ignored. And, not to cite further examples or to go into details, "without Wolff's help Vattel clearly excels Grotius in his formulation of the laws of war and of neutrality." "What Vattel lacks is a legal philosophy." Granted: the distinction between perfect and imperfect rights, though utilisable so far, yields only an apparent reconciliation of the sovereignty of the State with the subjection of the State to law. Still, is Vattel the only writer that has not managed to solve the problem?

"At a time when diplomacy recognised no other rules than caprice or interest Vattel mapped out its boundaries. At a time when the sovereignty of the State was still confused with the sovereignty of princes he formulated the rights of the Nation. Before the great events of 1776 and 1789 occurred, he had written an International Law, based on the principles of public law, which two Revolutions, the American and the French, were to make effective. . . . Vattel's 'Law of Nations' is international law based on the principles of 1789 the complement of the 'Contrat Social' of Rousseau, the projection on the plane of the Law of Nations of the great principles of legal individualism. That is what makes Vattel's work important, what accounts for his success, characterises his influence, and eventually likewise measures his shortcomings. Grotius had written the international law of absolutism; Vattel has written the international law of political liberty."

(2) Rachel's dissertations appear to have fallen into abeyance: "the original text is exceedingly difficult to procure." Dr. Pawley Bate furnishes an accurate and spirited rendering—the first English translation of the work. The introduction, by the late eminent Göttingen professor, Ludwig von Bar, gives an interesting sketch of the strenuous life of Rachel, and a brief but pointed summary of the contents of the dissertations. Dr. Brown Scott, the general editor, states concisely the grounds for including the work in this series:—"Rachel's Dissertations were in the nature of a protest against the school of natural law, of which Pufendorf was the very head and front, and contributed in no small measure to the conception of International Law as a system of positive law, and Rachel, by virtue of this work, occupies an honourable rank as a member or as a forerunner of the positive school." "To attack this [Pufendorf's] doctrine, which favoured arbitrariness, and based the Law of Nations solely upon the principles of Natural Law established by *a priori* reasoning, and at the same time to show that by the side of the *ius naturae* there exists a positive Law of Nations—this," says von Bar, "was a signal service." Rachel's claim to originality, like Vattel's, has been questioned; "writers of the late seventeenth and early eighteenth centuries, who dealt with his treatise 'De Iure Naturæ et Gentium,'" says Nys, "have remarked that its fundamental ideas were borrowed from that man of immense talent, Hermann Conring," whose lectures on public law he attended at the University of Helmstedt. Conring apparently needed an interpreter as much as Wolff did; but, however much Rachel may have been a populariser, or even (if you will) a plagiarist, he was undoubtedly a vigorous and sagacious man, capable of strong independent work, and Nys's report may be left over for future investigation. It is interesting to note that Rachel deals at considerable length with the views of some English jurists and theologians who "have devoted themselves more than others to the systematic analysis of Natural Law"—John Selden first and best, then Sharrock, Herbert of Cherbury, Cumberland, and, last, Hobbes "and his worse than barbarous philosophy." Whatever deductions may fall to be made, Rachel is still a strong link in the chain of development, and the Carnegie Institution has done good service in rediscovering him and re-introducing him to students of International Law.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE AND HORTICULTURE.

Cambridge University Press.—Plants Poisonous to Live-stock, H. C. Long (Cambridge Agricultural Monographs). *Cassell and Co., Ltd.*—Garden First in Land Development, W. Webb; Gardening: a Complete Guide, H. H. Thomas; Potatoes and Root-crops; Tomatoes and Salads; Profitable Small Fruits; The Beginner's Gardening Book. *Chapman and Hall, Ltd.*—Dairy Cattle Feeding and Management, Profs. C. W. Parson and F. S. Putney. *Longmans and Co.*—A Handbook of Nature Study and Simple Agricultural Teaching for the Primary Schools of Burma, E. Thompstone. *John Murray.*—The Book of the Rothamsted Experiments, issued with the authority of the Lawes Agricultural Trust Committee, originally edited by A. D. Hall, a new and revised edition, edited by Dr. E. J. Russell, with illustrations.

ANTHROPOLOGY AND ARCHÆOLOGY.

Chatto and Windus.—A History of Babylonia and Assyria from Prehistoric Times to the Persian Conquest, Prof. L. W. King, in three volumes, illustrated; vol. iii., A History of Assyria from the Earliest Period until the Fall of Nineveh before the Medes, B.C. 606. *Longmans and Co.*—The Folk-element in Hindu Culture: a Contribution to Socio-religious Studies in Hindu-folk Institutions, Prof. Benoy Kumar Sarkar, assisted by H. K. Rakshit. *Macmillan and Co., Ltd.*—Community: a Sociological Study, Dr. R. M. Maciver; The Origin and Development of the Moral Ideas, Dr. E. Westermarck, vol. ii., new edition.

BIOLOGY.

Cambridge University Press.—Growth and Form, Prof. D'Arcy W. Thompson. *Cassell and Co., Ltd.*—An Introduction to Biology, and Other Papers, the late A. D. Darbishire; Rockeries: How to Make and Plant Them, H. H. Thomas. *Chapman and Hall, Ltd.*—A Practical Entomology for Schools, E. D. Sanderson and Prof. L. M. Peairs. *Methuen and Co., Ltd.*—Secrets of Earth and Sea, Sir Ray Lankester, illustrated; The Mammary Apparatus of the Mammalia in the Light of Protogenesis and Phylogenesis, Prof. E. Bresslau, illustrated; British Ferns and How to Know Them, S. L. Bastin, illustrated; British Insects and How to Know Them, H. Bastin, illustrated; Vegeculture: How to Grow Vegetables, Salads, and Herbs in Town and Country, H. A. Day. *John Murray.*—The Study of Animal Life, Prof. J. Arthur Thomson, new edition, illustrated; Horses, R. Pocock, with a preface by Prof. J. Cossar Ewart. *L. Reeve and Co., Ltd.*—The Flora of Tropical Africa, vol. ix., part i., and vol. vi., section 2, continuing the Moraceæ, by J. Hutchinson. *T. Fisher Unwin, Ltd.*—Studies in Insect Life and other Essays, Dr. A. E. Shipley, illustrated.

Chemistry.

Baillière, Tindall and Cox.—Chemistry for Beginners, C. T. Kingzett. *Cambridge University Press.*—Chemistry and Technology of Oils and Fats, F. E. Weston and P. J. Fryer; Chemistry of Dyeing, Dr. L. L. Lloyd and M. Fort. *J. and A. Churchill.*—Explosives: their History, Manufacture, Properties, and Tests, A. Marshall, new edition in 2 vols. *Constable and Co., Ltd.*—Ozone: its Properties, Manufacture, and Uses, Dr. A. Vosmaer, illustrated; Chemical Calculations, Dr. H. Ashley, illustrated; Elements of Industrial Chemistry, A. Rogers, illustrated; The Theory and Use of Indicators, Dr. E. B. R. Prideaux; Mining and Mine Ventilation, J. J. Walsh, illustrated; Photography, A. H. Watkins, new edition, illustrated. *Gurney and Jackson.*—Supplementary volume to Prof. Lunge's Sulphuric Acid and Alkali, vol. i., dealing with the latest developments in this branch of chemical technology. *Crosby Lockwood and Son.*—Industrial and Manufacturing Chemistry: Inorganic, Dr. G. Martin, 2 vols., illustrated. *Macmillan and Co., Ltd.*—A Text-book of Thermo-chemistry and Thermodynamics, Prof. O. Sackur, translated and revised by Dr. G. E. Gibson. *University Tutorial Press, Ltd.*—Tutorial Chemistry, Dr. G. H. Bailey, part ii., Metals and Physical Chemistry, new edition.

Engineering.

Chapman and Hall, Ltd.—Treatise on Hydraulics, M. Merriman, new edition; Municipal Engineering Practice, A. P. Folwell; Elements of Refrigeration: a Text-book for Students, Engineers, and Warehousemen, Prof. A. M. Greene, Jr.; Water Supply, Prof. W. P. Mason, new edition; Laboratory Manual of Bituminous Materials for the Use of Students in Highway Engineering, P. Hubbard; Underpinning of Buildings, L. White and E. A. Prentiss; Concrete, Plain and Reinforced, the late Dr. F. W. Taylor and S. E. Thompson, new edition; The Design of Railway Location, C. C. Williams; The Engineers' Manual, R. G. Hudson, assisted by Dr. J. Lipka, H. B. Luther, and D. Peabody, Jr.; Elementary Cams, Prof. F. D. Furman. *Constable and Co., Ltd.*—Text-book of Motor-car Engineering, A. G. Clarke, vol. ii., Design, illustrated; Turbines Applied to Marine Propulsion, S. J. Reed, new edition, illustrated; Essentials of Electrical Engineering, J. F. Wilson, illustrated; Railway-maintenance Engineering: with Notes on Construction, W. H. Sellew, illustrated; Design of Marine Engines and Auxiliaries, E. M. Bragg, illustrated. *The "Electrician" Printing and Publishing Co., Ltd.*—The Theory of the Submarine Cable, Dr. H. W. Malcolm; Electric Measuring Instruments: their Design, Construction, and Application, Dr. C. V. Drysdale and A. C. Jolley; and new editions of Electric Mains and Distributing Systems, J. R. Dick and F. Fernie; Aitken's Manual of the Telephone; Submarine Cable Laying and Repairing, H. D. Wilkinson; Electricity Meters: their Construction and Management, C. H. W. Gerhardi; Primary Batteries: their Construction and Use, W. R. Cooper. *Crosby Lockwood and Son.*—The Aviation Pocket Book for 1917, illustrated, R. B. Matthews; The Engineer's Year-book for 1917, comprising formulæ, rules, tables, data, and memoranda, forming a compendium of the modern practice of civil, mechanical, electrical, marine, gas, and mine engineering, H. R. Kempe, illustrated; *Longmans and Co.*—Steam Turbines: a Text-book for Engineering Students, W. J. Goudie, illustrated; Tube Teeth and Porcelain Rods, Dr. J. Girdwood, illustrated; Warships: a Text-book on the Construction, Protection, Stability, Turning, etc., of War Vessels, E. L. Attwood, new edition. *Whittaker and Co.*—Manuals of Aeronautics, vol. ii., Properties of Aero-foils and Resistance of Aero-dynamic Bodies, A. W. Judge, illustrated; Modern Milling, E. Pull, illustrated; Continuous-current Motors and Control Apparatus, W. P. Maycock, illustrated; Electric Traction: A Treatise on the Application of Electric Power to Electric Traction on Railways and Tramways, A. Dover, illustrated; Power Wiring Diagrams: for users of electric-power plant, A. Dover.

Geography and Travel.

Macmillan and Co., Ltd.—Highways and Byways in Wiltshire, E. Hutton, with illustrations by Nelly Erichsen. *Methuen and Co., Ltd.*—Argentina and Uruguay, H. J. G. Ross, illustrated. *John Murray.*—Hunting Pygmies, Dr W. E. Geil, illustrated.

Geology and Mineralogy.

Chapman and Hall, Ltd.—Pocket Handbook of Minerals, G. M. Butler, new edition. *Gurney and Jackson.*—The Banket: A Study of the Auriferous Conglomerates of the Witwatersrand and the Associated Rocks, Prof. R. B. Young. *John Murray.*—Volcanic Studies in Many Lands, the late Dr. Tempest Anderson, 2nd series, illustrated.

Mathematical and Physical Sciences.

Edward Arnold.—Notes on Navigation, Naval Instructor S. F. Card, new and revised edition. *Cambridge University Press.*—The Psychology of Sound, Dr. H. J. Watt; Optical Theories: based on Lectures delivered before the Calcutta University, Dr. D. N. Mallik; A Treatise on the Analytical Dynamics of Particles and Rigid Bodies: with an Introduction to the Problem of Three Bodies, Dr. E. T. Whittaker, new edition. *Chapman and Hall, Ltd.*—Differential Calculus, H. B. Phillips; Elliptic Integrals, Prof. H. Hancock (Mathematical Monograph Series); Field Astronomy, Prof. A. H. Holt. *Constable and Co., Ltd.*—Ranges of Electric Searchlight Projectors, J. Rey, translated by J. H. Johnson, illustrated; Practical Surveying, E. McCullough, illustrated. *Longmans and Co.*—Differential Equations, Dr. H. Bateman; Practical Arithmetic and Mensuration, F. M. Saxelby and C. H. Saxelby; X-rays: an Introduction to the Study of Röntgen Rays, Capt. G. W. C. Kaye, new edition. *Methuen and Co., Ltd.*—Housecraft Science, E. D. Griffiths, illustrated. *T. Murby and Co.*—Electrical Experiments, A. R. Palmer. *University Tutorial Press, Ltd.*—Advanced Text-book of Magnetism and Electricity, R. W. Hutchinson, two vols.; Intermediate Magnetism and Electricity, R. W. Hutchinson; Elements of Physical Science, edited by Dr. W. Briggs, new edition.

MEDICAL SCIENCE.

Baillière, Tindall and Cox.—Field Sanitation, Capt. C. G. Moor, illustrated; The Organs of Internal Secretion: their Diseases and Therapeutic Application, Dr. I. G. Cobb; Physical Remedies: being Practical Treatment by Mechanical Apparatus, such as Exercise and Medical Gymnastics, Heat and Cold in Baths, Electricity, Radiation, and Massage, Dr. R. F. Fox, illustrated; The Pituitary Gland, Dr. R. B. Bell. *Cambridge University Press.*—The Spread of Tuberculosis, Dr. L. Cobbett (Cambridge Public Health Series). *Cassell and Co., Ltd.*—The Nation's Health, Sir Malcolm Morris; Electrical Treatment, Dr. W. Harris, new edition, illustrated. *J. and A. Churchill.*—New editions of Sanitation in War, Major P. S. Lelean, illustrated; and Minor Surgery and Bandaging, H. M. Davies. *Constable and Co., Ltd.*—Health and the State, Dr. W. A. Brend. *W. Heinemann.*—Malingering; or, The Simulation of Disease, A. B. Jones and Ll. J. Llewellyn, with a chapter on Malingering in Relation to the Eye, W. M. Beaumont; Painless Childbirth: A general survey of all painless methods, with special stress on "Twilight Sleep" and its extension to America, M. Tracy and M. Boyd; Studies in Forensic Psychiatry, Dr. B. Glueck (Criminal Science Monographs); Cerebellar Abscess: its Etiology, Pathology, Diagnosis, and Treatment, including Anatomy and Physiology of the Cerebellum, Dr. I. Friesner and Dr. A. Braun. *Longmans and Co.*—The Physiology of Food and Economy in Diet, Prof. W. M. Bayliss; The Secretion of Urine, Prof. A. R. Cushny. *Macmillan and Co., Ltd.*—Human Physiology, Prof. L. Luciani, translated by Frances A. Welby, with a preface by Prof. J. N. Langley, illustrated, in 5 vols., vol. iv., edited by Dr. G. M. Holmes. *Masson et Cie* (Paris).—Collection de Précis de Médecine et de Chirurgie de guerre:—Traitement des Fractures, R. Leriche, tome ii.; Hystérie-Pithiatisme et Troubles nerveux d'ordre réflexe en Neurologie de guerre, J. Babinski and J. Froment; Psychonévroses de guerre, Drs. G. Roussy and J. Lhermitte; Blessures de la Moelle et de la Queue de cheval, Formes cliniques et anatomiques, Traitement, Drs. G. Roussy and J. Lhermitte; Traitement et Restauration des Lésions des Nerfs, Mme. Athanassio-Benisty; Blessures du Crâne et du Cerveau, Formes cliniques et Traitement médico-chirurgical, C. Chatelin and de Martel; Les Fractures de la Mâchoire inférieure en Chirurgie de guerre, L. Imbert and P. Réal; Les Fractures de l'Orbite par Blessures de guerre, Prof. F. Lagrange; La Prothèse des Membres en Chirurgie de guerre, Prof. A. Broca and Ducroquet; Localisation et extraction des projectiles, Prof. Ombrédanne and R. Ledoux-Lebard; Guide pratique du Médecin dans les Expertises médico-légales militaires, Ducos and Blum. *Methuen and Co., Ltd.*—Tuberculosis, Dr. C. Riviere (Methuen's Health Series).

TECHNOLOGY.

Cambridge University Press.—Experimental Building Science, J. L. Manson, vol. i., Naval Architecture, J. E. Steele. *Constable and Co., Ltd.*—Wool, F. Ormerod, illustrated. *Crosby Lockwood and Son.*—In the "Books for Home Study" Series: Automobile Driving and Repairs, Hall and Cravens; Foundry Work, Gray; Refrigeration, Arrowood; Plumbing, Gray and Ball; Patternmaking, Ritchey and Monroe. *John Murray.*—Cotton and other Vegetable Fibres, Dr. E. Goulding (Imperial Institute Handbooks). *Scott, Greenwood and Son.*—Elementary Mathematics for Engineers and Architects, E. H. Sprague; Calculations for Steel Frame Structures, W. C. Cocking; Driving of Machine Tools, T. R. Shaw; Design of Machine Elements, W. G. Dunkley, 2 vols.; Elements of Graphic Statics, E. H. Sprague; Strength of Structural Elements, E. H. Sprague; Portland Cement: its Properties and Manufacture, P. C. H. West; Gear Cutting, G. W. Burley; Moving Loads by Influence Lines and other Methods, E. H. Sprague; Drawing Office Practice, W. Clegg; Estimating Steelwork for Buildings, B. P. F. Gleed and S. Bylander; The Theory of the Centrifugal and Turbo Pump, J. W. Cameron; Strength of Ships, J. B. Thomas; Machine-shop Practice, G. W. Burley; Iron and Steel, J. S. G. Primrose; Electric Traction, H. M. Sayers; Precision Grinding Machines, T. R. Shaw. *Whittaker and Co.*—International Technical Dictionary in English, French, Italian, and German, E. Webber.

MISCELLANEOUS.

A. and C. Black, Ltd.—An Introduction to the Physiology and Psychology of Sex: an Outline for Beginners, Dr. S. Herbert. *Cambridge University Press.*—Comptes Rendus of Observation and Reasoning, J. Y. Buchanan; Science and the Nation: Essays by Cambridge Graduates, with an introduction by Lord Moulton, edited by Prof. A. C. Seward; The Combination of Observations, D. Brunt. *Cassell and Co., Ltd.*—Psychical Investigations, J. Arthur Hill; The Borderlands of Science, Dr. A. T. Schofield. *Chapman and Hall, Ltd.*—Handbook for Rangers and Woodsmen, J. L. B. Taylor. *Wells Gardner, Darton and Co., Ltd.*—Story Lives of Great Scientists. *Macmillan and Co., Ltd.*—The Economic Annals of the Nineteenth Century, the late Prof. W. Smart, vol. ii., 1821–1830. *John Murray.*—The War and the Nation: a Study in Constructive Politics, W. C. D. Whetham. *Smith, Elder and Co.*—The Life and Letters of Sir J. D. Hooker, O.M., G.C.S.I., L. Huxley, 2 vols. *Watts and Co.*—The Origin of the World, new and cheaper edition.

RESEARCH IN INDUSTRIAL LABORATORIES.[1]

The Organisation of Industrial Research.

It is generally conceded by those engaged in the direction of industrial research that, in order to be efficient, research laboratories of this type should be as thoroughly equipped as possible. In the case of industrial concerns having a number of plants and in the case of organisations of manufacturers, the tendency of organisation should undoubtedly be towards concentration and co-operation in the maintenance of one large well-equipped research laboratory, rather than towards the erection and support of a number of smaller separated laboratories. It is, of course, necessary, especially in the case of chemical plants, that the analytical and control work should be carried out *in situ*, but experience indicates that it is much better practice to centralise the research work.

Since the policy which ensures adequate guidance to a research organisation must be based upon the accumulation of facts, method in laboratory administration should provide for facilities for securing detailed information on a vast field, and for competent counsel from those who have a store of specialised knowledge. When the laboratory executive's work has passed the one-man stage, a division of labour comes about, and it is here that he must see to it that he surrounds himself with men who are capable of effective effort—alert, original investigators of initiative and leadership.

An organised research administrative staff should result not only in effective division of labour, but also

[1] Report of a Sub-committee on Research in Industrial Laboratories, consisting of Drs. R. F. Bacon (chairman), C. E. K. Mees, W. H. Walker, M. C. Whitaker, W. R. Whitney, and presented at the meeting of the Committee of One Hundred on Scientific Research, New York, of the American Association for the Advancement of Science, December 26, 1916.

in efficient expenditure of executive energy, more effective plans, and general stabilisation. This can come about if there is a pervading organisation type of mind, which "is common to those drilled in systematic thinking and long immersed in the materials of their particular vocation. Such a mind sees details, but only as parts of a whole; reaches generalisations, but by the inductive route."

With regard to the investigatory staff, while the individual can exert only a very small influence except as a member of an organisation or institution, yet a research institution never gains note or influence except through the attainments and achievements of its individual members. The research department of a large industrial concern will be great because it has investigators on its staff who possess great originality and ability and because its director is wise and far-sighted. It is generally conceded that the personal factor is always paramount in industrial research, and that, as in every other organisation, the control of men is the real problem in laboratory administration.

A brief consideration of the conditions favourable to both pure and industrial research is pertinent in connection with any discussion of the personal organisation.

It is particularly adverse to progress to regard able investigators as abnormal men; for successful research demands neither any peculiar conformity nor any peculiar deformity of mind, but it requires, rather, peculiar normality and unusual industry and patience. It is little less inimical to expect productive work from those who are absorbingly preoccupied with other affairs than research; for fruitful scientific inquiry entails, in general, prolonged and arduous, if not exhausting, labour, for which all the researcher's time is none too much. This is the experience of the Carnegie Institution and all other research organisations. It is only to be expected, therefore, that those most likely to produce important results in research are those who have qualified for the responsibilities thereof by the completion and publication of several worthy investigations, and who are at the same time able to devote the bulk of their energies thereto. The productive researchers in our universities are those who are devoting their whole time, or practically their whole time, to investigatory work.[2]

Research should never be allowed to fall into the rut of prosaic routine. The *personnel* of the investigatory staff should be maintained at the very highest standard, and all administrative plans should be carried out with enthusiasm and earnestness.

In the research laboratories of manufacturing plants the personal co-operation of the research staff with the members of other branches of the organisation always proves an important aid in maintaining interest in the work and is, in addition, mutually educating.[3] In particular, the research department should have an *esprit de corps* that keeps things moving and should lead the way so strikingly as to be apparent to all other departments of the corporation. In consequence, mediocrity should never be tolerated. It should be borne in mind, however, that the research man can only accomplish efficient work when he is free from restraint and petty annoyances.

[2] As a rule, the head professors of chemistry in the larger universities are not giving more than three to five hours of lectures during the week, the rest of their time being devoted to research, while a number of them have one or more private research assistants, besides the candidates for advanced degrees, doing research work.

[3] In several of our largest corporations the plant superintendents make monthly reports to the research departments, including all ideas of their own or of their assistants which may in any way warrant investigation. Then, too, the salesmen report regularly to the research department regarding the various ways in which the company's products are used and what substitutes are employed for the company's products. Such plans stimulate closer thought and observation.

Co-operation is always contributory to success in a research laboratory, and, other conditions being equal, the valuable men are the ones who can and will co-operate with one another. As in business, men succeed only as they utilise the ideas and services of other men. It follows, therefore, that the strength of an investigatory staff, properly operated, should increase more rapidly than the increase of its numbers, and that a fraternal spirit will play an important *rôle* in the productiveness of any research department.

The experience in several of our most successful industrial research laboratories has clearly shown that co-operation between the different departments thereof can be adequately and completely obtained by well-planned weekly conferences on the subjects under study. While some directors of industrial research hesitate to spend the time which these conferences entail, it is the opinion of the sub-committee that conferences of this nature are worth far more than the time they take.

The Selection and Training of Students for Industrial Research.

Research leading to the discovery of new ideas requires not only intellect and training, but also initiative or genius; it can come only from an individual who possesses unusual intuition and insight. It follows, therefore, that there is a scarcity of men gifted with the genius for industrial research, and that it requires much experience in selecting suitable men and in training them to the desirable degree of efficiency, after having determined the particular qualities required.

The important requisites for industrial research are often unconsidered by manufacturers, who, in endeavouring to select a research chemist, are likely to regard every chemist as a qualified scientific scout. The supply of men capable of working at high efficiency as investigators is well below the demand; and chemists having the requisites and spirit of the researcher are indeed difficult to find even by those experienced in the direction of research. All research professors know that the location of a skilled private assistant—one who possesses not only originality, but also sound judgment and intellectual honesty—is not easy, because it frequently involves the gift of prophecy on the part of the searcher.[4] It has been truly said that the "seeds of great discoveries are constantly floating around us, but they only take root in minds well prepared to receive them."

On account of the extraordinary importance of new ideas, particular emphasis should always be laid upon finding and supporting brilliant researchers. Such individuals can best be found in the universities. The function of the university is to work with the beneficent idea of increasing the sum of human knowledge, and among its most valuable products are those who will work for the exercise of the investigative instinct and the pleasure of overcoming difficulties.

The examination of the training necessary for those proposing to take up industrial research which is common with all scientifically trained men, is too extensive a subject to be discussed by the sub-committee at this time. It is, however, appropriate to consider those subjects in which it seems desirable for the prospective researcher to specialise: reference is, of course, made to subjects other than those required by the average student of the sciences as distinguished from their industrial application, but the assumption is not made that what is desirable for research work should not also be available for all.

Research men frequently possess adequate training

[4] See discussion in *Science*, N.S., 41 (1915), p. 319.

and scientific acumen, but fail in their ability to use such. There is no question that the element most noticeably lacking in the modern graduate is *resourcefulness*. A qualified research chemist who possesses initiative is usually a creator; but owing to the neglect of existing difficulties in chemical pedagogy, the present-day graduates of our schools of chemistry are too often deficient in inspiration, ingenuity, and insight.

The failure to provide adequate and systematic instruction in chemical literature is illustrative of this contention.

Before commencing laboratory work upon any problem, it is obviously necessary to digest intelligently the important contributions which have been made upon the subject and to take advantage of what other workers have done in the same field. The average graduate is usually almost helpless when attempting to do this, and consequently requires close supervision. The main difficulties are:—

(*a*) He does not know how to go about it; he does not know where to look as the most probable source; and he is not familiar with the standard treatises and important journals.

(*b*) He fails to analyse the subject into its factors and hence generally looks for topics which are too general. Because he does not find any reference to the problem as a whole as he has it in mind, he assumes that nothing has been done upon it and that there is nothing in the literature which will be of aid to him in the investigation. Were he to separate his subject into its essential parts and then to consult the literature on each factor, he would find considerable information which he otherwise would miss.

(*c*) He does not critically digest the articles under examination, but often he makes only a few disconnected quotations and fails to interpret the work done.

The solution is to be found in the provision in the chemical curriculum, preferably in the senior year, of a course of lectures on the literature of chemistry, with particular reference to the character of the writings and the status of the authors. The purpose of these lectures should be to present a general survey of the voluminous literature and to impart an accurate, systematic working knowledge of chemical bibliography. A concurrent seminar should be devoted to indexing and tracing chemical literature, to the cultivation of an acquaintanceship with authorities, and to the solution of bibliographic problems.

The sub-committee also recommends that pedagogic attention be given to the arrangement of a course of study in the principles of technical reporting and in the criteria of literary excellence in the preparation of reports of researches and professional reports. The completion of such a subject, with its accompanying analysis, practice, and criticism, would usefully supplement the training received in chemical bibliography and would develop a capability which is much needed by chemical graduates.

It may be noted in passing that, during the academic year 1914–15, distinct courses in chemical literature and in technical reporting were established at the University of Pittsburgh. Much success has attended this pedagogic innovation.

The chemical graduate of to-day is also deplorably deficient in resourcefulness in planning research. While this is an extensive subject, a research student may be trained in correct methods of attack, namely:—

(*a*) *Analytical Methods*.—Almost all investigations require analytical control. In no feature of chemical work is there more apparent an inability to use the analytical training which the man has received.

(*b*) *Planning the Investigation*.—Resourcefulness in separating a problem into its essential factors and in clearly grasping the inter-relationship of these factors is most important. Too many men desire to start in at once and solve the problem at the first attempt. All this might be summed up in the expression "methods of research."

(*c*) *Apparatus*.—The sub-committee has not considered just how a man could be trained to be more resourceful in this respect, but it is surely a marked weakness in the average graduate. While a native cleverness is doubtless born, and not made, it ought to be possible to give the undergraduate some training in the use of his mental equipment in designing and planning apparatus which is to accomplish the desired end.

The Factors involved in the Promotion of Co-operation between Manufacturers and the Universities.[5]

The recent impetus imparted to the research activities in American chemical manufacturing has materially altered the traditional policy of industrial secrecy. A striking illustration of this improvement is to be found in the reports of the Industrial Conferences held at the fifty-third meeting of the American Chemical Society.[6] This change in attitude, a natural result of the appreciation of urgent action in industrial research, has long been desired by our universities, and it will undoubtedly result in the extension of the practice of referring certain of the problems of industry to university laboratories for study. Many of the numerous problems of chemical as well as mechanical technology could be advantageously attacked outside of the plants, but some central organisation is needed for securing and properly distributing those problems which are pressing. It is clear, however, that stable relations between the universities and industrialists will be worth while only if some mutual benefit can accrue therefrom. This co-operation can therefore be most satisfactorily promoted by actively demonstrating the advantages of the exchange or interchange of subjects for research, which primarily presupposes a reasonable freedom from the concealment of knowledge which persistently adheres to all industrial research.

Industrial research laboratories can be of mutual aid by supplying advice and materials. These laboratories should also publish reports of investigations just as freely as possible and thus, by proving the utility of it, assist in the general scheme of the universities—promote the dissemination of knowledge.

In general, the sub-committee endorses the conclusions of the University and Industry Committee of the New York Section of the American Chemical Society.[7]

The Promotion of a Better Appreciation of Research.

The promotion of a better appreciation of research by the general public can only be obtained by publicity.[8] No complaint can be made of a lack of this at the present time. The large corporations supporting industrial laboratories are themselves expending great sums on giving publicity to their research work. The sub-committee thinks, however, that though the general public now appreciates the value of scientific research, the thing required to increase the number

[5] The president of the American Chemical Society has been authorised to appoint a central committee from representatives of the universities and the industries to study opportunities and to make recommendations for co-operation.

[6] See *J. Ind. Eng. Chem.*, 8 (1916), pp. 947 *et seq.*

[7] See *J. Ind. Eng. Chem.*, 8 (1916), p. 658.

[8] It is important to mention here that the American Chemical Society has under consideration the publication of a journal of popular chemistry, a periodical for which there is a real need because of the desirability of the proper dissemination of chemical information to the public.

of laboratories is more information as to specific plans for starting and running them. General articles on the advantages of research work would be very much helped in carrying conviction if they were accompanied by definite proposals telling manufacturers of different industries and of different grades in the size of their work what they could do in the way of research work themselves.

The average person who has to decide whether his corporation will support research work can, in the nature of things, know little about it. He desires either to spend much less than is necessary for effective work, or he is frightened by the size of the expenditure which he thinks will be necessary. More specific information would enable him to form a truer idea as to what he was committing himself and what he was likely to get.

So far as possible, arrangements should be made for research institutions to have information as to their work available and to persuade them to give this information freely to inquirers. It would be a considerable step in co-operative effort if all the research institutions that can be reached could be persuaded to put information regarding themselves into some form so that a comparison could be made.

The Establishment of Stable Relations between Research Institutions and the Research Departments of Industrial Plants.

The suggestion has been frequently made that the establishment of stable relations between the types of organisations mentioned might be effected if a small group of selected representatives thereof could arrange to confer at regular times. After consideration, the sub-committee recommends the formation of an association of research institutions—that is, an association of all those bodies engaged in scientific and scientific industrial research, including such organisations as the research laboratories of Harvard University, the Massachusetts Institute of Technology, and other educational institutions, the Carnegie Institution laboratories, the Mellon Institute of Industrial Research, and the research laboratories of the corporations which are conducting a certain amount of research of scientific importance. Undoubtedly, an association of this nature would meet with satisfactory support, and it would eventually prove an important factor in improving the methods of research organisation.

Stable relations between various research organisations will be worth while only if some mutual benefits can accrue. These can be brought about by an exchange or interchange of "commodities," such as—

(*a*) Subjects for research.

(*b*) Special facilities for extraordinary conditions, such as extreme pressures, extremes of temperatures, etc.

(*c*) Special pieces of expensive apparatus.

(*d*) Helpful ideas on research already in progress.

(*e*) Candidates for employment.

This presupposes a freedom from the secrecy which still surrounds the industrial research of certain organisations. Undue secrecy is unnecessary and unwise, but it is only in those cases where publicity is compatible with industrial progress that full co-operation between the universities and the industries can be effected.

A Comparative Study of Investigational Activities.

This study would be distinctly worth while, but before the initiation of such a movement there must first be established more mutual confidence than now exists. A comparative study of this kind would be very difficult and would necessitate the expenditure of much time. Probably such information could be secured by obtaining the reports regarding the industrial research laboratories in operation, and there is no reason why a suitable questionnaire could not be prepared and distributed, in order to obtain information regarding research conditions and comparative data relating to the organisations maintaining laboratories.

It would be very useful indeed to have available a year-book pertaining to research laboratories, with the following lines of information: institutions, organisations or concerns supporting them, approximate purpose of laboratory, divisions of science represented therein, manufacturing facilities directly associated therewith, approximate annual expenditure for maintenance of research, number, and particulars relating to the training, of the members of the investigatory staff, and, finally, a list of the scientific publications for the past year. Such a book might also advantageously include mention of the special equipment of the laboratories unlikely to be possessed by every similar institution.

The National Research Council, through its committee on research in educational institutions, could well arrange to have some one whose sole duty it was to co-ordinate the work in university laboratories with reference to general or national welfare. While any attempt which may be made by a national society or association to secure co-operation between industrial and institutional laboratories will invariably encounter the difficulty of vested interests, an organisation with Governmental support might accomplish much fruitful research work through institutions of learning and in such a way that this would be of material benefit to the institutions concerned, as well as to the nation.

R. F. Bacon,
Chairman.
C. E. K. Mees,
W. H. Walker,
M. C. Whitaker,
W. R. Whitney.

Pittsburgh, Pa.,
December 15, 1916.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—On February 6 Convocation passed, *nem. con.*, a series of decrees providing for the administration of the important bequest received under the will of the late Christopher Welch, M.A., of Wadham College. The income derived from the trust is to be applied to the establishment of four scholarships, each of the value of £100 a year, for the promotion of the study of biology, and more especially for the encouragement of such students as give proof of capacity for original observation and research. Each scholarship is to be tenable for four years, and candidates may offer any one of the subjects botany, animal physiology, and zoology. The bequest is a valuable addition to the means at the disposal of the university for the promotion of scientific research.

The report of the Committee for Anthropology, lately issued, gives an account of the instruction offered during the past year in physical and social anthropology, geographical distribution, prehistoric archæology, and technology. Despite unfavourable conditions, eight fresh students entered their names on the register during the year.

Mr. E. J. C. Rennie, son of Prof. Rennie, of the University of Adelaide, has been appointed acting lecturer in electrical engineering in the University of Melbourne. He will take the place of Mr. E. B. Brown, who is about to engage in munition work in this country.

THREE letters on "Science in the School," contributed during last autumn to the *Educational Supplement of the Times* by Sir Clifford Allbutt, K.C.B., have been published in pamphlet form by Messrs. W. Heffer and Sons, Ltd., of Cambridge, at the price of 6*d*. net. Attention has been directed already in these columns (vol. xcviii., p. 241) to the argument of the letters, and it will be sufficient here to point out that the first letter may be summarised by quoting its concluding sentence:—"The 'science' we need in schools is a scientific method of teaching all things." The subsequent letters elaborate this definition. "It matters less," says the second letter, "what a boy is taught than how it is taught." "We need science in our 'classics' as we need humanity in our science." Similarly, in the third letter, we find:—"The cry of *what* is to be taught to boys is of less importance than the vision of *how* things are to be taught." "To regenerate all teaching by the spirit and method of science is far more important than the inculcation of special sciences." It may be hoped that the pamphlet will secure a wide distribution, for its lessons deserve frequent repetition in view of the reconstruction which the coming of peace will bring.

AT the opening of the New York State Museum in the State Education Building, Albany, New York, on December 29 last, Mr. Theodore Roosevelt gave an address on productive scientific scholarship, which is published in the issue of *Science* for January 5. Describing the functions of a museum, Mr. Roosevelt laid special emphasis on the need for it to give research facilities to the extraordinary and exceptional student, "the man who has in him a touch of the purple; the man who can supply that leadership without which it is so rare for even the laborious and well-directed work of multitudes of ordinary men to realise the ideal of large productive achievement." Later, in contrasting utilitarian with pure science, he said there is a twofold warrant for the encouragement of the study of pure science by the State. First, the knowledge justifies itself. Secondly, the greatest utilitarian discoveries have often resulted from scientific investigations which had no distinct utilitarian purpose. It is impossible to tell at what point independent investigation into the workings of Nature may prove to have an immediate and direct connection with the betterment of man's physical condition. The greatest need to-day, and the need most difficult to meet, is to develop great leaders, and to give full play to their activities. But it must also be our aim to develop men who, if they do not stand on the heights of greatness, shall at least occupy responsible positions of leadership.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, January 17.—Major H. G. Lyons, president, in the chair.—Major H. G. **Lyons** (presidential address): The winds of North Africa. It is now thirty years since the distribution of pressure over the region lying to the south of Europe was discussed, and during this period many new stations have been established. From the Mediterranean to the equator material is now available from about eighty stations, and a more trustworthy estimate of the distribution of pressure over North Africa and the consequent flow of the air currents can now be formed.

Geological Society, January 24.—Dr. Alfred Harker, president, in the chair.—Dr. Aubrey Strahan said that in 1914 a proposal was made to subscribe for a bust of Sir Archibald Geikie which would be presented to the Board of Education for preservation in the Museum of Practical Geology. A marble bust, executed by Prof. E. Lantéri, was presented to the board on March 14, 1916, and placed in the museum. The staff of the Geological Survey and Museum, thinking that a copy of the original model of the bust would be a suitable gift to the Geological Society of London, had caused a cast to be made, and Dr. Strahan, on their behalf, offered it for the acceptance of the society. The president gratefully accepted the gift on behalf of the fellows.—**Scoresby Routledge**: An account of Easter Island. An expedition was organised so that Easter Island, and other islands most near to it, should be thoroughly examined, and all information and material should be considered on the spot, or, if possible, be brought back for comparative study. The geologist of the expedition, the late Mr. F. L. Corry, contracted typhoid fever on the Chilean coast and never recovered sufficiently to rejoin the expedition. Hence no formal geological report on the island could be submitted. The conditions on Easter Island were illustrated by a series of photographs taken to illustrate geological features. The island was described as a plateau of basalt raised from 50 to 100 ft. above the sea. Superimposed on this were numerous cones ranging up to nearly 2000 feet. The plateau was covered but sparsely with soil, and could only be crossed with difficulty in any direct line. The cones, on the other hand, were generally smooth of surface, with a good depth of soil.

MANCHESTER.

Literary and Philosophic Society, January 9.—Prof. S. J. Hickson, president, in the chair.—F. **Jones**: Note on the action of hydrogen on sulphuric acid. Many years ago the author noticed that pure hydrogen, when left in contact with strong sulphuric acid, had a strong odour of sulphur dioxide. It appeared that hydrogen had reduced the acid in accordance with the equation $H_2SO_4 + H_2 = SO_2 + 2H_2O$. The action of *nascent* hydrogen on the acid was examined by Faraday in 1834. He found that when the strong acid was submitted to electrolysis, oxygen appeared at the anode, and hydrogen and sulphur at the cathode. Subsequent observers stated that no action took place between hydrogen and sulphuric acid at ordinary temperatures, but Berthelot maintained the opposite view. The author devised an experiment to show that action does take place at ordinary temperatures. Sulphuric acid is placed in the bulb of a non-tubulated retort containing hydrogen. The point is dipped under water, which slowly rises in the neck of the retort as the formation of sulphur dioxide proceeds.—T. A. **Coward**: An undescribed habit of the field vole. Mr. Coward said that towards the close of 1916 he found three field voles in nests, three to six feet above ground, in an osier-bed at Rostherne, Cheshire. One nest had probably been entirely constructed by the vole; the others were built upon old nests of birds. The voles were dead—one so recently that the fleas had not left it. The field vole, though capable of climbing, is terrestrial in habits, nesting on or beneath the ground; it is not known to hibernate, and is constantly abroad in hard weather. Collett records a bank vole making a similar elevated nest in Norway, but as an exceptional case. The osier-bed is frequently flooded, and during the frosts and thaws in December underground nests would have been death-traps, and the cause of death may perhaps be explained by the rapid changes in the weather, driving the voles to the elevated but exposed positions, where from habit they gathered only the quantity of material which would have sufficed to protect them in a burrow.

EDINBURGH.

Royal Society, December 4, 1916.—Dr. J. Horne, president, in the chair.—Miss Margaret **Ferguson**: The family budgets and dietaries of forty labouring-class families in Glasgow in war-time. The paper was founded upon statistics which had been gathered in connection with the investigation into the causes of rickets now being carried out by the Medical Research Committee of the National Insurance Act. The average income in war-time was about 42 per cent. higher than in the years preceding the war, and the average expenditure for food and rent was 37 per cent. higher. The supply of food energy was much the same. The consumption of proteins had fallen, that of fats risen, the latter fact being explained as due to the increased consumption of margarine. While the cost of food had risen about 50 per cent., the cost of living had increased only 36 per cent., thus leaving a greater surplus for other expenditures.—P. **MacNair**: The Hurlet sequence in the east of Scotland. The purpose of the paper was to correlate various members of the lower Limestone series of the Carboniferous rocks in the east and west of Scotland, and, in particular, to compare certain sections in the east with the well-known sequence at Hurlet between Glasgow and Paisley. The various Limestone horizons which were so correlated were characterised by a faunal association by means of which they could be traced over wide areas. This faunal association had been discovered by the author everywhere in the same position throughout the west of Scotland, and a similar fauna existed at Abden, in Fife, and in other localities in the Lothians. Its importance lay in the fact that it formed a well-marked datum line from which to determine the positions of the other members of the series.

December 18, 1916.—Dr. J. Horne, president, in the chair.—G. P. **Darnell-Smith**: The gametophyte of Psilotum. This formed one of a series of investigations now being carried out in the University of Sydney.—J. **Russell**: Transverse and codirectional induction changes in demagnetised iron and nickel in relation to the molecular theory of magnetism. When a rod of iron or nickel has been demagnetised by reversals, the application of a magnetising force at right angles to the original direction of magnetisation produces induction changes in that direction. The experimental results were compared with theoretical deductions based upon certain assumptions concerning the distribution as regards orientation of the molecules constituting the magnetic matter. Good agreements were obtained.—Prof. W. **Peddie**: The magnetic test of molecular arrangement in crystals: Magnetite and the α, β, and γ forms of iron. Iron exists in these three crystalline forms, of which α is the magnetic one. The author previously showed that the magnetic quality of α crystals, as tested by Weiss, proved that the arrangement of the magnetic molecules could not be on a simple cubic lattice, but might be on a face-centred lattice. The only other possible lattice is that of the centred cube. In the present paper it is shown that this lattice also could not give the observed characteristics. Therefore, the arrangement is on the face-centred lattice. The X-ray test has already led to this conclusion. It is shown also that the centred cubic lattice arrangement readily gives a non-magnetic grouping of molecules, and, therefore, presumably exists in the β form. This leaves the open cubic arrangement as a possibility in the γ form. The value of the magnetic test is further illustrated by the possibility of a magnetic molecular arrangement in magnetite different from that given by Bragg, but also fairly well satisfying the X-ray test.

DUBLIN.

Royal Irish Academy, January 8.—The Most Rev. Dr. J. H. Bernard, president, in the chair.—D. **McArdle**: Musci and Hepaticæ of the Glen of the Downs, Co. Wicklow. The paper dealt with the moss and liverwort flora of the Glen of the Downs, a wooded Glacial "dry gap" near Bray, Co. Wicklow. Of mosses eighty species, and of hepatics thirty-seven species, were enumerated, of which about one-half were previously unrecorded from the county.

January 22.—The Most Rev. Dr. J. H. Bernard, president, in the chair.—F. L. **Hitchcock**: The simultaneous formulation of two linear vector functions. The author considers Joly's expressions for two linear vector quantities in terms of six vectors. The possibility of such reduction fails in certain cases, and methods are explained for proceeding in each case. Geometrical applications to the curve of intersection of two quadrics are given. The theorem, fundamental in the theory of quadratic vector functions, that the locus of the *irreducible* vector $V\phi\rho\theta\rho$ cannot be a fixed plane is proved.

NEW SOUTH WALES.

Linnean Society, November 22, 1916.—Mr. C. Hedley, vice-president, in the chair.—D. B. **Fry**: A new Batrachian genus from New Guinea, with comparative notes on the pectoral musculature. The new genus belongs to a group comprising sixteen out of the twenty-six genera of Brevicipitidæ (Engystomatidæ auct.) recorded from the Oriental and Australian regions, characterised by having a highly specialised, sternal apparatus, modified by the loss of the procoracoid cartilage and clavicles. Apart from sternal characters, its affinities appear to be about equally divided between Hylophorbus, Macleay (Mantophryne, Blgr., et auct.), and Metopostira, Méhely.—Dr. J. M. **Petrie**: The chemical investigation of some poisonous plants in the N.O. Solanaceæ. Part iii., The occurrence of nor-hyoscyamine in *Solandra longiflora*. The leaves are found to contain nor-hyoscyamine as the chief alkaloid. This was previously isolated and described by the author as a new alkaloid in 1907, under the name of "solandrine," and is now identified with the alkaloid which Carr and Reynolds isolated in 1912 from other solanaceous plants. Solandra also contains hyoscyamine in smaller amount, but scopolamines are absent. The total amount of alkaloid obtained was 0·17 per cent. in the leaves (dried at 100° C.).—G. I. **Playfair**: Australian fresh-water phytoplankton (Protococcoideæ). One new genus is proposed, and descriptions are given of sixty-one forms which appear to be new, eighteen being classed as species, thirty-seven as variations, and six as forms.—Dr. H. S. H. **Wardlaw**: The change of composition of alveolar air after the stoppage of normal breathing. When normal ventilation of the lungs is stopped, (*a*) by holding the breath, (*b*) by rebreathing the same quantity of air, the changes in the alveolar tensions of CO_2 and O_2 are exponential functions of the time for which ventilation is stopped. When the same air is rebreathed, the rates of change of the tensions are greater, and the final values approached are further removed from the original tensions than when the breath is simply held. In the latter case, (*a*), the values reached are close to those which have been given for the tensions in venous blood. In the former case, (*b*), the tension of CO_2 approached is considerably higher, while that of O_2 is considerably lower, being zero. Holding the breath under positive pressure seems to have no effect on the rate of change of composition of alveolar air, while negative pressure accelerates the change to the same extent as rebreathing.—Dr. J. B. Cleland and E. Cheel: Records of Australian fungi, No. 1.—R. J. Tillyard: Further researches upon the problems of the radial and zygopterid sectors in the wings of Odonata, and upon the formation of bridges. In studying the tracheation of the rare larva of Neosticta (Protoneurinæ), the structure of the zygopterid sector (Ms) was found to be normal. But occasionally a peculiar abnormality occurs in one wing, trachea M_3 becoming hitched on to Ms near its base, while the supervening imaginal venation remains normal, so that the base of M_3 appears on the larval wing as a true bridge. This suggests that bridges in general are not cænogenetic developments in the venation, as held by Needham, but that they are the archaic condition, from which the tracheation has departed by specialisation. The question of the homology between Rs in Anisoptera and Ms in Zygoptera is dealt with by a complete marshalling of all the known evidence, both structural and ontogenetic. This is shown to be absolutely against the supposed homology. As a more probable explanation, the author suggests that the presence of two oblique veins in the archaic Petalurinæ and Cordulegastrinæ indicates the presence of both Ms and Rs in these forms, but that the Zygoptera, as a whole, have lost Rs by suppression at the subnodus, while all the rest of the Anisoptera only retain Ms as the bridge-vein basally, the more distal portion having become fused with Rs.

BOOKS RECEIVED.

How We Learn. By W. H. S. Jones. Pp. vii+64. (Cambridge: At the University Press.) 1*s.* 6*d.*

Nature Study Lessons seasonably Arranged. By J. B. Philip. Pp. ix+147. (Cambridge: At the University Press.) 2*s.* 6*d.* net.

Elementary Physics for Engineers. By J. Paley Yorke. Pp. viii+165. (Cambridge: At the University Press.) 4*s.* net.

Annuaire pour l'an 1917 publié par le Bureau des Longitudes. Avec des Notices Scientifiques. (Paris: Gauthier-Villars et Cie.) 2 francs net.

The Mythology of All Races. Oceanic. By Prof. R. B. Dixon. Pp. xv+364+plates xxiii and map. (Boston, Mass.: Marshall Jones Co.)

The Problem of Pain in Nature. By C. F. Newall. Pp. 131+7 illustrations. (Paisley: A. Gardner.) 3*s.* 6*d.* net.

Science in the School. By Sir Clifford Allbutt. Pp. 20. (Cambridge: W. Heffer and Sons, Ltd.) 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 8.

ROYAL SOCIETY, at 4.30. The Dynamics of Revolving Fluids: Lord Rayleigh.—Deflection of the Vertical by Tidal Loading of the Earth's Surface: Prof. H. Lamb. Spontaneous Generation of Heat in Recently Hardened Steel: C. F. Brush and Sir R. Hadfield.

ROYAL INSTITUTION, at 3.—The Mechanism of Chemical Change: Prof. F. G. Donnan.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Frequency Changers: R Townend.

OPTICAL SOCIETY, at 7.30 - Annual Meeting.—More Notes on Glass Grinding and Polishing: J. W. French.

FRIDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 5.30.—Experimental Phonetics and its Utility to the Linguist: D. Jones.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

MALACOLOGICAL SOCIETY, at 7.—Annual Meeting. Presidential Address: Systematic List of the Marginellidæ: J. R. le B. Tomlin.

PHYSICAL SOCIETY, at 5.—A Special Test on the Gravitation Temperature Effect: Dr. P. E. Shaw and C. Hayes.—To Measure Pressure in a High Vacuum by Observation of Logarithmic Decrement: Dr. P. E. Shaw.—Note on the Calculation of the Coefficient of Diffusion of a Salt at a Definite Concentration: Dr. A. Griffiths.

SATURDAY, FEBRUARY 10.

CERAMIC SOCIETY, at 7.—Acid and Basic Furnace Lining.

MONDAY, FEBRUARY 12.

ROYAL SOCIETY OF ARTS, at 4.30.—Town Planning and Civic Architecture: Prof. A. Beresford Pite.

TUESDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 3.—Pain and its Nervous Basis: Prof. C. S. Sherrington.

WEDNESDAY, FEBRUARY 14.

ROYAL SOCIETY OF ARTS, at 4.30.—Highways and Footpaths: Lawrence Chubb.

THURSDAY, FEBRUARY 15.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Structure and Development of the Tubular Enamel of the Sparidæ and Labridæ: Dr. J. H. Mummery.—(1) Distribution in Wheat, Rice and Maize Grains of the Substance the Deficiency of which in a Diet causes Polyneuritis in Birds and Beri-beri in Man. (2) Effect of Exposure to Temperature at or above 100° C upon the Substance (Vitamine) whose Deficiency in a Diet causes Polyneuritis in Birds and Beri-beri in Man: Harriette Chick and E. M. Hume.

ROYAL INSTITUTION, at 3.—The Mechanism of Chemical Change: Prof. F. G. Donnan.

SOCIETY OF GLASS TECHNOLOGY, at the University, Western Bank Sheffield, at 4.30.—The Annealing of Glass: F. Twyman.

ROYAL SOCIETY OF ARTS, at 4.30.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—The Wet Assay of Tin Concentrate: H. W. Hutchin.—Hydraulic Tin Mining in Swaziland: J. Jervis Garrard.

FRIDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 5.30.—Authors' Dedications in the Seventeenth Century: The Dean of Durham.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Annual General Meeting.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

SATURDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 3.—The Mystery of Counterpoint: Dr. H. Walford Davies.

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

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THURSDAY, FEBRUARY 15, 1917.

AERONAUTICAL THEORIES.

(1) *Bases Théoriques de l'Aéronautique. Aérodynamique.* By Prof. N. Joukowski. Pp. xviii+227. (Paris: Gauthier-Villars et Cie, 1916.) Price 11 francs.

(2) *Dynamical Stability of Aeroplanes.* By Jerome C. Hunsaker, assisted by T. H. Huff, D. W. Douglas, H. K. Chow, and Capt. V. E. Clark. Pp. 78. (Smithsonian Miscellaneous Collections, lxii., 5; Hodgkins Fund.) (Washington: Smithsonian Institution, 1916.)

(3) *Air Screws: an Introduction to the Aerofoil Theory of Screw Propulsion.* By M. A. S. Riach. Pp. viii+128. (London: Crosby Lockwood and Son, 1916.) Price 10*s.* 6*d.* net.

(4) *Aérodonétique.* Par F. W. Lanchester. Traduit de l'anglais sur la deuxième édition par le Commandant C. Benoît. (Paris: Gauthier-Villars et Cie, 1916.) Pp. xvii+478. Price 14 francs unbound.

(1) FOR the French translation of Prof. Joukowski's work we are indebted to Dr. S. Drzewiecki. In a separate preface the latter writer emphasises the fact that the use of the principles of mathematical physics did not receive adequate attention in the early days of artificial flight, and he advocates the recognition of aerodynamics as a separate branch of theoretical science. We regret to find that whatever extraneous arguments may be and have been adduced for placing this subject on an independent footing, there is nothing, either in the translator's eloquent introduction or in the subject-matter of the book, to justify the present claim.

Dr. Drzewiecki admits the important part which the study of fluid motions has played in the development of aeronautical theories. But he fails to realise that the matter of which the book treats is hydrodynamics pure and unadulterated. There is nothing in it of a sufficiently distinct and novel character to form the nucleus of a distinct subject with such a name of its own as aerodynamics.

On the purely mathematical side, the treatment does not extend very much beyond the formulation of the equations of motion and continuity for perfect and viscous fluids, together with the pressure equation, and a somewhat diffuse treatment of the laws of vortex motion. This, together with considerations of a practical character, occupies the first five chapters. The subsequent sections contain accounts of some of the more recent attempts to solve the equations of motion in the case of cylinders and laminæ resembling the sustaining surfaces of an aeroplane. In this connection prominence is given to the theories and experiments of Profs. Kutta, S. A. Tchapliguine, and Karman, and the Aerodynamic Laboratory at Moscow is described in an appendix. It must not, however, be forgotten that there are two ways of reconciling the existence of a pressure on a moving lamina with the properties of a perfect fluid. One method is to assume that there is circulation of the fluid round the lamina. Thus, for example, a cylinder in a perfect liquid acted on by gravity tends to travel horizontally if there is cyclic motion round it. This method appears to form the basis of most of the work in Prof. Joukowski's later chapters. On the other hand, we have the theory of discontinuous motion, originated by Kirchhoff, which has now been greatly elaborated in this country by means of the Schwartz-Christoffel transformation. Of this theory Prof. Joukowski's treatment is practically *nil*.

Up to the present time very little has been done in investigating the motion of solids through *compressible* fluids. It is true that compressibility does not greatly affect the character of the motion so long as the velocities are everywhere small compared with the velocity of sound in the same medium. But this condition can scarcely be regarded as binding in the neighbourhood of a sharp-edged boundary; in fact, according to Boyle's law, the pressure would simply vanish and would not become negative at a point at which the velocity was infinite. The problems treated by Prof. Joukowski are essentially based on the hypothesis of a velocity potential satisfying Laplace's equation of continuity, and they therefore belong to the subject of hydrodynamics proper. According to the usual convention in this country, experimental and practical considerations regarding the motion of fluids are classified under the designation of *hydraulics*. It is very important that engineering students who are proposing to take up aeronautical work should be equipped with a knowledge of the necessary hydrodynamics and hydraulics, and Prof. Joukowski's lectures were probably admirably adapted to the students in his classes. But the book goes only a very little way towards covering the subject-matter contained in the English treatises on hydrodynamics of more than thirty years ago, with their chapters on sources, doublets, and images, motion in rotating cylinders in the form of lemniscates and cardioids, motions of a solid in a liquid, tides and waves, and detailed treatment of discontinuous motion in two dimensions. It is quite clear that the advanced student will find it much more helpful to turn to one of these early books for a thorough grounding in hydrodynamics than to rely on a more superficial and fragmentary treatment of the same subject, which is all that he will find in the present volume.

(2) An examination of the paper by Messrs. "Hunsaker and others" suggests that in the scientific study of aeroplane stability America is far behind Great Britain. The only part of this paper which has any claim to novelty consists in the determinations of the coefficients of stability of two aeroplanes (the Clark and Curtiss types) based on experiments with models. The methods of experimenting were identical with those used in our National Physical Laboratory, of which the details were developed by the energies of Mr. L. Bairstow.

The publication of these experimental data derives additional interest from the fact that owing to war conditions the National Physical Laboratory has been unable to issue published results of experiments with any machines other than a Blériot monoplane which was tested as an illustration of the general method before the war broke out. On the other hand, the paper deals largely with mathematical considerations, and on examination there will be found to be scarcely a single feature for which chapter and verse cannot be found in the present reviewer's "Stability in Aviation," published five years ago. It scarcely appears desirable, when so much further work remains to be done, that the resources of the Hodgkins Fund should be expended in duplicating what has previously been said and worked out in greater detail elsewhere. Furthermore, several changes that have been introduced into the treatment are open to serious objections. We all regret the discrepancy between the coordinate axes of the National Physical Laboratory papers and those used in the mathematical theories; unfortunately, as the result of mutual discussion, it is evidently impossible to break the continuity of the Teddington investigations. But there is no justification for extending this lack of uniformity to an entirely new set of investigations started in America. The main reason for objecting to the system in question is that the notation is unfamiliar to English students, all of whom have acquired their knowledge of applied mathematics, in the first instance, from the study of two-dimensional problems, and afterwards extended it to three-dimensional space. This objection applies with special force to the problem of longitudinal stability, which is essentially two-dimensional. But Messrs. "Hunsaker and others" make further changes which are not only very confusing, but out of accord with the usage of both our mathematicians and our physicists. The most objectionable feature is the use of the letter D in two entirely different meanings in the same equation with only a suffix to distinguish them. The writers would have done well to study a little more carefully the long alphabet at the end of "Stability in Aviation."

The exclusive reference to Mr. Bairstow in connection with the splitting up of the two biquadratics is open to the objection that it would be quite impossible for anyone without exceptional mathematical ability and power of insight to deduce the formulæ in question by any method of factorisation or numerical substitution indicated in the advisory committee's National Physical Report, Paper No. 77, and even verification by long multiplication is none too easy, whereas the proof in "Stability in Aviation" is perfectly straightforward and simple.

The omission of references to methods of *successive* approximation is again unfortunate when the authors come to describe the character of the lateral motions. Why, for example, is one root of the biquadratic said to represent a "spiral dive" and another pair to represent a "Dutch roll"? These things can be found partially explained in "Stability in Aviation" (although the late Prof. Harper worked the subject out in greater detail in a paper he never published) and also in Mr. Bairstow's National Physical Laboratory researches, but a reader of this paper would think that the difference in the periods and logarithmic increments or decrements was the only essential distinction.

A still worse feature of the whole investigation is that while acknowledging the influences of circular motion on stability, the writers completely ignore the "Harper effect." The present reviewer hopes that a fitting recognition may be given to the work of his former assistant and colleague, the late Lieut. E. H. Harper, M.A. (professor of mathematical physics in University College, Cork, and recently killed in action), by thus associating his name with his independent discovery that stability, both longitudinal and lateral, is greatly affected by even small changes in the inclination of the line of flight to the horizon. An aeroplane fatality has recently been reported which was clearly attributable to this cause.

It was no intention of the author of "Stability in Aviation" to extend his criticisms to statements, conclusions, and expressions of opinion which fall within the province of the physicist or engineer rather than within that of the mathematician. But apart from specific references to the two machines which formed the subject of the experiments, the similarity between the present treatment and that of the Science Monograph obtrudes itself on one's notice in the most unexpected quarters. It will be most interesting to learn whether Mr. Hunsaker fares better than did the present writer in appealing to practical men to study stability with models rather than to rely on experiments in the open air. He states (p. 5) that he actually "knew a pilot" who nearly lost his life by trying a spiral dive in the air! But when "Stability in Aviation" was in the press fatalities occurred daily, and killing off the pilots of unsafe machines was the only method that the practical man would have anything to do with. To invoke the assistance of a mathematician would have been an idea too terrible for words, and as for compensating him for his loss of time over the work, this might have cost 100*l.*, which would have been a preposterous waste of money when the same thing could be done by smashing up ten machines costing 1000*l.* each.

Mr. Hunsaker claims that laboratory experiments and calculations are superior to tests made in the open air, and remarks that "weather conditions, motor troubles, personal peculiarities of pilots, etc., tend to add to the complexity of an otherwise very simple problem." But exactly the same considerations were invoked in 1910 by the opponents of theoretical and physical methods as proving that the latter methods were practically useless. The large number of mathematical investigations (some of them in progress) that were bundled into the collection of "problems" at the end of "Stability in Aviation" will give some idea of the amount of work which, as the result of this opposition, was suspended on the ground that no useful purpose would be served by its continuance.

(3) It was in 1882 that Drzewiecki first propounded a theory of propeller action based on the supposition that if the length of a screw-blade be split up into small elements the fluid motion in the neighbourhood of any element may be regarded as two-dimensional, and independent of the differences of shape of the neighbouring elements, so that the effect is the same as if the element in question formed a section of a cylinder moving through the same medium with uniform velocity. Reference to the same method will be found in Lanchester's "Aerodynamics." But at the time of Drzewiecki's first papers the principal screws occurring in engineering practice were the propellers of ships, and these are sometimes broad enough to account for considerable divergences between theory and experiment. Parenthetically, too, it will be seen from Sir G. Greenhill's "Dynamics of Mechanical Flight" that Newton's "sine squared" law of resistance still figures largely in some of the well-known theories of propeller action.

The assumption under consideration is the same as that made by the present writer in connection with lateral stability under the title, "Further Hypotheses regarding Narrow Planes." Mr. Riach's figures of the blades of modern air screws suggest that these are sufficiently narrow to justify an investigation of their efficiency based on this admittedly rough-and-ready, approximate method.

It is the object of the present work to develop this method of investigation to its ultimate logical conclusions. This is a perfectly definite piece of purely mathematical work involving nothing harder than writing down integrals, except that the solid geometry of the screw and the different kinds of pitch associated with it is rather puzzling. It would thus be easy for anyone to work out all the results for himself, and it is doubtful whether it is worth paying ten shillings to have this done. But even if nothing else could be said in favour of the book, it is a great gain to have the formulæ ready worked out and displayed in print. And, after all, there is a great deal to be said on the subject, and there are many minor details which not everyone would think of working out. The various forms of blade proposed and described as the "efficiency curve," "rational," "normal," and "constructional limit" outlines are interesting.

Mr. Riach is under no misapprehensions as to what his investigation does and does not prove. If the fundamental assumptions are admitted, the rest follows as a logical consequence. Divergences between theoretical and experimental results will depend on the extent to which the actual stream-lines of the medium differ from those based on the two-dimensional or aerofoil hypothesis. The author finds that in many cases a fairly close agreement has been found between theory and practice, but, as he freely admits, there are cases in which the differences may be considerable. It is important to bear these facts in mind, because there is a certain type of individual, unfortunately very common, who cannot, or will not, appreciate the value of an investigation conducted in this spirit, and we can only hope that Mr. Riach will not find himself dragged into a hornet's nest of controversy by cranks and faddists. There is nothing that retards progress and wastes time so much as the irrelevant "discussions" which are so often started on a perfectly straightforward piece of work. What is now required is further comparison of theory with experiment.

The book also contains chapters dealing with the stresses in propeller-blades, their design and construction, and other similar matters. It would be well, however, to point out that in working with a theory which is at best an approximation, it would be sheer waste of time to worry about evaluating complicated integrals, as a process of summation over a finite number of elements would be sufficiently accurate. At the same time, many of the integrals are comparatively simple, and some of them can be simplified by a trigonometrical transformation to an angular co-ordinate the geometrical meaning of which is obvious from the figures.

(4) Mr. Lanchester's books are too widely known to require further comment, and Commandant Benoit has adhered fairly rigorously to the original text in his translation, not even venturing to insert a preface of his own in addition to that dated May, 1908, by the author. Probably this was the best plan, for everything has now changed so greatly that it would be impossible to bring a book up to date nearly nine years after publication.

G. H. BRYAN.

MILK AND THE PUBLIC HEALTH.

Milk and its Hygienic Relations. By Dr. Janet E. Lane-Claypon. Pp. viii + 348. (London: Longmans, Green and Co., 1916.) Price 7s. 6d. net.

THIS book is published under the auspices of the Medical Research Committee, which is charged with the administration of the Research Fund which has become available under the provisions of the National Insurance Act for the advancement of medical knowledge by research. Milk has very important relations to the public health, but the study of milk has been conducted by workers in chemistry, physiology, bacteriology, agricultural science, and clinical medicine, and the results of their researches have appeared in journals devoted to all these branches of science. With the view of collating this mass of literature, the Medical Research Committee invited Dr. Janet Lane-Claypon to assist them in collecting the available scientific evidence upon the hygienic relations of milk from all the best sources of information, however widely scattered, and the present volume is the outcome of her labours. Not only has a large mass of literature been abstracted, but critical summaries are provided in addition, and extensive bibliographies are appended to the subjects dealt with which will be very valuable to future workers.

The general composition of milk and its organic and inorganic constituents are summarised in chaps. ii., iii., and iv. The "biological" properties of milk are next considered, first the ferments or enzymes, and then the substances concerned in the production of immunity; important properties have been attributed to the former which do not, however, seem to be borne out by the clinical and experimental work which has been carried out concerning them. Breast-feeding, the nutritive value of raw and boiled milk for the young of the same and of different species, and clinical data on the nutritive value of raw and boiled milk for infant feeding and on the alleged production of Barlow's disease and rickets by the use of heated milk for infants, are rightly dealt with at some length. Dr. Lane-Claypon arrives at the conclusions:—(1) The superiority of breast-feeding over artificial feeding is striking; (2) little difference, if any, appears to be detected between feeding with raw and feeding with boiled milk; (3) the changes which occur on heating milk to a temperature of about 100° C. for a short period cannot be regarded as having any detrimental influence from the nutritional point of view; (4) there may be a connection between the *twofold* heating of milk and Barlow's disease, but the ætiology is not clear; and (5) there is no evidence to show that the use of heated milk is productive of rickets.

The cellular content of milk, the changes which ensue in milk on heating, pathogenic organisms in milk, sources of contamination of milk and the means whereby such contamination may be lessened or prevented, are other subjects dealt with.

A few errors have been noted and one or two criticisms might be made. On p. 10, in a table giving the composition of milk for different breeds of cows, the total solids are given as ranging from 26·7 to 34·7 per cent. These figures, of course, are utterly wrong (they should be in the neighbourhood of 12·0–13·0 per cent.), and it is difficult to surmise to what they refer. On p. 50 Fe_2O_3 is three times referred to as "ferrous oxide." Minute quantities of iron are present in milk—1–2 parts per million for human milk, and 0·3–0·7 part per million for cows' milk, of Fe_2O_3. May not so small a quantity be derived from admixed red-blood corpuscles? We believe that a few red-blood corpuscles are *always* present in milk, but no reference is made to this. In dealing with the composition of milk, while German and other foreign figures are largely quoted, no mention is made either in the text or in the bibliography of the numerous analyses by Droop Richmond—in fact, his name does not appear in the volume—and some of the data quoted are derived from papers twenty to thirty years old.

These, however, are minor points in a volume of such general excellence. We think the Medical Research Committee has been well advised to expend some of the funds at its disposal on the preparation of a work of this kind—a precedent which we hope to see repeated for other branches of medical science—and we congratulate Dr. Lane-Claypon on the admirable summary she has presented of so great a mass of material at her disposal. A number of plates, and of figures and charts in the text, add to the completeness of the volume, which is issued at a very moderate price.

OUR BOOKSHELF.

The Towns of Roman Britain. By the Rev. J. O. Bevan. Pp. viii+66. (London: Chapman and Hall, Ltd., 1917.) Price 2*s.* 6*d.* net.

THE compilation of this little book was suggested by the author's work in connection with the preparation of an archæological map of Herefordshire. His object, as he states it, was "to provide a compendious guide to readers who desire to study the fruits of the Roman occupation, to trace the roads they laid down, and to possess themselves of the position and essential features of the centres where they congregated for commerce, pleasure, or defence." After a short account of the history and results of the Roman occupation of Britain, Mr. Bevan gives, in alphabetical order, a short account of the chief Roman cities. This is useful so far as it goes, but it is confined to the chief Roman cities, and leaves untouched the numerous other places of interest, in particular the villas, the excavation of which has thrown such clear light on the life of the invaders. It may be hoped that the author will be encouraged to extend his survey. This scheme, carried out within reasonable limits, does not require, as he supposes, "a volume of stupendous size." If, in a new edition, he confines himself to the restricted plan which he has adopted, he would do well to add to his accounts of Roman cities references to the best authorities. A list of the more important general works on the subject would also be a useful addition.

Decennial Index of the "Analyst: The Journal of the Society of Public Analysts and other Analytical Chemists." Vols. xxxi.–xl. (1906–1915). Compiled by Muriel A. Baker. Pp. 733. (London: Simpkin, Marshall and Co., Ltd., n.d.)

THE subject-matter of this index has been classified under three heads, namely, authors, subjects, and original communications. The last group refers to papers read before, or contributed directly to, the Society of Public Analysts; the others, by far the more extensive, include also references to the numerous abstracts which form so valuable a feature of the society's journal. By the use of heavy type the name, or the subject, as the case may be, is brought prominently before the reader's eye, as is also the date of the paper indexed—a matter which is often of importance in looking up references. A system of punctuation is adopted which, combined with the heavy type, renders it easy to turn up a subject and to see at a glance the scope of the paper indexed, in so far as this is conveyed by the title and sub-title. Two instances taken almost at random will indicate the fullness of the record. The entries under "Arsenic" alone occupy three pages of the index, and those under "Milk" seven pages. In short, the index forms a valuable guide to the development of analytical chemistry in all its branches during the decennial period which it covers; and it may safely be said that during this period not much of practical importance in this branch of chemistry has been published which cannot be traced by means of the references supplied.

LETTERS TO THE EDITOR.

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

The Atomic Weight of "Thorium" Lead.

IN continuation of preliminary work published by Mr. H. Hyman and myself (Trans. Chem. Soc., 1914, cv., 1402) I gave an account in NATURE, February 4, 1915, p. 615, of the preparation of 80 grams of lead from Ceylon thorite and of the determination of its density in comparison with that of ordinary lead, which proved the thorite lead to be 0·26 per cent. denser. Taking the new international figure, 207·20, for the atomic weight of common lead, that for the thorite lead would be 207·74 on the assumption that the atomic volume of isotopic elements is constant.

This lead and the comparison sample were each distilled in three fractions, and the atomic weights of the two middle fractions were determined from the ratio, $Pb : PbCl_2$, by converting the metal into chloride, *via* nitrate, in a quartz vessel. Only single determinations were done, which gave the values 207·694 and 207·199 respectively, which are in the ratio of 100·24 to 100.

This result, which indicated clearly that the atomic volume of isotopic elements is constant, was communicated in a lecture to the Royal Institution, May 15, 1915, and to Section A of the British Association at Birmingham, 1915.

Since then Prof. T. W. Richards and Mr. Wadsworth at Harvard have shown that the density of lead derived from uranium minerals is less than that of common lead, but, as in the case of thorium lead, the atomic volume is constant. Varieties of lead of atomic weight from 206·08 to 207·18 varied in density from 11·273 to 11·337. The latter values refer to common lead.

Dr. R. W. Lawson, at present interned in Vienna but allowed full liberty to continue his investigations at the Radium Institut under Prof. Stefan Meyer, communicated to me in July last year the desire of the investigators in that institute to examine independently the atomic weight of some of my thorite lead, and I accordingly sent him the first fraction of the distilled lead, weighing some 12 grams. He has now written to me, and it is a pleasant duty first to mention that he speaks in the warmest terms of the utmost kindness and consideration shown him by the staff of the institute and of the courtesy and consideration of the police and other authorities during his internment. He reports that Prof. Hönigschmid has made four determinations of the atomic weight of my lead, according to the method of gravimetric titration and the relation of chloride to silver, and four by gravimetric analysis, whereby the weights of the chloride and silver chloride were determined. The complete mean of the eight results was $207·77 \pm 0·014$, which is in excellent agreement with my own figure, 207·74, found indirectly from the density, and shows that my single atomic-weight determination, 207·694, was not seriously in error.

It is especially gratifying to have the conclusion that the atomic weight of thorium lead is higher than that of common lead confirmed by an investigator of the training and experience of Prof. Hönigschmid. For, although the converse proposition that the atomic weight of lead from uranium minerals is lower than that of ordinary lead has, since the publication of the first paper by Mr. Hyman and myself on thorite lead, been thoroughly and conclusively established by the work of many investigators at Harvard, in Vienna, and in Paris, several of them famous for their atomic-weight determinations, doubt has lingered with regard to our results for the very much more difficult case of thorium lead. In the first place, no one but myself has been able to obtain a suitable material by which to test the question, and I, of course, can claim no previous experience of atomic-weight work. In the second place, there has been an unfortunate confusion between my material, Ceylon thorite, and thorianite, a totally distinct mixed thorium and uranium Ceylon mineral. Lastly, there has been the widespread view, due to Holmes and Lawson, Fajans, and others, mainly derived from geological evidence, that thorium-E, the isotope of lead resulting from the ultimate change of thorium, was not sufficiently stable to accumulate over geological periods of time. This confirmation from Vienna thus clears up many controversial matters, and we now know of varieties of lead differing from 206·08 to 207·77 in atomic weight, and from 11·273 to 11·376 in density, the atomic volume in all cases examined being constant.

According to analyses by Miss A. F. R. Hitchins and myself, the 20 kilos of selected thorite worked upon contained 0·4 per cent. of lead, 57 per cent. of thorium, 1·03 per cent. of uranium, and 0·5 c.c. of helium per gram. Taking the ratio of the period of thorium to that of uranium as 3·2, and assuming that *the whole of the lead is of radioactive origin and is stable*, 94·5 per cent. is derived from thorium, and 5·5 per cent. from uranium. If 206·0 is the true atomic weight of uranium lead, Prof. Hönigschmid's value, 207·77, for thorite lead gives the figure 207·87 for the atomic weight of thorium lead, whilst his figure, 232·12, for the atomic weight of thorium gives a total loss of 0·25 unit of mass in the six α- and four β-ray changes suffered by the thorium atom. From these data and from Silberstein's and his own theories of mutual electromagnetic mass, perhaps Prof. Nicholson may be able to give us further information as to the constitution of the nucleus of the thorium atom.

FREDERICK SODDY.

Marischal College, Aberdeen, February 1.

The Bursting of Bubbles.

PRESUMABLY all bubbles when they burst on the surface of a liquid commence to do so at the top and thus give rise to gaseous vortices. In the ordinary way these are not apparent, but recently we have accidentally discovered a neat way of making them easily visible. The method consists in creating the bubbles by sparking with a Ruhmkorff coil between two wires beneath the surface of some resin oil and thus gasifying the latter. As the bubbles are full of smoke, when they burst the vortex effect is clearly indicated by the formation of beautiful little smoke rings. The size of the bubbles and of the rings depends upon the viscosity of the oil, greater viscosity causing bubbles and rings to become larger. This can easily be shown by cooling or warming the oil.

A. A. CAMPBELL SWINTON.
EVELYN BEALE.

66 Victoria Street, London, S.W.
February 6.

A Plea for a Scientific Quadruple Entente.

THE letter of Prof. Eugenio Rignano in NATURE of January 25 may have recalled to some a discussion on literature which took place in Section D at the British Association meeting at Manchester in 1915, a discussion which was introduced almost precisely from the same point of view as that now given by Prof. Rignano. It is the fact that Germany, by welcoming and publishing papers in French, Italian, and English, as well as in German, and by printing the material practically as fast as it arrived, had gained an ascendancy and even an actual or presumptive international position with regard to scientific publication. For example, the *Internationale Revue der gesammten Hydrobiologie und Hydrographie* is published in Leipzig, and it must be confessed that it is conducted with considerable ability and adequately fulfils its function. Such works, too, as the "Nordisches Plankton" show how keen our present enemies have been in publishing monographs which have become indispensable. It is not necessary, however, to look for sinister intentions in the progress which Germany has made in publication. In all countries scientific literature has had a similar history, and its evolution may be said to mark the progress made by each with respect to science. In all countries, societies, museums, and laboratories have sought an outlet for their investigations by publications which have the primary advantage of securing by exchange similar publications from institutions at home and abroad.

The result is somewhat chaotic, and for this reason we are thankful to the societies and publications and agencies which attempt to give us periodical lists of literature and summaries of papers. I confess I do not see how the national output of scientific papers is to be controlled, or, indeed, if it is desirable that it should be controlled. This is a matter which it appears must be left to the editor and the writer. But now that our attention has been directed to the subject, the opportunity should be taken to discuss whether we should be content with pre-war conditions, or if improvements could be suggested so far as the nation is concerned, and especially with regard to the control of such publications as are meant to be international in character. We have to recognise that each country must necessarily have an output of material for publication for which provision must be made. The fact that so many English papers have been published in Germany raises the question whether the provision is adequate. It might be suggested that each country should publish its own material, and that the desirability of publishing year-books bringing together summaries of the important papers and discoveries in each subject should be considered. If this were done by each country, probably the necessity for international journals would disappear, and better so, for it would be difficult to determine in each case which country and which language to choose.

An improvement of great value would result if a suggestion which has been made before were carried into effect, viz. that a size of page for octavo and for quarto periodicals should be decided upon. If this were agreed to by each country, and the effort made to issue the more monographic papers separately, it would be possible to bind in any way suitable to the institution or worker. A. MEEK.

Armstrong College, Newcastle-upon-Tyne, January 27.

Science in Education.

ON p. 432 of your issue for February 1 it is stated in an unsigned article that "in the early fifties of the nineteenth century a little experimental science crept in almost shamefacedly, introduced by the peripatetic teacher with his box of tricks." Then after mentioning Queenwood in 1847 it goes on: "But it was not until twenty years later that this example was followed in other schools. Then Clifton took the lead in 1867, and was followed immediately by the Manchester Grammar School."

Your correspondent is not very well informed.

At Rugby in 1849 William Sharp, F.R.S., was appointed by Dr. Tait reader in natural philosophy, and gave systematic teaching to classes of boys. He was succeeded by Henry Highton, a distinguished electrician (see Arago's "Tonnerre"), who taught chemistry and physics to about forty boys. He became headmaster of Cheltenham College in 1859, and Dr. Temple appointed me to succeed him. A chemical laboratory was built, and I taught physics, chemistry, and a little geology to somewhat larger classes. Then in 1865, after the Public Schools Commission, a great increase in science teaching took place; the Rev. T. N. Hutchinson was appointed to take chemistry, and Mr. Kitchener took botany with large classes. I went on with physics and geology. All this happened before 1867.

Clifton College is an excellent school, but it need not be exalted at the expense of its mother.

JAMES M. WILSON,
Sometime mathematics and science master at Rugby, and afterwards headmaster of Clifton College.

OBVIOUSLY the article referred to did not profess to give a complete history of the introduction of science teaching into schools. That would be a long story, and would necessitate reference to several schools besides Queenwood, such as the Friends' School at Ackworth, in Yorkshire, where for many years some teaching of science subjects had been established long before Rugby and other public schools had made a beginning. The claim for Clifton is based on the fact that it is believed to have been the first great school in which natural science was introduced as a constituent of the curriculum imposed on *the whole school* (except the Classical VI.), and not as a voluntary subject taken up by a small number of boys as an alternative to modern languages or other subjects, as was the case at Rugby in 1859.

THE WRITER OF THE ARTICLE.

"Frost Thistles."

IN NATURE of January 11 Dr. R. T. Gunther describes a very beautiful freezing effect. I recently obtained a similar effect on a much larger scale. One of the large bottles, holding several litres, used for collecting rainfall in the London parks, in connection with the investigation of atmospheric pollution, was found, when brought into the laboratory for examination, to contain a hollow cylinder or annulus of ice, perforated with silvery air-tubes arranged, as Dr. Gunther remarks, for all the world like lines of force round a magnetic pole. We were unable to detect any visible specks of solid matter at the peripheral ends of the tubes; but these ends were pointed, whereas the inner ends were rounded and expanded, probably terminating thus where ice and the central core of water met. The surface of this central portion was covered with a scum of air-bubbles. One feature which was noticed particularly was that, in addition to the air-tubes, other channels filled with something (probably liquid water containing dissolved matter) were arranged radially throughout the mass.

The water represented the accumulated rainfall of January, and, in addition to matters in solution, contained an appreciable deposit. It is, therefore, quite probable that small particles were present on the sides, and thus formed collecting points for the air first liberated when congelation began.

The various points observed agreed entirely with those already described, except that the very much larger quantity of water had not solidified throughout its mass. If this had occurred it would have probably been a slow action and the opaque central mass would not have been seen. J. H. COSTE.

Teddington, February.

Note.—Since writing the above I have seen another mass of ice solid throughout, which had broken the bottle; a small opaque central cylinder, or inverted cone, was observed.—J. H. C.

THE NATION'S FOOD.[1]

An important White Paper has just been issued which deals with this most pressing problem of the day. It is a report drawn up by a committee of the Royal Society at the request of the President of the Board of Trade. The committee consists of physiologists (Profs. A. D. Waller, chairman; F. G. Hopkins, Noël Paton, and W. H. Thompson) and agriculturists (Mr. A. D. Hall, Mr. T. H. Middleton, and Prof. Wood); the remaining names are those of Prof. Ashley of Birmingham, and Mr. Flux of the Board of Trade. It is a sign of the times that scientific men of this type should be called in to advise the Government, and an earnest of that scientific mobilisation in the nation's service that we all long to see fully accomplished. Physiologists have always taken the flattering unction to their souls that all their work is for the benefit of humanity, but it is not often that they have had such a striking opportunity of placing their knowledge to such an immediate practical use, or, what is more, seen their recommendations so promptly acted upon. The report in question is crammed full of valuable statistical data, and it, moreover, possesses the rare merit of being clear and brief. There can be no doubt that the recent actions of the Government in reference to the milling of flour and the limitation of grain used in brewing have been the direct outcome of this report. The more recent enactment relating to the voluntary restriction in meat, flour, and sugar which Lord Devonport has suggested is also founded on the general principles here laid down.

The first section of the report deals with the period before the war, and it is remarkable that the allowance then of protein, fat, and carbohydrate should so closely have coincided with the standard dietary usually associated with the name of Voit. Per head per day, these figures are a little below the Voit regimen, and give a total of 3090 Calories; but per "man" (*i.e.* making due allowance for women and children, whose needs are smaller), it works out above the standard (4000 Calories), so that a margin of waste was provided for. Part ii. deals with the year 1916, and shows that here again the available food was more than sufficient, so that reduction is possible; but the increase in prices has accentuated inequalities of distribution, and, as the committee points out, reduction below the necessary amount causes a large diminution in the working capacity of the individual. Organisation in distribution is therefore called for; it would be foolish economy to produce a harmful effect upon the working population who form the backbone of the nation in its present crisis.

The final section of the report treats of methods of economy. The milling of flour and the reduction of beer we have already alluded to, but one important set of recommendations still remains to be mentioned; it deals with meat production, and is important as it is probably here that we shall shortly be experiencing the severest pinch. One of the recommendations is that cattle should be slaughtered at seventeen months old instead of two and a half years; such young beef would be a little poorer in fat, but that is counterbalanced by the enormous saving in feeding-stuffs; economies may also be effected by certain changes suggested in the amount and character of the fodder employed. Finally, an increase in the making of cheese as compared with butter is urged.

These are the main features of the report, but the full report, which can be obtained for fourpence, is worth careful perusal and study.

Although it is dated 1917, it was drawn up last year—that is, before the threatened renewal of the German submarine menace; and until that menace is overcome the people of this country must first loyally and faithfully abide by the restrictions imposed by Lord Devonport's decree, and next be prepared for still further and more stringent reductions which may be rendered necessary either by the partial success of the German blockade, or by their own foolishness in not following out the present voluntary system. For it must be clearly understood that although the figures of the present allowance are within the normal physiological limits, there is no margin for waste now; some difficulties may be experienced in getting along with 4 lb. of bread or its equivalent in flour per week, but that is only because bread has come to be regarded, not in the proverbial, but in the actual sense, as the staff of life. Many nations and vast populations never eat wheaten preparations. We do not want to advocate the Japanese dietary; that has its own peculiar evils. Still, the carbohydrate supply, which is the biggest fraction of our daily food, may be made up by a more generous use of rice and other grains which are comparatively neglected by the average Englishman, just as the protein supply in meat may be compensated for by the greater utilisation of the protein-rich pulses.

One omission we notice in the report which furnishes the text for this article, though it must have been in the minds of the authors, and no doubt was a factor in their resolve to recommend the use of "straight-run" flour. We mean the "vitamine" question. Pure protein, fat, and carbohydrate, with the necessary salts and water in addition, will not maintain health, still less promote growth. Certain unknown food-accessories in small quantities are necessary also: some of these so-called vitamines are present in the outer portion of the grains, but others equally vital are only soluble in fat, and are particularly abundant in butter. As they are absent in the vegetable fats, and so much vegetable fat is used in the preparation of butter substitutes, it really is a matter of national importance that the inferior nutritional value of the cheaper brands of margarine should be widely known.

[1] "The Food Supply of the United Kingdom." A Report drawn up by a Committee of the Royal Society at the request of the President of the Board of Trade. (Cd. 8421.) Pp. 35. Price 4*d*. net.

THE NEW CANADIAN OBSERVATORY AT VICTORIA, B.C.

THE erection of the new Canadian Government Observatory on Saanich Hill (elevation, 732 ft.), near Victoria, B.C., is progressing very

FIG. 1.—The Canadian Observatory at Victoria, B.C., on July 15, 1916.

satisfactorily, as the accompanying illustrations show.

The dome, which is 66 ft. in diameter and weighs 120 tons (of 2000 lb.), was completed by the Warner and Swasey Co. in March last, and, after being put together and tested at Cleveland, was shipped on March 28. It reached Victoria about April 15, and the structural work was finished about July 1. Both the building and the dome have double walls of sheet-iron, with openings at the foot of the walls and louvres at the top of the dome. Being entirely of metal, the building quickly assumes the temperature of the surrounding air, which circulates freely between the double walls. Though so massive, the dome revolves with great ease.

The mounting of the telescope was complete in May, and on May 25 its operation was shown to a number of invited guests. After the inspection a luncheon was given by Messrs. Warner and Swasey, the guest of honour being Dr. J. S. Plaskett, who will be director of the new observatory. The instrument was then taken down, and after a few slight additions was finally shipped from Cleveland on July 29. It reached Victoria on August 15. The erection began on September 5, and the heavier parts were in place in ten days. However, considerable time was required for the wiring, as seven motors are used to produce the various motions. Fifty wires pass through the polar axis, thirty-four of them being led along the declination axis.

Fig. 1 shows the condition of the building on July 15. The walls are covered with sheet metal, and the dome is ready to receive its sheathing, which was fastened to the lighter iron strips passing in horizontal circles about the dome. In Fig. 2 is shown the way in which the 9½-ton polar axis was transported from Victoria to the summit, a distance of 9½ miles, over the new road built by the British Columbia Government. The great mass of iron left Victoria at 5.30 a.m., August 28, and was at its destination at 1 p.m. The observatory and an observer's house (the only one yet built) are seen in the background. In Fig. 3 the telescope is shown. As will be seen, the mounting is of the English type. The polar axis is nearly

FIG. 2.—Transporting the 9½-ton polar axis to the Observatory, August 28, 1916.

23 ft. long, and consists of two conical tubular portions bolted to a central cubical section.

These are castings of the best steel. The driving clock is at the lower end of the axis. The worm-wheel by which the axis is turned is 9 ft. in circumference, and weighs 2 tons. When hoisted into its position the entire weight of the polar axis was about 14 tons. The approximate positions of its bearings had been determined beforehand by means of a wire stretched from one to the other and adjusted by observations with a surveyor's transit. The declination axis is a steel forging $5\frac{1}{4}$ tons in weight, $14\frac{1}{2}$ ft. long, and $15\frac{1}{2}$ in. in diameter.

The telescope tube is composed of three sections. At the bottom is the steel mirror cell, $7\frac{1}{2}$ ft. in diameter, which, with mirror counterpoises and mirror, weighs 6 tons. It is bolted to the central section, a steel casting 6 ft. long and weighing 7 tons; while surmounting this is the skeleton tube, more than 23 ft. long, and weighing, with attachments, about 2 tons. Through the centre of the mirror there is a circular hole $10\frac{1}{2}$ in. in diameter, and behind this the eyepiece is placed when the telescope is used as a Cassegrain reflector. There are two 4-in. finders, one on each side of the tube, and one of aperture 7 in. and focal length 30 ft. To assist in the adjustment of the axis of the telescope, the long-focus finder was mounted centrally in the tube. The objective can be seen at the upper end of the tube (Figs. 3 and 4), and the eyepiece at the centre of the mirror cell. The correction required to be made to the upper end of the polar axis was 1/50 in. in altitude and 1/25 in. in azimuth. The observing platform is seen near

FIG. 3.—The 72-in. reflector, October 22, 1916.

the upper end of the tube. It is moved up and down the shutter opening on rails fastened to the main ribs by cables operated by an electric motor. At each side of the platform are wings, one of which is shown in the figure, movable in and out, to embrace the tube at any convenient position for observing.

In order to operate the telescope there are two similar switchboards on the south pier, one on each side, that one being used which happens to be most convenient. In operation the assistant will stand at either one of these switchboards and set the telescope and dome to the required approximate position by means of the three operating switches shown on the switchboard. The one on the left turns the dome east or west at the rate of 60° per minute, the centre one moves the tube north or south 45° per minute, and the switch

FIG. 4.—The Observatory, October 22, 1916. The shutters are open their full width (15 ft.), and the wind-shield is seen before the telescope.

to the right moves the whole telescope east or west on the polar axis 45° per minute. The push-button switches above serve to illuminate the declination, sidereal, and hour circles, by which the approximate positions are obtained, and to clamp and unclamp the slow motions in R.A. and Declination. The fine setting and guiding are performed by the observer at either the upper or lower end of the tube by small keyboards carried by him when observing, the one at the lower end being shown attached to the cable passing across the lower end of the cell. By pressing the keys on this board two motions are given in either direction in either co-ordinate, the fast one for fine setting 1° in five minutes, and the slow one for guiding at 1/20th of this speed. The telescope responds instantly to all these motions, and can be handled with as great ease as a small refractor.

When it is desired to remove the mirror from the telescope the tube is turned to a vertical position, and a carriage running on rails is brought under it and raised to the required height to receive the cell as it is unbolted from the tube. As the mirror and cell weigh almost 6 tons, a steel strut, running in vertical guides below the floor and counterweighted so as to be easily raised or lowered, is brought up and placed under the other end of the declination axis to prevent it from sinking downwards.

The entire mass of the moving parts is 45 tons, and yet it moves with the greatest ease and smoothness. A small pressure on the upper end of the tube suffices to put it in motion, while the power required to move the telescope at quick speed over that required by the motors when running idle is about 50 watts. The electric power required for the various purposes at the observatory is obtained from the British Columbia Electric Railway, which runs along the foot of the hill. By means of a motor-generator it is transformed from three-phase alternating to direct current at 220 volts.

The great mirror is not yet completed. It is 73 in. in diameter, 12 in. thick at the edge, and weighs 4340 lb. The face was made spherical some time ago, and work on parabolising it is proceeding. This has been delayed through the lack of a sufficiently large plane mirror for testing. Such a mirror has been under construction for some time by the John A. Brashear Co., which expects to have the great mirror completed by the spring, in which case the regular work of the observatory will begin next summer.

The mounting and adjusting of the telescope were under the immediate direction of Dr. Plaskett. Indeed, the entire project must be considered largely his own creation. It was he who first proposed it, and his enthusiastic advocacy of it led the authorities to approve of its construction; his experience as an observer and his great mechanical skill have had much to do with the perfection of the instrument; and his energy is shown in the rapid progress which has been made.

C. A. CHANT.

NOTES.

THE New Year Honours List, the publication of which had been postponed, was issued on Monday, and contains, among others, the following names:—Dr. R. Armstrong-Jones, Prof. R. Lodge, Edinburgh, Mr. V. L. Raven (formerly chief mechanical engineer of the North-Eastern Railway Co.), and Prof. P. Vinogradoff, Oxford (the honour of knighthood); Dr. A. Newsholme (K.C.B.); Sir Cecil Harcourt-Smith, Victoria and Albert Museum (C.V.O.); Dr. F. Watts, Imperial Commissioner of Agriculture for the West Indies (K.C.M.G.); Mr. L. Rodway, Government Botanist, Tasmania (C.M.G.). A later list states that the honour of knighthood has been conferred upon Prof. Jagadish Chandra Bose, of Calcutta, and Rai Bahadur Sundar Lal, Vice-Chancellor of the Benares Hindu University.

THE committee of the Athenæum Club has elected the following under the provisions of the rule of the club which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services":—Sir R. Hadfield, Field-Marshal Sir Douglas Haig, and Prof. G. Gilbert A. Murray.

THE Advisory Council of the Government's Department of Scientific and Industrial Research has added to the list of its technical committees a Standing Committee on Glass and Optical Instruments. The membership of the committee is at present as follows: Prof. H. Jackson (chairman), Mr. Conrad Beck, Prof. C. V. Boys, Mr. F. J. Cheshire, Mr. A. E. Conrady, Mr. A. S. Esslemont, Mr. J. W. French, Dr. R. T. Glazebrook, Sir Howard Grubb, Mr. E. B. Knobel, Dr. T. R. Merton, Prof. J. W. Nicholson, Capt. Creagh Osborne, Mr. H. J. Stobart, Mr. J. Stuart, Mr. M. P. Swift, Mr. W. Taylor, Mr. F. Twyman, Lt.-Col. A. C. Williams, and Mr. W. F. J. Wood. The committee, having regard to the urgency of the problems requiring investigation in respect of these essential industries, has appointed a series of sub-committees to which various special problems have been referred. Among these problems the more important are: (*a*) Raw materials for glass and glass-making. (*b*) Optical properties of a large range of glasses. (*c*) General physical and chemical properties of glass and glassware for scientific and industrial purposes. (*d*) Testing and standardising of glassware. (*e*) Workshop technique. (*f*) X-ray glass apparatus. (*g*) Optical calculations and lens designing. (*h*) Optical instruments. (*i*) Translation of foreign works on optics. The Standing Committee does not propose to limit itself to these subjects, but is prepared to consider and report upon the necessity for investigation in other directions relevant to its terms of reference. Manufacturers who have experienced difficulties requiring investigations for their solution in connection with the subjects of glass and optical instruments, or who desire to make suggestions for special researches on these subjects, are invited to communicate in the first instance with the secretary of the Research Department, Great George Street, Westminster, S.W., who will direct the correspondence into the appropriate channels for attention.

THE Food Controller has appointed the following committee of manufacturers of sulphate of ammonia to advise him on questions affecting its production and distribution, and to give effect to an approved scheme for regulating the distribution of supplies to farmers in all parts of the United Kingdom:—Mr. D. Milne Watson (chairman), Mr. W. Fraser, Mr. E. J. George, Mr. W. R. Hann, Mr. N. N. Holden, Mr. A. K. McCosh, Alderman F. S. Phillips, Mr. A. Stanley, and Mr. F. C. O. Speyer, secretary.

THE Director of Army Contracts, War Office, has issued a circular letter to timber merchants directing attention to the fact that the Army Council has assumed control of all stocks of soft wood, planed and unplaned, excluding pit-props, in the United Kingdom. This step has been taken owing to the urgent necessity of safeguarding essential supplies of timber for military purposes, and in view of the growing scarcity of tonnage it is imperative that existing stocks of wood shall be conserved to the utmost, and that no wood shall be consumed for any purpose not essential or where any substitute for wood can be utilised. Pending further regulations, which will be drawn up in consultation with the Timber Trades Federation, dealings in the timber referred to will be permitted, subject to the conditions laid down in the letter.

MAJOR P. A. MACMAHON has been elected president of the Royal Astronomical Society in succession to Dr. R. A. Sampson.

The gold medal of the Royal Astronomical Society has been awarded to Prof. W. S. Adams, of the Mount Wilson Observatory, California, in recognition of his research work and papers on solar and stellar spectroscopy.

A branch of the Ministry of Munitions, to be known as the Munitions Petroleum Supplies Branch, has been established. It will deal with the provision and distribution of petroleum and similar mineral oils for the purposes of the Ministry, and be under the direction of Mr. E. Houghton Fry. Sir Boverton Redwood has consented to take charge of the research section, and will be known as Director of Munitions Petroleum Research.

The Marquess of Crewe has been appointed a member of the Committee of the Privy Council on the Organisation and Development of Scientific and Industrial Research.

The following awards of the Society of Engineers (Incorporated) were presented on February 5: The president's gold medal to Prof. C. G. Cullis for his paper on "The Mineral Resources of the British Empire as regards the Production of Non-Ferrous Industrial Metals"; the Bessemer Premium to Prof. W. G. Fearnsides for his paper on "The Mineral Requirements of the British Iron and Steel Industries"; the Bernays Premium to Prof. J. A. Fleming for his paper on "Engineering and Scientific Research"; the Nursey Premium to Mr. J. E. Lister for his paper on "Modern Coal and Coke Handling Machinery as used in the Manufacture of Gas"; and the Society's Premium to Mr. Ewart S. Andrews for his paper on "The Design of Continuous Beams."

The Alvarenga prize of the Swedish Medical Association for 1916 has been awarded to Dr. E. Nilsson for his study of the physical development and fitness for military service of the young men of Sweden between the years 1861 and 1913. The jubilee prize of the association has been won by Mr. H. B. Lundborg for his medical-biologic study of generations of certain Swedish families.

The following have been elected as the officers of the Optical Society for the year 1917–18: *President*, Mr. F. J. Cheshire; *Hon. Treasurer*, Mr. H. F. Purser; *Hon. Secretary*, Mr. W. Shackleton; *Hon. Librarian*, Mr. J. H. Sutcliffe; *New Members of the Council*, Mr. L. G. Martin, Dr. W. Rosenhain, Mr. T. Smith, Mr. F. Twyman, Dr. R. Mullineux Walmsley, Mr. R. S. Whipple, and Lt.-Col. A. C. Williams.

The annual general meeting of the Institution of Mechanical Engineers will be held at the Institution of Civil Engineers, Great George Street, Westminster, at 6 o'clock to-morrow evening, when the annual report of the council will be presented, and a paper read by Dr. W. Mason entitled "Alternating Stress Experiments."

The trustees of the late Lord Kitchener have loaned to the London County Council, for exhibition at the Horniman Museum, Forest Hill, the collection of Eastern weapons and armour made by Lord Kitchener. Most of the weapons of northern India, and of the advanced peoples of other parts of India, are represented in the collection, together with a few from Persia, China, Japan, the Sudan, and elsewhere. The collection is in course of arrangement, but may be seen whenever the museum is open to the public.

We regret to have to record the death, on Sunday last, at the age of sixty-nine years, of the Duke of Norfolk, Chancellor of the University of Sheffield.

The *Aurora*, under the command of Capt. J. K. Davis, with Sir Ernest Shackleton on board, arrived at Wellington, N.Z., last Friday, bringing the survivors of the Ross Sea party of the Imperial Antarctic Expedition. A despatch from Sir Ernest Shackleton to the *Daily Chronicle* amplifies the brief account sent by wireless last week, which announced the death of Capt. Macintosh, Mr. V. G. Hayward, and the Rev. A. P. Spencer Smith. Between January and March, 1915, this party of men had been engaged in laying depôts as far as 80° S. lat. in anticipation of Shackleton's cross-continental journey. On March 14, 1915, one sledge party returned to Hut Point three days after the *Aurora* had been forced to move to Cape Evans on account of MacMurdo Sound freezing. Eight days later the second sledge party returned, badly frost-bitten, and having lost all their dogs. Open water or thin ice prevented their reaching Cape Evans until June 1, when they found the *Aurora* had gone. The winter was spent in the hut at Cape Evans. Provisions were abundant, but coal was short, as the main coal supply had been washed away soon after being landed. Blubber, however, served as fuel, and the deficiency in clothing was made good from the materials left by the Scott expedition. In September, 1915, a sledge party again set out for the south, and a depôt was successfully laid near Mount Hope, at the foot of the Beardmore Glacier, on January 26, 1916. Two of Capt. Scott's sledges were found. On the return journey scurvy appeared among the party, and Capt. Macintosh and Mr. Spencer Smith were seriously affected. Near One Ton Depôt they were overtaken by a furious blizzard, just as Scott was, from February 17 to March 1, but they decided to push on, as their provisions were very short. Forty miles from Hut Point the strength of the six men was almost exhausted. Capt. Macintosh then elected to be left behind to give the others a chance, as neither he nor Spencer Smith could walk, and had to be carried on sledges. The following day (March 9) Spencer Smith died, and two days later Hut Point was reached. A relief party succeeded in bringing Capt. Macintosh back in safety. Early in May the ice between Hut Point and Cape Evans seemed thick enough for travel, and Macintosh and Hayward, who had by that time recovered from scurvy, set out to reach Cape Evans, but broke through thin ice on the way and perished. The winter of 1916 was spent in sledging stores from Shackleton's old hut at Cape Royds to Cape Evans, in view of a possible third winter of detention. On January 10 this year the *Aurora* arrived at Cape Evans and picked up the seven survivors, H. E. Wild, E. Joyce, A. Stevens, Cope, Gaze, Richards, and Jack. No new geographical discoveries were made and none were expected, for this Ross Sea party was merely a supporting one in the event of Shackleton crossing the continent. However, the meteorological records will prove of great value.

By the death of Dr. C. V. Burton on February 3, owing to an accident at the Royal Aircraft Factory, the country loses a mind of great originality and power. In 1891, when his strain figure theory of the constitution of matter was first published, he was only twenty-four years of age, and had already shown his capability as an investigator. During the next four or five years he added greatly to his reputation by his papers on the propagation of explosive waves through gases, on the rise of pitch of the note of a tuning-fork as it dies away, and on the mechanism of electrical conduction in metals. In 1905 he gave in these columns an account of his researches on the artificial production of diamonds, and three years later investigated the pressure oscillations in an atmosphere subjected to periodic heatings and coolings.

In 1909 he developed a suggestion of Prof. Hicks into a "pulsation theory" of gravitation. Problems connected with gravitation and with the relations between matter and ether occupied his attention during the succeeding years, his papers appearing in the *Philosophical Magazine.* With the analytical powers necessary for the prosecution of these researches Dr. Burton combined an insight into the construction and capabilities of instruments which made his position almost unique. His micro-azimometer may be taken as an example of his powers as a designer of instruments. The necessity for an instrument of great sensitiveness arose out of his search for a possible effect of the motion of the earth on the azimuth of a thin metal sheet suspended *in vacuo,* a search on which he was still engaged when the war broke out. An echelon grating, built up of reflecting elements and having a resolving power in the neighbourhood of the D-line of more than two millions, was also under construction by Dr. Burton, and shows his great skill. From the time when he was a demonstrator in physics at University College, London, Dr. Burton was an active member of the Physical Society of London, and his quiet manner and clear method of exposition made him a valuable asset at any meeting he attended.

CHARLES OWEN WATERHOUSE, whose death, at the age of seventy-three, was announced in NATURE of last week, was an entomologist of a type which, in these days of specialisation, is gradually becoming rarer. Few entomologists of his time had a wider or more varied knowledge of insects, although, as a specialist on the Coleoptera, he probably published less work than did many of his contemporaries. His papers were very numerous, and the mere titles of them would fill some pages, but the majority of them were very short, and related chiefly to species which, possessing some exceptional or striking character, attracted his attention. These species were drawn from almost every family of Coleoptera, and not a few belonged to other orders of insects. He was not fond of descriptive writing, and, in fact, wrote comparatively little, his most sustained effort in this direction being his contribution on the Buprestidæ to the "Biologia Centrali-Americana," in which he had to deal with 434 species, 300 of which were new. The morphological side of his subject seemed to have the greatest interest for him, and he often turned to it as a relief from the monotony of arranging long rows of specimens in cabinet drawers, or writing out pages of descriptions. His hands were at all times rather shaky, and it was wonderful to watch with what great success he could carry out the most delicate piece of manipulation. In his later years he co-operated with the late Fred Enock in collecting and studying the Mymaridæ—parasitic Hymenoptera of the smallest dimensions, some of which could pass readily through the eye of a needle. The exhibited series of insects in the insect gallery of the Natural History Museum, the guide-book to this series, and the many drawings, diagrams, models, and explanatory labels were nearly all prepared by him or under his direction, and afford some of the best evidence of the value of his work. He must have commenced his study of entomology at a very early age and under the most favourable auspices. His father, G. R. Waterhouse, the friend of Darwin and Owen, although officially connected with the British Museum as keeper of the Department of Geology, was himself almost more distinguished as an entomologist than he was as a geologist. Mr. Waterhouse entered the British Museum as an assistant in 1866, and from 1905 until his retirement in 1910 was assistant-keeper of the Zoological Department, and head of the Entomological Section. Just before his retirement the Companionship of the Imperial Service Order was conferred upon him.

THE death is announced at the age of sixty-seven of Rai Bahadur Sarat Chandra Das, C.I.E., the Bengali explorer of Tibet. In his younger days he was a schoolmaster at Darjeeling, and at the age of thirty paid his first visit to Tibet. In the following year he explored the Yarlung valley and Lake Palti and visited Lhassa. In 1882 he accompanied the late Mr. Macaulay on his mission to Sikhim and the Tibetan frontier, and in 1885 he again accompanied Mr. Macaulay when he went to Peking to ask permission of the Chinese Government for a mission to enter Tibet. For his services on this occasion Chandra Das was awarded the C.I.E. In 1888 the Royal Geographical Society awarded him the Back bequest for his geographical researches. For political reasons his researches in Tibet were not published until 1902. He was a great student of Buddhist writings and the founder of the Buddhist Text Society of India. Chandra Das was a man of great ability and conspicuous daring. To his initiative and courage is due much of our knowledge of the Indian frontier lands.

WE regret to note from the *Engineer* the death of Mr. James Gilchrist, chairman of Messrs. Barclay, Curle and Co., Ltd., of Glasgow. Mr. Gilchrist was born in Glasgow in 1847, and was associated with his firm for about fifty-five years. The ocean-going motor-ship—the *Jutlandia*—was built and engined by his firm in 1912, and was the first vessel of this class built in the United Kingdom. Mr. Gilchrist was a member of the Clyde Navigation Trust.

THE death of Mr. Isaac John Mann is also announced in the *Engineer.* Mr. Mann was educated at Trinity College, Dublin, and was for several years assistant engineer to the Dublin Port and Docks Board. He was associated with Sir John Fowler in the construction of Rosslare Harbour, and was afterwards resident engineer at the harbour construction works at Fishguard. He was a member of the Institution of Civil Engineers, and was awarded a Telford premium for his book on the formation of river bars.

THE death is announced in *Science*, at the age of 105, of Mr. John Finlayson, after whom Finlayson River and Finlayson Lake in Yukon Territory were named. Finlayson was a gold miner in California and Oregon until he was eighty-six years old, and then did much pioneer exploration work in British Columbia and Yukon Territory.

THE death is announced of Mrs. P. Amaury Talbot, wife of the District Commissioner of the Nigerian Political Service, and author of "Woman's Mysteries of a Primitive People: the Ibirios of Southern Nigeria." Mrs. Talbot travelled extensively, accompanying her husband for many years on all his journeys.

THE lecture given before the Aeronautical Society on February 7 by Mr. F. Handley Page on "The Case for the Large Aeroplane" reminds us that after the war the problem of the large aeroplane will assume even greater importance than at present. The demand in war time is for a machine having high speed and good climbing powers, but after the war the problem of using large aircraft for the transport of passengers and mails will certainly receive much attention. The success of the large aeroplane depends more upon constructional questions than upon aerodynamics. A large machine can be designed which is certainly not inferior to the small ones from a purely aerodynamic point of view. The same performance can therefore be secured if the weight of the machine and the horse-power are proportional to the wing area, *i.e.* to the square of the linear dimensions. If it be assumed that engines of the same weight per horse-power are used, the problem resolves itself into that of constructing large machines with a sufficient factor of safety, and with the actual constructional weight proportional to the wing area. Whether this can be done or not is an open question; Mr. Handley Page is of the opinion that it is possible. Of course, it must further be remembered that, in peace time, the same high performance in speed and climb will not be so necessary as it is for war purposes, and this will materially simplify the problem of building larger machines.

After the first day or two of February a change occurred in the character of the cold weather which had been so persistent since the commencement of January, and the night frosts, which were at first of a very mild character, became generally severe over Great Britain. In the Midland district of England the sheltered thermometer fell below zero at well-equipped stations. The reports from the health resorts which are issued daily through the Meteorological Office show 2°, or 30° of frost, at Ross-on-Wye, while at coast stations the thermometer in the screen registered 12° at Southport and Skegness, 13° at Aberystwyth, 17° at Yarmouth and Weston-super-Mare, and 18° at Eastbourne and Dover. The lowest temperature recorded at South Kensington was 21°, but the thermometer fell 5° lower in parts of the London suburbs, on higher ground. Frost had become more general and was more severe than on any occasion since the winter of 1894–95, but the intense cold was much less continuous. A break in the frost occurred over Scotland and the northern districts of England towards the close of last week, and by the commencement of the present week it had extended to all parts of England, although the thaw at first was by no means rapid.

The report of the Medical Officer of the Local Government Board for 1915–16 has recently been issued. So far as infectious diseases are concerned, with the single exception of measles, the record of 1915, like that of 1914, remained favourable. Eighty-one cases of smallpox occurred, but the disease failed to obtain more than a temporary footing in any district. More than a million and a half tubes of vaccine lymph have been distributed from the Board's establishment. The work of the medical department has centred chiefly around the military position, and a dual problem has arisen with regard to several infectious diseases: the increased risk arising within the United Kingdom, and the increased risk of the importation of infection. Dr. Bruce Low contributes to the report an account of the epidemiology of acute anterior poliomyelitis (infantile paralysis) in recent years. A number of reports on scientific investigations undertaken for the Board have been unavoidably postponed, but Drs. Eastwood and Griffin have contributed a report on the characteristics of tubercle bacilli in human bone and joint tuberculosis, and Dr. Griffin one on bovine actinomycosis in which he shows that the disease occurring among cattle in this country is frequently identical with the special form described by Lignières and Spitz in Argentina as actinobacillosis.

In the January issue of *Man* Sir Hercules Read describes two interesting bronze castings of Siberian or Scythian work and a monstrous animal in jade, the castings having been presented to the British Museum by Mr. Louis Clarke, the jade figure the property of Mr. Oscar Raphael. In one casting an animal with a horse-like body, griffin head, and ibex-like horns stands calmly while a wolf-like creature bites its foreleg. The second represents a combat between a lioness and an eagle. The jade figure shows an animal in a crouching posture. The recent work of Mr. Minns, "Scythians and Greeks," supplies much information which helps towards the interpretation of these objects of art, which are of special interest because many well-known features of our pagan Saxon art, and that of Western Europe generally, have their roots in the Siberian culture, and it is claimed that Carlovingian art is equally in its debt.

The object of the elaborate monograph by Dr. H. B. Ferris, reprinted from vol. iii. of the Memoirs of the American Anthropological Association, on the Indians of Cuzco and the Apurimac, is to provide materials for the solution of some important problems: the derivation of the Peruvians; the time of their advent into the country; the extension and physical characteristics of the Aymara and Quichua; and the cultural relations of the Peruvian to the Argentine and Chilean aborigines. Dealing with the pure Quichuas, the author finds them to be mesocephalic, and in very large proportion hypsicephalic, the facial index being similar to that of the North American Indian. The results are not worked out in detail, but he arrives at the interesting conclusion that "in many of the body proportions and in some physiognomic characters the Quichua resemble certain North American Indians."

Mr. E. J. Weyland, in *Spolia Zeylanica*, vol. x., part 38, describes and figures the canine and the first left upper molar of a horse found in a bed of grey sandy clay at a depth of 23 ft. below the surface during the digging of a trench by the Colombo Drainage Works at Wellawatta. The author inclines to the view that these teeth represent a Pleistocene species scarcely distinguishable from the existing horse, but for which he proposes the name *Equus zeylanicus*. The author discusses at length the possibility that horses may have been introduced into Ceylon by human agency, but is of opinion that the evidence, on the whole, justifies the assumption that they entered the island with the elephant by means of a land-bridge.

Prof. Clayton Smith, of the University of California, contributes to the *American Naturalist* for January a valuable summary of his experiments on the comparative resistance of Prunus to Crown gall. This disease, known also as plant tumour and plant cancer, is due to the presence of the motile *Bacterium* (*Pseudomonas*) *tumifasciens* in the cells at the point where the root is given off from the trunk. By artificially inoculating various forms of Prunus with pure virulent laboratory cultures, he sought to find a suitable resistant stock which could be adapted to the propagation of the stone fruits. The variety known as Golden Beauty, *P. hortulanum*, has so far shown more marked resistance than other varieties of the species hitherto tested, and it further displays a number of excellent qualities that would recommend it as a stock. *P. pumius* is entirely resistant to artificial inoculation, which constitutes a far more severe test than obtains under the usual field conditions. The work conducted to the present shows that seedlings of the German and Italian prunes might be promising stock for certain of the stone fruits, probably of the *domestica* type. However, no definite recommendations can be given, as the work is now only in its preliminary stages.

In *Physis, Revista de la Sociedad Argentina de Ciencias naturales* (No. 11, tome ii.), an account is given by Ana Manganaro of cleistogamic flowers in *Ranunculus hilairei, Cardamine chenopodifolia*, and *Trifolium argentinense*. The article is illustrated by photographs of the plants showing the cleistogamic, or self-fertilised, flowers, and the way in which they bury themselves in the ground. In the Ranunculus these small flowers are produced in the axils of the outer radical leaves, and the flower stalks bend over and lengthen, carrying the developing fruits underground. In the Cardamine the contrast between the normal flowers borne on long inflorescences and the small abnormal flowers borne in the axils of the leaves of the basal rosette is very striking. In the Trifolium the abnormal heads contain some five to eight flowers, whilst the normal ones contain as many as thirty.

M. DE MONTESSUS DE BALLORE, the director of the Chilean Seismological Service, recommends that scales of seismic intensity should be abandoned (Bull. Seis. Soc. America, vol. vi., 1916, pp. 227–31). The suggestion, if carried out, would involve the disappearance of isoseismal lines from our earthquake maps. He would retain only the following lines:—The curve which bounds the disturbed area, and those which surround the places of greatest intensity and the area of damage. The last-mentioned curve would be fairly definite, but the first would be illusive, for the perception of a shock depends on certain accidental conditions. An earthquake which occurs on a Sunday afternoon, for instance, will be felt over twice the area of one in the middle of a weekday.

It is commonly taught by the agricultural chemist that one of the many useful effects of an application of lime to the soil is the bringing into solution of a portion of the potash contained in the soil. The present lack of potash manures has, indeed, caused stress to be laid upon the increased use of lime or calcium sulphate as one means of drawing more rapidly upon the potash reserves of the soil. The assertion seems, however, to rest upon a very slender basis of evidence, and, as regards a certain type of soil, is directly challenged by Messrs. L. J. Briggs and J. F. Breazeale in the *Journal of Agricultural Research*, vol. viii., No. 1 (January, 1917). In experiments with orthoclase and pegmatite, and also with soils of granitic type, they failed to detect any increase of the solubility of the potassium on treatment with various proportions of calcium hydroxide or sulphate. In the case of orthoclase and of one of the soils, the presence of calcium sulphate in solution actually depressed the solubility of the potassium, the quantity of the latter in solution decreasing progressively as the concentration of the calcium sulphate increased. These results were fully borne out by the amounts of potash taken up by wheat seedlings grown in the respective solutions. The experiments thus indicate that the availability to plants of the potash in soils derived from orthoclase-bearing rocks is not likely to be increased by the application of lime or gypsum.

An interesting article on "The Training of an Analyst" is contributed to the *Chemical News* for January 26 by Mr. Frank Browne, who was formerly Government analyst at Hong Kong. Mr. Browne ventures to assert that a chemical student may leave college with a good degree and yet know little of the practical side of the analytical profession. Such a student, going directly into a works laboratory or that of a public analyst, will probably in the course of time acquire sufficient experience to become very useful so long as his scope is limited to routine analyses. But, given a sample of unusual kind for analysis, he may be found wanting on account of lack of training in good, rapid analytical methods. The training of an analyst should be such that from a work of reference he can devise an analytical method for any strange sample and apply it successfully without interfering overmuch with his routine duties. Emphasis is laid on the fact that, by careful study, nearly any system of analysis can be shortened to a remarkable degree, and some methods of doing this are indicated. The author strongly supports Mr. A. Chaston Chapman's recommendation that to the curriculum of chemical students who intend to become professional chemists a year should be added in which they would be trained under conditions resembling those of a technical rather than those of an academic laboratory. He suggests that the programme for the year should include analyses of water, fuel, oils, fats, and waxes, alcoholic liquids, metals and alloys, whilst a good working knowledge of the microscope, polarimeter, refractometer, and spectroscope should be acquired. It is also desirable that the student should have a sound knowledge of the British system of weights and measures.

We are asked to say that the work of Prof. Percy Groom upon the Indo-Malayan Yang wood (Dipterocarpus sp.), referred to on p. 450 of NATURE for February 8, was carried out at the Imperial College of Science and Technology, and not at the Imperial Institute as stated in the article.

The spring list of announcements of the Oxford University Press (Mr. Humphrey Milford) includes: "Three Lectures on Experimental Embryology," the late Capt. J. W. Jenkinson, with a short biographical notice of the writer by Dr. R. R. Marett; "The Beginnings of English Overseas Enterprise," Sir Charles P. Lucas, with notes, references, and an appendix of the First Charter to the Merchant Adventurers; "Sir Walter Raleigh: Selections from his 'History of the World,' Letters, and other Writings," edited, with introduction and notes, by G. E. Hadow, with maps, a portrait, and a facsimile of his handwriting; "The Casting Counter and the Counting-Board: A Chapter in the History of Numismatics and Early Arithmetic," F. P. Barnard, illustrated; "Education To-day and To-morrow," P. Matheson; "The Origin and Meaning of Some Fundamental Earth Structures," C. F. Berkey; "Milk Production Cost Accounts: Principles and Methods"; "Aristotle: Meteorology," edited by F. H. Fobes; "The Order of Nature," L. J. Henderson; "An Adequate Diet," P. G. Styles; "Calculus of Variations," W. E. Byerly; "Organism and Environment," J. S. Halldane.

OUR ASTRONOMICAL COLUMN.

A Great Sun-spot.—A group of spots large enough to be seen with the naked eye has been visible on the sun during the past week. A writer in the *Times* of February 9 describes it as one of the largest groups ever photographed at Greenwich, and gives the heliographic co-ordinates as long. 10°, lat. 15° south. It is further stated that the disturbed area was 125,000 miles long and 64,000 miles broad, and consisted of two very large spots connected by a group of small ones. The diameter of the preceding spot was 35,000 miles, that of its umbra being 13,000 miles. The following spot was larger, with several umbræ. The spot passed the central meridian on February 9 and will remain visible until February 15, when it will be near the west limb.

Prof. Fowler informs us that on February 7 observations with the spectroscope indicated great activity, especially among the smaller connecting spots; in this region many brilliant reversals of the $H\alpha$ line were noted.

PARALLAXES OF PROCYON AND ALTAIR.—Among the large number of stellar parallaxes recently determined by photographic methods at the Leander McCormick Observatory, Dr. S. A. Mitchell has directed special attention to the results for Procyon and Altair (*Pop. Ast*, vol. xxv., p. 38). For Procyon, the values which have been previously determined are remarkably consistent, ranging from 0·287″ to 0·34″, and Dr. Mitchell's parallax of 0·309″ ± 0·007″ is in perfect agreement with the mean of all. The parallax arrived at for Altair is 0·218″ ± 0·007″, and this again accords very closely with the weighted mean value 0·220″ derived from earlier determinations.

DENSITIES OF VISUAL BINARY STARS.—An interesting attempt to advance our knowledge of the densities of stars of different classes has been made by E. Öpik, of Moscow, in a discussion of the probable densities of visual binaries for which orbits have been calculated (*Astrophysical Journal*, xliv., p. 292). He proceeds by developing a series of formulæ by which the density can be determined when the surface brightnesses of the components are known. The surface brightness itself is determined from the spectral type, in conjunction with the corresponding effective temperatures given by Wilsing and Scheiner, and an application of the radiation formula of Planck. The mass-ratio of the two components must also be known, and where such data are not available, approximate values are estimated from the differences in magnitude. The densities calculated in this way for forty pairs cover a wide range (0·012 to 5·9, in terms of the sun), but a considerable proportion of them approach the density of the sun. The mean values for the different spectral classes, which are only to be regarded as roughly approximate, are as follows:—

Spectral type	No. of stars	Density
A 0–A 5	9	0·65
F 0–F 8	19	0·59
G	7	0·23
K, K 5	5	0·072

So far as they go, though the author does not comment upon this point, the figures show an order of density opposite to that which would be expected on the supposition that celestial evolution is along a line of descending temperature only. When accurate magnitudes and spectral types (or colour-indices) become available for each component, it will be possible to obtain separately the densities of the components, and an important region of stellar statistics will be opened up.

EXPERIMENTS ON ASCARIS INFECTION IN HONG KONG.

AN important paper by Capt. F. H. Stewart, Indian Medical Service, appeared in the *British Medical Journal* for July 1, giving the life-history of *Ascaris lumbricoides*, which is extremely common both in man and the pig at Hong Kong, where the author is stationed with the 74th Punjabis. In this preliminary communication he showed that the parasite presents an alternation of hosts. Thus, when ripe eggs reach the alimentary canal of the rat or mouse the larvæ are liberated, and six days after infection they are found in the blood-vessels of the lungs and liver, and the host is seriously ill with pneumonia. They next pass from the blood-vessels into the air-vesicles of the lung, causing hæmorrhage into them. On the tenth day they occur only in the vesicles and in the bronchi. If the disease does not prove fatal, the host recovers on the eleventh or twelfth day, whilst on the sixteenth day it is free from parasites. The affected animals could readily contaminate by the nose or mouth the food of man or the dust and earth of his surroundings.

Capt. Stewart has continued his experiments since the foregoing date both with *A. lumbricoides* and *A. suilla*, and finds that the larvæ appear in the bronchi, trachea, and mouth of the rat and mouse on the night of the seventh day and during the eighth day after infection by the mouth, and he believes that they pass by means of the saliva on to the food which is being nibbled by the rodents. It is possible that one attack of Ascariasis in rats renders them immune against subsequent attacks, but further confirmation is necessary. He found that the larvæ survived longest (twenty-four hours) in blood on moist bread. In water, normal salt-solution, and in mouse's blood they survived three hours.

Out of five experiments to test the infection of pigs from the foregoing rodents, three gave positive results, two negative. In estimating the value of the negative experiments the very high mortality among the parasites employed under somewhat unnatural conditions must be kept in mind. Capt. Stewart endeavoured to obtain an estimate of this mortality by comparing the number of ripe eggs given to a mouse with the number of larvæ found in the lung. An average dose contained about 5000 eggs, whilst the number of larvæ found in the lungs did not exceed fifty. The transfer from the rodent to the pig is probably the most vulnerable part of the life-cycle, since the larva is a very delicate organism. The author also carried out control experiments with the pig.

Lastly, Capt. Stewart carried out some experiments which demonstrated that *A. marginata* of the dog has also its intermediate host in the mouse.

He concludes by stating that if ripe eggs of *A. lumbricoides* are swallowed by rats or mice they hatch. The larvæ bore into the venules of the portal system or ascend the bile-duct. They are found in the dilated capillaries of the liver between the second and the fifth days. As their diameter is three times that of a blood-corpuscle in the mouse, they cannot pass through a normal capillary. The liver-cells in the neighbourhood of the larvæ undergo rapid degeneration, and the larvæ are thus enabled to pass by the hepatic vein and vena cava to the heart, and by the pulmonary artery to the lungs, where they are filtered off at the entrance to the capillary field. Embolism of the arterioles takes place, and the larvæ pass with the effused blood into the air-vesicles on the sixth day. They are found in the bronchi on the seventh day, and in the trachea and mouth on the eighth day, after infection. The larvæ from the lungs of rodents can infect the pig, and it is probable that in Nature infection of both man and the pig takes place by food contaminated by rats and mice.

W. C. M.

SEX-LIMITED FACTORS IN HEREDITY.

FEW of the results obtained in recent years by students of heredity on Mendelian lines have appealed to biologists as a whole more forcibly than such cases of "sex-limited" inheritance as are exemplified by colour-blindness in mankind or the special type of wing-marking in the magpie-moth (*Abraxas grossulariata*) described by Dr. Leonard Doncaster in his work on the "Determination of Sex." Those who have followed the progress of research on the subject during the last five years recognise how important have been the results obtained by Prof. T. H. Morgan and his colleagues in their studies of inheritance in fruit-flies of the genus Drosophila.

An admirable summary of these studies, entitled

"Sex-Linked Inheritance in Drosophila," by Prof. T. H. Morgan and Dr. C. B. Bridges, has now been issued by the Carnegie Institution of Washington (Publication 237, 1916). These flies are excellent subjects for investigation, as they can be reared in very large numbers, and they show an extensive series of characters in eye-colour, body-pattern, wing-nervuration, etc., which are definitely sex-linked, being transmitted by the male to his daughters only, who show a character if dominant, and conceal it if recessive, while the female transmits such characters to her offspring of both sexes impartially. Many of these characters have appeared as "mutants" in the course of the experiments, which have thus furnished proof of the segregation of new forms. But the most striking feature of the researches on Drosophila is the apparently certain connection between the observed inheritance of the sex-linked characters and the behaviour of the sex-determining (x) chromosomes. "Over a hundred characters that have been investigated as to their linkage relations are found to fall into four groups, the members of each group being linked in the sense that they tend to be transmitted to the gametes in the same combinations in which they entered from the parents. . . . A most significant fact in regard to the linkage shown by the Drosophila mutants is that the number of linked groups corresponds to the number of pairs of the chromosomes."

The authors claim that there is conclusive evidence of the x-chromosome's part as sex-determinant, and they believe that they can locate the position in this x-chromosome of many of the sex-linked factors. In a small proportion of individuals of the F_2 generation it sometimes happens that the sex-linked characters are not distributed according to expectation. In such cases "an interchange has taken place between the two x-chromosomes in the female in such a way that a piece of one chromosome has been exchanged for the homologous piece of the other." This "crossing over" of pieces of paired chromosomes is one of the most remarkable hypotheses founded on sex-limited inheritance, and would help to explain various anomalies in Mendelian results. "There are," the authors remark, "certain facts familiar to the cytologist that furnish a clue as to how such an interchange might take place." Those who wish to follow the subject further may consult with profit Dr. H. J. Muller's series of papers on "The Mechanism of Crossing Over," the last of which, with a summary, appeared in the *American Naturalist* of July, 1916 (vol. l., No. 595), as well as Dr. A. H. Trow's "Criticism of the Hypothesis of Linkage and Crossing Over" (*Journ. of Genetics*, v., No. 4), enforcing the "extraordinary difficulties" which prevent some students of heredity from accepting a theory "simple enough at first sight."

A short paper on "Sex-Limited Colour in Ayrshire Cattle," by Prof. E. N. Wentworth, has been published in the *Journal of Agric. Research* (vi., No. 4). The author concludes that black-and-white—a combination long known in the breed—is a simple allelomorph to the more favoured red-and-white, black-and-white being dominant in bulls and red-and-white in cows.

Miss R. Haig Thomas describes studies of "Colour and Pattern Transference in Pheasant-Crosses" (*Journ. of Genetics*, v., No. 4); her paper is illustrated by a good series of coloured plates and photographs. The Swinhoe, Silver, Formosan, and Reeves species formed the subjects of the experiments, which afford interesting examples of sex-limited inheritance analogous to those shown in other organisms. "The male parent always transmits the female characters of his species to his female offspring, and the female parent transmits to her male offspring many of the male characters of her species. . . . The phenomenon of pattern- and colour-transference is present in all the experiments made in pheasant-crosses up to date. These consist sometimes of transference from one area to a different area in the same sex, or from one area to a different area in the opposite sex, or from an area in one sex to the same area in the opposite sex. . . . In the fertile hybrids, plumage, dimension, leg colour and structure, habit, call, are all correlated, but moult is independent and liable to great disturbance in hybridisation."

Sex-linked factors in domestic animals may determine characters of much economic importance. For example, the work of Dr. Raymond Pearl with barred Plymouth Rock fowls has shown that high winter egg-production depends on two Mendelian factors, one of which is sex-linked. In the *American Naturalist* (xlix., 1915, No. 586) Dr. Pearl gives an account of the results of selection-breeding for this character over a period of seventeen years. From 1898 to 1907 "mass selection" for breeding of high producers was carried on without any test of the progeny from particular matings, and this was found to be ineffective in improving the strain. Since 1907 the light thrown on the problem by research on Mendelian lines has enabled selection to be based on the genetic nature of the birds as shown by the performances of their progeny, and such selection "was extremely and quickly effective," so that "if one selects genetically high producers . . . he succeeds very rapidly in fixing a high-producing strain."

To many students the facts of sex-linked inheritance, together with the difference indicated by the presence of one or two x-chromosomes in the nuclei of one or the other sex, have strongly suggested the conclusion that maleness and femaleness are themselves to be regarded as Mendelian alternative characters (allelomorphs), and that sex is irrevocably determined in the fertilised egg. As mentioned above, this conclusion is strongly urged in Morgan and Bridges's memoir on Drosophila. Yet such facts as the development of female characters in male crabs parasitised by Sacculina, demonstrated by the late Dr. Geoffrey Smith's well-known researches, forbid sweeping generalisations as to the determination of sex throughout the animal kingdom solely by the nuclear constitution of the germ-cells. On this fascinating subject Dr. O. Riddle has lately published a contribution (*American Naturalist*, l., No. 595) on "Sex Control and Known Correlations in Pigeons." Acknowledging that "when one nowadays states that he has obtained a real control—a reversal—of the development of sex, he can feel assured that his biological audience demands a very large volume of rigid proofs," the author believes that such proofs are forthcoming from the work on pigeons of the late Prof. Whitman, supplemented by researches of his own. He states that "width of cross" in pairing leads to a high proportion of males in the offspring, and that in the ordinary reproduction of pigeons of the same species males predominate among chicks hatched from the early, small-yolked eggs, and females among those from the later, large-yolked eggs. By appropriate treatment it was found possible to "begin the production of females at earlier and earlier stages of the season." It is likely that Dr. Riddle will not succeed in convincing those biologists who have faith in the absolute determination of sex from the nuclear structure of the fertilised egg, but his paper may be effective in checking the tendency to too positive statements on this fascinating subject.

G. H. C.

RECENT WORK IN PALÆONTOLOGY.

SEVEN new genera of trilobites, Menomonia, Millardia, Dresbachia, Norwoodia, Saratogia, Vanuxemella, and Hanburia, are described in C. D. Walcott's second paper on "Cambrian Trilobites" (Smithsonian Miscell. Coll., vol. lxiv., No. 3, 1916). The first four are placed in Beecher's Proparia, and "establish the existence of a strong group of the order in Cambrian time."

Part 3 of vol. lxxi. of the Quarterly Journal of the Geological Society of London (September, 1916) contains evidence that the honours of research in Cambrian faunas are not to be left entirely to workers in North America. V. C. Illing (p. 386) describes a rich fauna of Middle Cambrian age from ninety feet of strata in the Stockingford Shales near Nuneaton. More than fifty distinct forms of trilobites are recorded. T. C. Nicholas, in "Notes on the Trilobite Fauna of the Middle Cambrian of the St. Tudwal's Peninsula (Carnarvonshire)" (p. 451), somewhat modestly regards his work as a supplement to the remarkable discoveries near Nuneaton. Prof. C. Lapworth, who first recognised the Cambrian age of the beds near Nuneaton, has added some stimulating remarks in the discussion on both these papers.

Prof. H. Douvillé, in describing the marine invertebrate fossils collected during the British expedition to Tibet (Mem. Geol. Surv. of India, Palæontologia Indica, vol. v., Mem. 3, 1916), is able to revise the classification of the strata in this little-known district. The interest centres in the passage-beds from the Cretaceous to the Eocene (p. 44), which are marked by gastropods of Danian and Cainozoic types side by side, while a Cretaceous type of nautilus occurs in Operculina limestones, and, with other fossils, is held to carry these beds down into the Danian stage.

Little by little our knowledge of dinosaurs in South Africa spreads. In April, 1915 (Proc. Geol. Soc. S. Africa, vol. xviii., 1916, p. xxxiii), H. B. Maufe, director of the Geological Survey of Southern Rhodesia, communicated a report by S. H. Haughton on bones found twenty-five miles from Bulawayo. These came from the Forest Sandstone, and resemble Thecodontosaurus and Gyposaurus from the Cave Sandstone of the Cape Province and the Orange Free State. Mr. Maufe consequently regards the Forest Sandstone as of Stormberg age. A month later, A. W. Rogers read a paper on "The Occurrence of Dinosaurs in Bushmanland" (Trans. Roy. Soc. S. Africa, vol. v., 1915, p. 265). The remains were found in the ancient infilling of a valley cut in gneiss, and the author draws the interesting conclusion (p. 268) that the present valley was initiated in Mesozoic times, when the climate was wetter than at present, and that continuous infilling has since gone on. S. H. Haughton (*ibid.*, p. 259) refers the bones and a tooth to a new genus, Kangnasaurus, intermediate between the Upper Jurassic Camptosaurus and the Upper Cretaceous Mochlodon. It is thus probable that the alluvial deposit is of Cretaceous age.

E. L. Troxell describes two interesting birds' eggs of Oligocene age from near Harrison, Nebraska (Journ. Washington Acad. Sci., vol. vi., 1916, p. 422). They are probably those of a water-fowl, and are now filled by calcite. In one case chalcedony has crept in at the narrow end, and a layer of agate preceded the deposition of the calcite. In the other case a large central amber-coloured crystal of calcite, surrounded by white crystals of smaller grain, reproduces by a coincidence the colouring of the original contents.

G. E. Pilgrim and G. de P. Cotter describe "Some newly discovered Eocene Mammals from Burma" (Records Geol. Surv. of India, vol. xlvii., 1916, p. 42). The remains are of special importance, as representing the earliest known Asiatic mammals. The Yaw Clays and underlying Pondaung beds in which they are found probably "correspond with some part of the Upper Eocene." Ninety-five per cent. of the specimens from the Pondaung sandstones represent Anthracotheres. A Titanothere, *Telmatherium (?) birmanicum*, n. sp., shows by its teeth an intermediate character between the Eocene and Oligocene members of the family.

Clement Reid and J. Groves (Proc. Roy. Soc., B, vol. lxxxix., 1916, p. 252) find that the remains of Characeæ in the Purbeck limestones are partly silicified. This has enabled them to etch out certain interesting structures connected with the stem, including clusters of small club-shaped processes set on the "sheathing tubes" of a new genus which they style Clavator. In addition to the photographs of specimens, which are faithfully given, a sketch would be welcome showing the author's reconstruction of the plant in its habit as it lived.

The investigation of the Mesozoic floras of Queensland has been aided by the discovery of a Cretaceous marine fauna below plant-beds that were supposed to be Triassic (A. B. Walkom, "Flora of the Ipswich and Walloon Series," Queensland Geol. Survey, Publication No. 252). It is possible that the two underlying series dealt with in the present memoir may prove to be of Jurassic age. The equisetales of the Ipswich beds have affinities with Rhætic forms.

G. A. J. C.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A Grace passed the Senate on February 10 approving the establishment of the new research degrees, Master of Letters and Master of Science. The object of these is to encourage students to remain in residence for one or two years after they have completed their work for the Tripos, and engage in research under competent direction. These new degrees are mainly intended for Cambridge graduates, but they will be open to properly accredited students from other universities. The proposal to establish new research degrees has been under careful consideration by the University throughout the greater part of the duration of the war. A suggestion that a doctorate should be awarded to research students of the standing in question was rejected on the ground that the degrees of Litt.D. and Sc.D. were already in existence and demanded a much higher standard of attainments.

The Senate also formally approved the proposal to found an Institute of Agricultural Mechanism in the University. The Board of Agriculture and Fisheries and the Development Commission have had under consideration the question of an institute for investigating problems relating to agricultural machinery, and they suggested that such an institute might be most suitably established at Cambridge in association with the schools of engineering and agriculture, financial support being provided from the Development Fund. The proposal was cordially welcomed by the authorities concerned, and the Senate has authorised the appointment, as soon as the necessary funds are available, of an engineer as director and an agriculturist as assistant-director, the first duties of whom will be to formulate a definite programme of work for the institute.

LEEDS.—In the twelfth annual report of the University of Leeds, for the year 1915–16, attention is specially directed to the generous gifts of Sir James

Roberts, Lord and Lady Cowdray, and Mr. Walter Morrison for the endowment of the chairs of the Russian and Spanish languages and literatures.

Reference is made to the departure of the chancellor, the Duke of Devonshire, on his appointment to the position of Governor-General of Canada.

Rawdon College (Baptist) has been affiliated to the University, following the precedent of Mirfield College (Church of England) and Headingley College (Wesleyan Methodist). In spite of a diminished staff, members of which have been seconded by the Government for war work, the teaching has been maintained with its usual efficiency, and a substantial amount of pure research has been published; in addition to which several of the science and technical departments of the University have continued to give valuable aid to the Ministry of Munitions in connection with the textile industries, leather, and the testing of the raw material for explosives and of the finished product; and to the Royal Society War Committee in the preparation of necessary drugs. The many activities of the University in other departments, such as the training of welfare workers, of munition workers, and of women for farm work, are enumerated on pp. 45 and 46. The total number of day students was 698 (465 men and 233 women), and of evening students 103.

A loss of income through the reduction in the number of students is estimated at several thousand pounds, but the economies effected, together with a special grant from the National Exchequer, have saved the University from financial embarrassment. A list of nearly one thousand students, staff, and members of the University O.T.C. who have joined the Colours is given in an accompanying pamphlet.

LONDON.—Applications for grants from the Dixon Fund for assisting scientific investigations will be received not earlier than April 1, and not later than by the first post of May 15. Particulars of the grants may be obtained from the Academic Registrar, University of London, South Kensington.

An appointment to the Gilchrist studentship for women will shortly be made, and the Lindley triennial studentship of the value of 100*l*. will be awarded. The studentship is open to students qualified to undertake research in physiology, and will be held in the physiological laboratory of the University. Particulars of the candidate's qualifications and of the mode in which he proposes to carry out his research must reach the Academic Registrar by April 30.

The Rosebery prize of 25*l*. for the session 1915–16 of the London School of Economics and Political Science has been awarded to Messrs. W. G. Chapman and W. H. Jarvis for their joint paper on "Workmen's Trains." The Rosebery prize of 10*l*. for the same session has not been awarded.

IT is reported from Zurich that, in consequence of lack of coal and the impossibility of heating the buildings, all lectures in the University of Vienna have been suspended since January 29.

MR. C. J. STILL has resigned his position as lecturer and demonstrator in chemistry at the Municipal Technical Institute, Belfast, to become a research chemist with Messrs. Levinstein, Ltd., Manchester.

WE learn from *Engineering* that the Liebig Scholarship Society of Germany has recently been formed, with a capital of upwards of a million marks from German industries, for the purpose of assisting young German chemistry students to proceed with their studies, after their examinations, by working as assistants in the technical high schools.

THE following gifts in America for educational work are announced in *Science*: 200,000*l*. by the Billings family of Chicago to the University of Chicago towards the endowment of the medical school; 10,000*l*. by Mr. J. H. Schiff to New York University for the division of public affairs in the school of commerce; and a bequest by Mr. J. D. Archbold to Syracuse University amounting to 100,000*l*.

ACCORDING to *Science*, a school of fisheries in connection with the University of Washington is to be established within the next two years, provided that the Appropriation Bill for the University is passed as it stands. The passing of the appropriation would make possible the addition to the University staff of an expert authority on fishing and fisheries, increased laboratory space and equipment, and the enlargement of the scope of the University.

PROF. W. RIPPER, having been appointed vice-chancellor of the University of Sheffield in place of the Rt. Hon. H. A. L. Fisher, will be unable to deliver the course of Howard lectures on "Works Organisation and Efficiency" at the Royal Society of Arts in April and May; he will, however, deal with the subject in a paper at one of the ordinary meetings after Easter. Howard lectures on "The National Shortage of Cheap Iron-ore Supplies" will be delivered at the Royal Society of Arts on April 30 and May 7 by Prof. W. G. Fearnsides.

BY the will of Sir George Franklin, Pro-Chancellor of the University of Sheffield, who died on September 23, 1916, the following sums, among others, have been bequeathed, in the event of his adopted daughter leaving no issue:—25,000*l*. to the University of Sheffield to be applied for founding such chairs (to be called after him) as the council may decide, hoping that a portion may be applied in the foundation of a chair having for its object the advancement of some branch of medical science connected with the relief of human suffering; and 5000*l*. to the Corporation of Sheffield, the income to be applied by the local education committee in providing scholarships tenable at Sheffield University for boys and girls educated at the Central Secondary School.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 25.—Sir J. J. Thomson, president, in the chair.—Hon. R. J. **Strutt**: Spectroscopic observations on the active modification of nitrogen. V. The faint red bands 6394·45, 6468·53, 6544·81, and 6623·52, belonging to the first positive group, truly belong to the afterglow spectrum of nitrogen. The second positive group is entirely absent from the afterglow spectrum. The β and γ groups only appear when oxygen-containing gases are introduced into the afterglow, or are originally present in the nitrogen used. Using nitrogen that only gives the β and γ bands very faintly, it is found that oxygen or nitric oxide added to the afterglow brings in the β and γ bands with a certain relative intensity which may be called the standard. Carbon dioxide gives greater relative intensity to the β bands, and carbon monoxide to the γ bands. If nitric oxide or nitrogen peroxide is introduced in sufficient quantity into the overglow, the β and γ groups disappear and a visually greenish continuous spectrum is substituted. Nitric oxide in a blow-pipe flame gives this same greenish continuous band, together with the γ, but not the β, group. Chemical tests show that when oxygen is introduced into the afterglow there is no detectable oxidation of nitrogen, and certainly not nearly enough to account for the β and γ bands on the view that these are due to nitric oxide generated.—Prof. J. W. **Nicholson** and Prof. E. **Wilson**: Magnetic induction and its reversal in spherical iron shells. A solution of problems which arise in the production of an effective magnetic shield for large spaces. These relate mainly to the effective demagnetisation of the shells of which the shield is constituted. Theoretical solutions of problems relating to the effects of indefinitely closely wound coils on various shells of such a shield are given, and compared with the experimental values for an actual coil. The experiments supply an estimate of the deviations of Maxwell's formula, for the field inside a spherically wound helical wire, from the true values, when the spacing in the helix is of importance. A study of the necessary interval between current reversals in the process of demagnetisation has been made, and it is shown that the delay in reversal of magnetic phenomena in considerable masses of iron, due to eddy currents, is negligible when the magnetic inductions are fewer than 300 C.G.S. units.—S. **Brodetsky**: The two-dimensional motion of a plane lamina in a resisting medium. Some of the types of motion of a plane lamina in a resisting medium, such as the air, are discussed. Experimental laws of resistance are used for varying circumstances of shape and motion. The motion is in two dimensions. Part i. deals with a lamina of large moment of inertia. For the case of no forces acting on the lamina other than the resistance of the medium, relations are obtained connecting the components of velocity, the rotation, and the time. In the case of a wide lamina an investigation is given of the oscillatory part of the motion. The graphical method is then extended to the case where forces in addition to the resistance act on the lamina, notably gravity. In part ii. the case of a lamina the moment of inertia of which is negligible is considered, and equations are found for correcting the paths found in Lanchester's phugoid theory. Part iii. treats of the oscillations about a steady fall. The vertical fall of a lamina is shown to be unstable unless the centre of mass is at a distance below the centre of figure lying between two limits given by a quadratic equation. The stability of a parachute with a hanging body attached to it is also considered.

February 1.—Sir J. J. Thomson, president, in the chair.—Sir Ronald **Ross** and Miss H. P. **Hudson**: An application of the theory of probabilities to the study of *a priori* pathometry. Part ii. A number of hypothetical epidemics on the basis of the equations of part i. are constructed. The influence of some of the principal parameters is considered. The equations are generalised to include a wider range of *a priori* suppositions as to the laws of the happening, and further suggestions are made as to the comparison of the results with mortality statistics. The following tentative conclusions are arrived at: The cases considered have led to exactly the series of curves required by the facts: 1. The steadily rising curve of a happening that gradually permeates the whole population (VII., iii.). 2. The symmetrical bell-shaped curve of an epidemic that dies away entirely (VII., v.). 3. The unsymmetrical bell of a new happening that begins with an epidemic and settles down to a steady endemic level (VII., v.). 4. The periodic curve with regular rise and fall due to a seasonal disturbance (XI., iv.). 5. The more irregular curve where there is recrudescence before the end of an epidemic, or where outbreaks differing in violence occur at unequal intervals (XI., v.). This suggests that the rise and fall of epidemics may be explained by the general laws of happenings as studied.—Dr. J. **Brownlee**: An investigation into the periodicity of measles epidemics in London from 1703 to the present day by the method of the periodogram. The statistics for the epoch of registration give the main periodicity of measles in London for the last seventy-two years as almost exactly ninety-seven weeks. The amplitude of this period is 0·4 of the mean number of cases. Periods with amplitudes of about one-half of this are found for one year and for six months. These periods probably reflect the influence of the weather upon the deaths from measles, though the evidence is not complete. There are two sets of periods grouped on either side of the main period in such a way as could be explained by interference with long waves of prevalence or severity of the disease. These periodicities are probably the expression of something in the life-history of the organism causing the disease.—Capt. J. **Hammond**: The causes responsible for the developmental progress of the mammary glands in the rabbit during the latter part of pregnancy. Experimental results show that the development of the mammary gland of the rabbit during the second half of pregnancy is under the same influence as that which controls the development during the first half, namely, the *corpus luteum*. This gland is active during the second half of pregnancy. The further development of the *corpus luteum* is due to the influence of the fœtus. The view that milk secretion in pseudo-pregnancy takes place in correlation with the involution of the *corpus luteum* is confirmed. Apparently the secretion of milk results whenever the influence causing the glandular growth is removed or lessened in amount, provided that the initial development has gone far enough.—F. H. A. **Marshall** and E. T. **Halnan**: The post-œstrous changes occurring in the generative organs and mammary glands of the non-pregnant dog. The uterus and mammary glands of the non-pregnant bitch undergo pronounced post-œstrous development under the influence of the *corpora lutea* during a definite pseudo-pregnant period. Retrogressive changes do not set in with any of these organs until about thirty days after ovulation. The developmental changes are similar to those taking place during pregnancy. The relatively long persistence of the *corpora lutea* in the bitch is probably correlated with the monœstrous habit. This persistence elucidates the phenomenon of bitches which had not been impregnated secreting milk at or near the end of the pseudo-pregnant period. The changes which occur in the generative organs and mammary glands after œstrous are now brought into relation with the rest of the œstrous cycle.

Physical Society, January 26.—Prof. C. V. Boys, president, in the chair.—C. O. **Bartrum**: A clock of precision. The principal feature is the employment of a "slave" clock to do most of the work, leaving the master pendulum no function beyond that of controlling the rate of the other. The master pendulum swings freely except for a short period every minute, during which it receives an impulse from a falling pallet electromagnetically released by the slave clock. At the end of its fall the pallet closes a second circuit and is restored to its initial position. The electric circuits also energise parts of the mechanism in the slave clock by which the latter is kept in time with the master pendulum. The lagging of correction behind error, with the resulting periodic fluctuation in the rate, is reduced almost to the vanishing point by a "negative backlash" in the control mechanism. A mathematical discussion of the best working conditions and of the possible magnitude of errors is given.—Dr. F. **Schwers**: The effect of water vapour in the atmosphere on the propagation of electromagnetic waves. The probable influence of moisture in the atmosphere on the refraction of electromagnetic waves round the earth's surface is discussed. The conclusion of Kiebitz that the presence of moisture does not affect the dielectric constant by more than 10 per cent. is shown to be erroneous. In the absence of more accurate data for ordinary temperatures, the author prefers to assume a value for the dielectric constant of water vapour obtained by extrapolating the results secured by Baedeker for higher temperatures. It is shown that the lowest layers of the atmosphere refract electromagnetic waves towards the earth, so that the greater part of the space waves will reach the receiver, contrary to the conclusion of Kiebitz.

Challenger Society, January 31.—Dr. S. F. Harmer in the chair.—G. H. **Fowler**: (i) The currents of the United States Atlantic coast, illustrated by the drift of the Nantucket Shoals buoy, 1915–16. The buoy was at large for twenty months; it drifted down the Labrador current to off Cape Hatteras, was drawn into the Gulf Stream, went east, and was thrown out southward; this occurred three times, the buoy being returned to the Gulf Stream twice by the Bahama branch of the N. Atlantic Drift and once by towage. (ii) A graphic method of finding the density of sea-water from the salinity and temperature based on Knudsen's tables.

BOOKS RECEIVED.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, September–November, 1916. By R. M. Milne. Pp. 32. (London: Macmillan and Co., Ltd.) 1s. net.

A Bibliography of British Ornithology. By W. H. Mullens and H. Kirke Swann. Part v. (London: Macmillan and Co., Ltd.) 6s. net.

High-speed Internal Combustion Engines. By A. W. Judge. Pp. ix+350. (London: Whittaker and Co.) 15s. net.

A Practical Manual of Autogenous Welding (Oxy-Acetylene). By R. Granjon and P. Rosemberg. Translated by D. Richardson. Fourth edition. Pp. xxv+244. (London: C. Griffin and Co., Ltd.) 5s. net.

The Study of Animal Life. By Prof. J. A. Thomson. Revised edition. Pp. xi+477. (London: J. Murray.) 6s. net.

Plants, Seeds, and Currents in the West Indies and Azores. By H. B. Guppy. Pp. xi+531+3 maps. (London: Williams and Norgate.) 25s. net.

A Text-book of Thermochemistry and Thermodynamics. By Prof. O. Sackur. Translated and revised by Dr. G. E. Gibson. Pp. xvi+439. (London: Macmillan and Co., Ltd.) 12s. net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 15.

ROYAL SOCIETY, at 4.30.—Structure and Development of the Tubular Enamel of the Sparidæ and Labridæ: Dr. J. H. Mummery.—And other papers.

ROYAL INSTITUTION, at 3.—The Mechanism of Chemical Change: Prof. F. G. Donnan.

SOCIETY OF GLASS TECHNOLOGY, at the University, Western Bank, Sheffield, at 4.30.—The Annealing of Glass: F. Twyman.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indian Silk Industry: Prof. H. Maxwell-Lefroy.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—The Wet Assay of Tin Concentrate: H. W. Hutchin. Hydraulic Tin Mining in Swaziland: J. Jervis Garrard.

LINNEAN SOCIETY, at 5.—The Home-life of the Sparrow-hawk: J. H. Owen.

FRIDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 5.30.—Authors' Dedications in the Seventeenth Century: The Dean of Durham.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Annual General Meeting.—Alternating Stress Experiments: Dr. W. Mason.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

SATURDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 3.—The Mystery of Counterpoint: Dr. H. Walford Davies.

MONDAY, FEBRUARY 19.

ROYAL SOCIETY OF ARTS, at 4.30.—The History and Practice of Town Planning and Civic Architecture. Lecture iv.: Prof. A. Beresford Pite.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—The Baghdad Railway and its Tributaries: H. Charles Woods.

ARISTOTELIAN SOCIETY, at 8.—The Nature of Knowledge as conceived by Malebranche: Morris Ginsberg.

VICTORIA INSTITUTE, at 4.30.—From World Dominion to Subjection; the Story of the Fall of Babylon: Dr. T. G. Pinches.

TUESDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—Pain and its Nervous Basis: Prof. C. S. Sherrington.

ZOOLOGICAL SOCIETY, at 5.30.—(1) Notes from the Caird Insect House, with Exhibition of Specimens and Lantern-slides: (2) The Coleoptera of the Family Cissidæ found in Britain, with Descriptions of Two New Species. A New Species of the Coleopteran Genus Cryptorrhynchus, Illiger: C. J. C. Pool.—Heude's Collection of Pigs, Sika, Serows, and Gorals in the Sikawei Museum, Shanghai: A. de C. Sowerby.—The Lizards of the Genus Philochortus, Matschie: G. A. Boulenger.

ROYAL STATISTICAL SOCIETY, at 5.15.

ILLUMINATING ENGINEERING SOCIETY, at 5.—The Effect on the Eye of Varying Degrees of Brightness and Contrast: Dr. James Kerr.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—Liquid Fuel and its Combustion: Prof. J. S. S. Brame.

WEDNESDAY, FEBRUARY 21.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Parasitology of Pyorrhœa: Dr. A. H. Drew and Dr. Una Griffin.

ROYAL SOCIETY OF ARTS, at 4.30.—The Training of Educated Women for Secretarial and Commercial Work, and their Permanent Employment: Mrs. C. Hoster.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Heat Balance of the Atmosphere: W. H. Dines.—Continentality and Temperature: C. E. P. Brooks.

THURSDAY, FEBRUARY 22.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Fossil Human Skull found at Talgai, Queensland: S. A. Smith.—The Magnetic Storm of August 22, 1916: Dr. C. Chree.—The Ordinary Convergence of Restricted Fourier Series: Prof. W. H. Young.

ROYAL INSTITUTION, at 3.—Memorial Art in History: Prof. E. S. Prior

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Origin and Growth of the Dry Lakes in Western Australia: J. T. Jutson.

FRIDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 5.30.—Some Guarantees of Liberty: H. Wickham Steed.

SATURDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 3.—The Pronunciation of Languages in General: Daniel Jones.

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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

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THURSDAY, FEBRUARY 22, 1917.

PLANT PHYSIOLOGY AND TERATOLOGY.

(1) *Botany: a Text-book for Senior Students.* By D. Thoday. Pp. xvi + 474. (Cambridge: At the University Press, 1915.) Price 5s. 6d. net.

(2) *The Principles of Plant-Teratology.* By W. C. Worsdell. Vol. i. Pp xxiv + 269 + plates xxv. (London: The Ray Society, 1915.) Price 25s. net.

(3) *Some Recent Researches in Plant Physiology.* By Dr. W. R. G. Atkins. Pp. xi + 328. (London: Whittaker and Co., 1916.) Price 7s. 6d. net.

(1) MR. THODAY'S text-book is intended primarily for use in connection with the Senior Cambridge Local Examinations, but it is hoped that it may prove of more general service to teachers as well as to scholars in the upper forms of secondary schools. Since the author brings to bear on his task not only his experience as a teacher, but some years' experience as an examiner, he should be in a fair way to succeed. A good text-book is one of the factors which may bring success in these examinations, but the efficient teacher and adequate provision in the school curriculum are also factors which cannot be eliminated.

However, our concern is with Mr. Thoday's book, and we congratulate him on his achievement. It is different from other text-books. There is a certain refreshing originality of treatment in dealing with the common objects of the examination syllabus, and the matter is well and clearly written; it is, in fact, a readable text-book. The point of view is the physiological one; the vegetative organs of the plant are approached and studied as structures adapted for carrying out the life-functions of the plant; form and structure are subservient to function. The rigid morphologist will feel that an opportunity has been missed. Experimental work falls naturally into place in the subject-matter, and good use is made of matters of common observation in Nature and plant-life. In the chapters dealing with classification the author has worked out the characters of some of the best-known British families of flowering plants by reference to commonly occurring genera and species, and the various grades of relationship are used to illustrate the ideas of evolution and variation. The last section, entitled "Plants in relation to their Environment," contains a good chapter on trees and a short introduction to the study of plant associations. Text-figures are sufficiently frequent and good; many of them are new.

(2) The plant morphologist will find food for thought in plenty in Mr. Worsdell's volume on "The Principles of Plant-Teratology." In 1869 the Ray Society issued the late Dr. Maxwell Masters's work on "Vegetable Teratology"; this was for many years the standard work on the subject, and is even to-day the book to which one naturally turns for easy reference in matters teratological. Mr. Worsdell does no more than justice when he expresses himself as "in some degree indebted to Dr. Masters for facts and ideas." "The present work," he states, "is intended to present the subject in more scientific fashion and in quite a new form, both as regards the mode of treatment and the large number of additional facts." The author's position may be briefly summarised as follows. The work is not a mere descriptive tabulation of interesting and curious freaks, but a contribution to the evolutionary origin of plant-organs, of which there are three categories only, root, stem, and leaf, although in reality the stem is non-existent, being composed of leaf-bases. Comparative and teratological, as contrasted with developmental and anatomical, are the only trustworthy methods of morphological investigation. Many abnormalities are progressive in character, not reversions; they are of great importance for the interpretation of structures of doubtful nature. All structures, whether normal or abnormal, are regarded as purposive rather than fortuitous in their origin. They are originated and maintained by the action of a regulative vital force, and not by mere chemico-physical energies: the dynamic teleological or vitalistic position is upheld as against the mechanistic or materialistic one. This is enough to indicate Mr. Worsdell's point of view and to show that the author invites severe criticism from the more orthodox plant-morphologists. Moreover, one cannot but feel that the insistent and somewhat aggressive emphasis of matters of theory does to some extent detract from the value of what is otherwise a useful piece of work. It is for this reason not a safe book to put into the hands of the non-critical student.

Mr. Worsdell has been for many years studying plant-abnormalities at first hand, and the present volume embodies the results of his investigations so far as concerns the non-vascular plants and the vegetative organs of the vascular plants. Abnormalities described by previous writers are also recorded and discussed, while frequent bibliographical lists supply a large number of additional references. The chapter on fungi is a short one, and deals with the various abnormal developments of the sporophore of the cap-fungi. A similar remark applies to the bryophytes; a few pages are devoted to adventitious shoots and protonema formation; and there is a short account of "double" sporogonia. The root of the vascular plant is less prone than any of the other organs to deviate from the normal form, and its aberrations occupy only a few pages. The greater part of the book deals with the stem and the leaf. The second volume will deal with the flower. A useful feature is the large series of photographic plates, twenty-five in number, at the end of the volume; there are also a number of rather crude figures distributed through the text. The typography is clear, and there is a useful subject-index.

(3) Dr. Atkins, in his handy little volume on some recent researches in plant physiology, aims

at presenting to senior students and investigators the results of recent work in a few of those branches which are at present attracting attention. It is supplementary to the text-books, and should prove of great value to those whom the subject more nearly concerns. The value of the work is enhanced by the author's choice of material, since he has selected those subjects with which he was specially familiar and on which he was able to write with a first-hand knowledge. Starting with the classic researches of Brown and Morris, the author deals in the first two chapters with the carbohydrates of the leaf in relation to photosynthesis and with the methods of estimating carbohydrates in plant extracts. This is followed by short chapters on the carbohydrates of the cellular cryptogams. Other chapters deal with osmotic pressure and its relation to plant distribution, and to morphological variations; the permeability of protoplasm and of other organic membranes; and the magnitudes of osmotic pressures and electrical conductivities in plants. A chapter on the functions of the wood is followed by an account of the plant oxydases and their relation to pigmentation, and the final chapter is on the oxydases in relation to plant pathology and to technology. At the end of the volume there is a bibliography classified under the headings of the subject-matter adopted in the text.

WORKS ON CIVIL ENGINEERING.

(1) *American Civil Engineers' Pocket-Book.* Editor-in-chief, M. Merriman. Third edition, enlarged. Pp. ix + 1571. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 21*s.* net.

(2) *Parks and Park Engineering.* By Prof. W. T. Lyle. Pp. viii + 130. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 5*s.* 6*d.* net.

(3) *Masonry Dam Design, including High Masonry Dams.* By Dr. C. E. Morrison and Orrin L. Brodie. Second edition, revised and enlarged. Pp. ix + 276. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 10*s.* 6*d.* net.

(4) *Earth Pressure, Retaining Walls, and Bins.* By Prof. William Cain. Pp. x + 287. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 10*s.* 6*d.* net.

(1) THE "American Civil Engineers' Pocket-Book" has already established an enviable reputation for trustworthiness and completeness, which is well maintained in the third edition. A new section of ninety-six pages on river and harbour works has been added, whilst important additions have been made in the other sections. The scope of the book is wide, each subject being written by a specialist in the particular branch dealt with, although the treatment is simple and requires a minimum of previous knowledge.

Valuable features of the book are the numerous examples worked out where concise and accurate description would otherwise be difficult. Although the question of cost varies enormously with time and locality, the tables of prices of works executed will add greatly to the use of the volume.

In view of the importance of the subject to makers and users of machinery, it is somewhat disappointing to find only one short paragraph devoted to hardness tests of metals. We also think that it is time some of the work which has been carried out lately upon struts and columns should be incorporated.

This pocket-book is one which is probably destined to form a standard reference-book for every civil engineer.

(2) It is now generally recognised that amongst the best investments for an urban community is the provision of parks and recreation-grounds. Indeed, in several recent cases the actual appreciation in value of surrounding property following upon the transformation of waste land to this purpose has been greater than the outlay. A very readable book upon the subject of parks and park engineering has been written by Prof. W. T. Lyle, of Lafayette College, which, although dealing with the American aspect of the case, will be found useful by members of public bodies responsible for the planning of our cities and towns. The first chapter of the book deals with the acquisition of parks and their lay-out. Other chapters are concerned with the survey and design, while interesting and instructive articles on labour and contracts and construction should prove of great assistance to the non-professional man, and also to young and inexperienced engineers of construction. In his preface the author points out that "the art of the park engineer, though a specialty, is, however, not a narrow specialty. He must be proficient in matters pertaining to the acquisition of lands, and be well versed in a great variety of engineering operations, such as earth excavation, masonry, waterworks and sewerage construction, road building and lighting, and occasionally the construction of steel and reinforced-concrete bridges. He must also be a good expert witness." The scope is very wide, and can only be superficially treated in one volume. The book will undoubtedly fill a useful place and serve as an introduction to more specialised works on construction.

(3) During the last few years there has been considerable discussion amongst engineers as to what methods should be adopted and what assumptions made in the design of high masonry dams. The subject is of extreme importance, since we have, on one hand, large expenditure of money in providing margins of safety above those really necessary, and, on the other, the fact that failure must be rendered impossible. The most recent methods of calculation and design are very ably treated in Morrison and Brodie's "Masonry Dam Design," the second edition of which has just been published. In the revision the authors have amplified a number of points which were treated very shortly in the

earlier edition. Chapters on the overfall and arched types of dam have been added, and an excellent series of cross-sections of typical masonry dams, arranged chronologically, forms an appendix. The method of analysis followed is that due to Wegmann, used for the first time in connection with the design of the new Croton dam. The authors have amplified the analysis by a consideration of the uplift due to water penetrating the foundations or the horizontal joints of the masonry, and also by taking into account the ice-thrust exerted against the up-stream face of the dam when the reservoir is frozen over. The latter portion of the book is devoted to the problems of tension in the vertical sections near the toe, to which attention was first directed by L. W. Atcherly. Appendices i. and ii. contain the mathematical theory of arch dams. The book is one which should occupy a place in the library of all designers of masonry dams.

(4) Probably one of the most difficult problems which the engineering designer has to face is that concerned with the pressures which may exist at the back of retaining walls. Many mathematical theories have been evolved which assist materially in solving the problem, but the infinite variety of physical conditions met with in the earth's crust render exact calculations impossible in many cases. This difficulty is undoubtedly responsible for the comparatively small amount of experimental work available. The book on earth pressures just issued by the professor of mathematics in the University of North Carolina deals with the theory of soil pressures, covering a wide range of physical properties of earth, from those of Rankine, where the soil is assumed to be devoid of cohesion and subjected to no other external force than its own weight, to cases where surcharging and cohesion are taken into account.

Both analytical and graphical methods are employed, and the work is comprehensive in scope. The last chapter is devoted to a consideration of bin theory, the ordinary hopper-bin containing coal or ore and the deep bin such as those met with in grain silos being dealt with in an adequate manner. The stresses in wedge-shaped reinforced-concrete bins, such as occur frequently in the toes, heels, and counterforts of retaining walls, form the subject of an appendix, whilst some experiments made by the author on model retaining walls at the limit of stability are dealt with in Appendix ii. The book well repays the reader. It ought to serve a useful end.

THE GEOLOGY AND SUPPLY OF MINERAL OIL.

Principles of Oil and Gas Production. By Prof. R. H. Johnson and L. G. Huntley. Pp. xv + 371. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 16*s*. net.

THIS book should be of especial usefulness owing to its combination of practical information, including branches of the subject not usually considered in general text-books on oil-mining, and its clear and accurate statements of scientific principles. The twenty-three chapters may be divided into three groups: the first is devoted to the chemistry, physical qualities, and geology of oil and natural gas; the second includes eleven chapters on the development and management of oil and gas wells; and the third, consisting of one chapter which occupies nearly a third of the book, gives a most useful summary of existing knowledge of the oil and gas fields of North America.

The most striking feature of the first division of the work is its clear expression of the reaction from the school which held that the one determining factor in oil geology is the folding of the beds. It is no doubt true that the folding has often largely determined the distribution of the oil, and is the best guide in the economic development of the field. There are, however, numerous cases in which the rocks are not folded, yet the concentration of the oil into pools is due to the factors which elsewhere drove it into the arches of the folds. The authors therefore devote especial attention to the texture of the beds, to the variation in the range of those most suitable for oil storage, and to the forces which have compressed the oil into pools. The authors discuss the origin of mineral oil, and firmly reject the inorganic theories. They recognise the wide range of oil throughout geological time, but that Cambrian and pre-Cambrian rocks are unlikely to contain it in commercial quantities. Important oilfields occur in the Ordovician and in all later systems.

In an interesting chapter on folds the authors urge more general agreement in the meanings of the terms "homocline" and "monocline," and set a good example of concession, as Prof. Johnson abandons his previously advocated use of "monocline" for beds with a uniform dip in one direction. He now accepts Daly's term "homocline" for a bed with one dip, and "monocline" in its more familiar sense for a one-limbed fold. Horizontal beds the authors describe as "aclines"—a perhaps unnecessary term. They introduce the term "chute" for the pitch of a minor fold, which is very different from its usual use in mining geology. The chapter on the laws and leasing of oil lands appears to be a clear synopsis of the American law; it quietly explains how to avoid by suitable terminology the legal decision that the oil or gas under a tract of land cannot be sold. They point out, too, that the oil and gas industries are hampered by anti-trust laws, which in some cases prevent reasonable economic co-operation and necessitate wasteful expenditure.

Perhaps the most valuable section of the book is the description of the oilfields of North America. It is illustrated by an excellent geological map of the continent and numerous diagrams of the special fields. The literature on them appears well up to date. The authors describe the fields, ranging from that of Lima-Indiana, which is unique as yielding its produce from Ordovician beds, to the still more remarkable oilfield among the salt-domes of Louisiana. They show that the most recent work has confirmed the hypothesis that these salt-domes occur at the intersection of two rectangular series of fractures. The Calgary field, which created a fever of speculation in south-western Canada, is more than once quoted as illustrating that the predominance of light oils is a discouraging feature as an indication that the oils have travelled for some distance. They refer to the present investigations to check Höfer's theory that the geothermal gradient rises most rapidly in oilfields, but they regard it, even if verified, as a not very hopeful method of prospecting.

The final chapter is on the oil market and future supply. All through the book may be recognised the tacit assumption that the days of an oilfield are short and that a period of declining oil production is not far distant. Then, say the authors, will be the day of the oil shales, of which there are large quantities, which can then be more profitably worked. They remind us, however, that there is not likely ever to be an absolute failure of oil for purposes for which it is indispensable. So soon as oil production begins to decline the price will rise, and its employment will be restricted to the purposes for which oil alone can serve. It will no longer be squandered on uses for which there are more enduring reserves of alternative materials. J. W. G.

OUR BOOKSHELF.

Wisconsin Geological and Natural History Survey. Bulletin No. xxxvi. *The Physical Geography of Wisconsin.* By Dr. Lawrence Martin. Pp. xxii + 549. (Madison, Wis.: Published by the State, 1916.)

THE "Educational Series" to which this work belongs is "primarily designed for use by teachers and in the schools" (p. 486), and the cloth-bound volume of 549 pages, with abundant maps and illustrations, is "sent on receipt of 15 cents" ($7\frac{1}{2}d.$) to those who are sufficiently keen to ask for it. Wisconsin, like Canada, places no bar to the spread of educational information collected by the State.

Dr. Martin is careful to explain technical terms as they arise, but he writes for the advanced teacher, who will appreciate the details shown in his well-selected maps. The romantic history of Indian, French, and American Wisconsin is bound up with the geographical position. To this day (p. 12) the most valuable articles manufactured in the State are "the products of the wood-working industry, which come from the soil." In many ways, even in the abundance of lakelets in the north (p. 388), we are reminded of Finland, where the soils depend also to a large extent on glacial transport. But Wisconsin has some 40 in. of annual rainfall, distributed under the extremes of a continental climate, and the wind-weathering that forms pinnacles and rock-tables in the driftless areas does not imply continuous aridity. On the west we come across the broad sweep of the Mississippi, flowing below Prescott between isolated bluffs, which are in reality the extremities of divides cut through by the young and dominant stream. We are grateful to the author for the sympathetic record on p. 170 of Black Hawk's heroic stand on the Mississippi bluffs in 1832. The human, and thus the humane, touch can never lie far from the geographer. GRENVILLE A. J. COLE.

The North Staffordshire Field Club. Jubilee Volume, 1865–1915. Edited by S. A. H. Burne, J. T. Slobbs, and H. V. Thompson. (Published by J. and C. Mort, Stafford.) Price 7s. 6d.

AN immense amount of good and useful scientific work has been accomplished during the last fifty years in the United Kingdom by local natural history and archæological societies. Not only have these bodies stimulated local research, but by affording means of publication they have been of inestimable service to science in placing on record accounts of local discoveries, co-ordinating methods of study, and enabling the embryo student to try his prentice hand at authorship.

The North Staffordshire Field Club is a typical society of the kind, and having attained its jubilee, it has just issued a commemorative volume, which consists of a sufficiently full record of the work performed by the members during the fifty years of its existence, compiled by the president, together with an account of the work done in the various sections by the respective chairmen. The work of the club is organised in sections, and is carried on by means of monthly excursions under approved leaders during the summer, and the reading of papers and debate at evening meetings during the winter, and it must be admitted that the results of the fifty years' work are an unqualified success. It is not permitted to everyone to live to see the full fruition of their pioneer work, but the fates have been kind enough to Mr. W. D. Spanton to permit him to live not only to see his offspring successful, but also to act as president on the fiftieth anniversary of the club he was instrumental in founding.

Having now reached maturity, it behoves the club to consider itself more seriously and to extend its work. For example, the histories of Roman and Saxon Staffordshire have still to be written. Botany and zoology include much more than the mere listing of finds, and the annual volumes would be better if shorn of the many platitudes which still add to their bulk, but not to their usefulness.

Macmillan's Graphic Geographies. The British Isles. By B. C. Wallis. Pp. 32. (Macmillan and Co., Ltd.) Price 9d.

THE beginner in geography is here provided with a combined atlas and text-book. The simply worded lessons, in which the human note is predominant, are supplemented by four coloured, full-page, orographical maps and twenty-four further maps in black and white. The exercises at the end of the lessons, and the occasional test-papers, will supply the teacher with the material necessary to secure the active co-operation of the pupil throughout the course of instruction.

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.]*

Impending Developments in Chemical Enterprises.

Attention has already been directed in the columns of Nature to the sporadic manner in which capital is being diverted into certain branches of industrial chemistry. The shortage of dyes, drugs, and other fine chemicals has rendered this form of manufacturing enterprise very lucrative even to comparatively small capitalists. The commercial success attending these undertakings is a proof in itself that these manufacturers are supplying the essential needs of the community, and to this extent their efforts are entirely praiseworthy. It must, however, be conceded that the multiplication of small businesses engaged in producing the same article will sooner or later lead to competition of a particularly wasteful and disastrous kind, and this clash of internecine interests will become most pronounced at the cessation of hostilities, precisely when all productive energies should be nationalised against external competitors. This danger is not absent even in the larger chemical enterprises, and it is evident that there are great difficulties ahead in the most fundamental of all chemical manufactures, namely, the production of sulphuric acid. At present the explosives factories cannot have too much of this essential chemical reagent, and large plants for producing it have been erected all over the country. Sulphuric acid producers have been circularised recently by the managing director of a firm of acid-makers, who insists on the urgent need for co-operation among this group of industrialists in order to prevent the absolute chaos which must arise in the sulphuric acid trade at the conclusion of peace if manufacturers are not more closely associated. Certain of the remedies proposed are somewhat drastic. It is proposed that Parliament should consent to legislation "whereby the entirely wasteful introduction of capital by superfluous and speculative parties without experience in the trade would be prohibited until the merits of the proposition had been examined by a committee of expert manufacturers in conjunction with expert Government representatives." So far as this inhibition is directed against new capital unaccompanied by new ideas something may be said in favour of legal restrictions. But, on the other hand, the history of human invention has always manifested the self-sacrificing obstinacy of the inventor, a characteristic which has mainly benefited, not the individual himself, but the community. One can foresee the short shrift which an inventor, inexperienced in the trade, but with a revolutionary process, would receive at the hands of a committee consisting of manufacturers interested in maintaining the *status quo*, and Government officials looking forward to an honoured age of pensionable retirement received as the guerdon of a policy of masterly inactivity. Such agencies might possibly prevent some waste of capital; they would, however, be much more likely to expatriate inventive genius.

Krypton.

Science in Public Schools.

Perhaps you will kindly allow me once more to correct your correspondent. Clifton College was not in advance of Rugby, either in the date, or in the extent, of the teaching of science, but closely followed Rugby in both. Your correspondent gave 1867 as the date for the general introduction of science for the whole school at Clifton. I have before me the lists of the Rugby classes in 1866. Out of 48 Sixth Form boys 24 learned science; of 133 Fifth Form, 60; of 155 Upper Middles, 155; of 135 Lower Middles, 135; of 30 Lower School, none. Clifton College never exceeded this proportion.

It is the fact that under Dr. Temple Rugby took the lead.

James M. Wilson.

Formerly science master at Rugby, and headmaster of Clifton College.

The Nature of Growths in Colloidal Silica Solutions.

Dr. Bastian has described certain experiments in this journal[1] in which he claimed to have synthesised from sterile colloidal solutions living bodies which were capable of reproducing themselves. Considerable weight is lent to Dr. Bastian's demand for independent investigation by the undeniable fact, that since the earth cooled, life has already once been synthesised from its inorganic constituents. In spite, therefore, of the inherent improbability of Dr. Bastian's results, I decided to repeat his experiments. Since the best criterion of life is the ability of organisms to reproduce themselves in sterile media, this test was employed throughout; and it is hoped that the resulting experiments, taken in conjunction with recent work in the same field,[2] may help to decide whether these "organisms" are in reality alive or merely colloidal simulacra.

Because of the great importance attached to the particular sample of sodium silicate employed, I procured two of the samples used by Dr. Bastian himself, as well as a third preparation—a 0·01 per cent. colloidal solution—specially made for me by Grübler. More than a hundred of the same tubes as used by Dr. Bastian were filled with his two solutions, and were sterilised at various temperatures from 100° C. to 130° C., and for various periods of time.

After they had been kept in the incubator for about two months they were exposed to a northern light for from two to three years. In order to examine the tubes the necks were cut with a white-hot glass point, and elaborate precautions taken to ensure sterility while transferring some of the centrifugalised deposit to the subcultivating media. At the same time films were made from each deposit and examined microscopically. The precautions mentioned consisted in carrying out all operations under cloths steeped in disinfectant and in an atmosphere that had been sprayed with a steam atomiser containing 4 per cent. lysol.

Three fluids were employed for the subcultures: (*a*) ordinary nutrient broth, (*b*) Dr. Bastian's ammonium tartrate and sodium phosphate solution, and (*c*) "tryptic broth," a special medium recently described by S. W. Cole and the writer. This medium contains a considerable amount of tyrosine, as well as other amino-acids, and was adopted after Dr. Bastian had stated that the presence of tyrosine very greatly increased the growth of his "organisms."

The subcultures were incubated for two periods of ten days, first at room temperature, and then in the incubator, but only one tube out of the hundred showed a visible growth, even under the microscope. I have no doubt that this growth was due to an accidental infection during the process of subcultivation, because the tube was one of a few that were opened soon after they had first been sealed, and without the elaborate precautions afterwards used. I am, more-

[1] Nature, January 22, 1914, p. 579.

[2] Benjamin Moore and J. A. Webster. Proc. Roy. Soc., B. 693, p. 163, October, 1913: and Benjamin Moore, Proc. Roy. Soc., B. 609, p. 27, July, 1915.

[3] *Lancet*, July 1, 1916, p. 9.

over, acquainted with the morphology and some of the cultural characteristics of this organism, which is a frequent source of contamination in my laboratory. Further, a number of similar bacilli were found in the smears from the other deposits, but in every case they were dead and quite incapable of growth. In many of these smears circular bodies were also visible, often very suggestive of torulæ. They varied so much in shape and size, however, that though some specimens were indistinguishable from living organisms, others were clearly irregular plates of silica which were capable of absorbing the usual stains.

As a result of these experiments I am forced to conclude that the remarkably lifelike bodies described and photographed by Dr. Bastian are due to the deposition of silica round minute nuclei or on the detritus of dead organisms, in the manner described by Moore and by Paine.[4]

I am quite at a loss to discover an explanation of the results of A. and A. Mary,[5] whose original paper I have been unable to read, unless they are due to lack of sufficiently stringent precautions, as in the case of the contamination mentioned above; for when the greatest care is exercised, tubes prepared in this manner will still be absolutely sterile even after an interval of three years. H. ONSLOW.

Biochemical Laboratory, Cambridge.

Stability in Flight.

ALTHOUGH I am quite incompetent to hold any opinion on problems in human aeronautics, I venture to submit that the inference drawn by Prof. D'Arcy Thompson from the flight of certain birds (p. 409) does not agree with accurate observation, and may prove misleading.

Prof. Thompson's proposition is that long tails are disadvantageous to safety and stability in windy weather, and that birds of skilful or agile flight are equipped, "on the whole, with small tails and comparatively small and narrow wings." No such generalisation can stand in the face of facts. One has but to watch the evolutions of flocks of two of the commonest British birds—the rook with a long and broad tail, the lapwing with a shorter one, and both with remarkably broad, rounded wings—to admire their perfect mastery of flight in stormy weather.

Prof. Thompson describes the pigeon (species or variety not defined) as "a splendid flyer for mere distance," but indifferent in manœuvring because of its "large, rounded wings." No species of pigeon known to me has rounded wings; all have them long and pointed, and as for "sudden and acute changes of course," the pigeons in St. Paul's Churchyard have inherited a remarkable faculty in that respect from their "blue rock" ancestors, which had to thread their way at top speed through narrow sea-caves. Moreover, one variety—the tumblers—are perpetually "looping the loop," notwithstanding their long tails.

Coming to birds of prey, Prof. Thompson classes the kestrel with the buzzard as a broad-winged hawk, and remarks that falconers despised both. But the kestrel is a true falcon as testified by the dark iris, the notched maxilla, and the long and pointed wing (the second and third primaries being the longest). It is true that falconers had little use for the kestrel, not because of its inferior wingmanship, for it has few rivals in power and dexterity of flight, but because it preys chiefly on mice, beetles, and other diminutive ground game. But the goshawk and the sparrow-hawk are Accipitrinæ, with broad, rounded wings, the fourth and fifth primaries being the longest. Falconers greatly prized the goshawk for its prowess in flight, and the sparrow-hawk is distinguished by extraordinary agility and quickness in turning when in pursuit. Two opposite types of bird may be noted as having long tails and superb powers of flight, viz. the kite and the nightjar, the latter taking all its prey on the wing.

Lastly, when Prof. Thompson suggests that the outstretched legs of a heron act "as a very useful counterpoise to the long neck and bill," he seems to have forgotten that this bird does not fly with outstretched neck like a swan or a mallard. The heron extends its neck in rising from the ground; but so soon as it is fairly on the wing it tucks back its neck and rests its head between its shoulders, thereby reducing to a minimum the lengthened axis which Prof. Thompson regards as "contributing very materially to the creature's longitudinal stability."

Monreith. HERBERT MAXWELL.

I WILL give in to Sir Herbert Maxwell so far as to say that some of my examples might have been better chosen; I will go further and admit that my kestrel was clearly not a case in point. On the other hand, Sir Herbert throws more responsibility on me than I ever undertook, and he sweeps aside all the qualifying and questioning words with which I was careful to safeguard my letter: not that I wanted to hedge or hide behind these, but simply that my object was to suggest an inquiry, not to lay down the law. As to the mechanical advantages of short tails compared, *caeteris paribus*, with long tails, I made no assertion and laid down no proposition; but certain learned mathematicians had done so, bringing forward their proofs, and the naturalist has no right to dispute such abstract and theoretical demonstrations. When Galileo showed the mechanical advantages of a hollow pillar he adduced the straw and the quill as exemplifications of the principle; and the mere fact that so many trees and so many feathers are not hollow at all gives the naturalist no sufficient right to question it. I directed attention to the fact that Prof. Bryan and Dr. Brodetsky, after demonstrating a principle, had stopped short of inquiring whether it could be illustrated by, or recognised in, the case of the living flying organism; I considered that there were many cases in which it could be so recognised, and I am of that opinion still. We must not forget that "*caeteris paribus*" is an essential condition of our comparison, and that this condition we can only seldom and approximately fulfil. Moreover, we are dealing only with differences of degree, with grades of excellence. No one doubts that the rook flies extremely well, and for that matter every flying bird is marvellous in our eyes; but for all Sir Herbert may say to it, I don't believe that a flight of rooks can approach a flock of sandpipers, in the particular qualities of grace, dexterity, and precision of movement.

As to the heron and its long neck, it would almost seem to me as though Sir Herbert had gone out of his way for the sake of fault-finding. I never said the heron flew with its neck stretched out; I said it flew with its legs stretched out. Why, I was brought up in my boyhood within a couple of miles of a heronry, and saw the birds every day of my life! But the heron *has* a long head and a long neck, and they have to be carried somehow; and it is somehow by help of the long legs that they have to be counterpoised and balanced. The slender bill, narrow body, and long, thin legs make up a sort of long, narrow, axial framework associated with the machinery of flight. I was surely entitled to suggest, or to surmise, that this extended axis (a little like a witch's broomstick) might have a notable influence on the motions of the bird.

[4] *Annals of Botany*, vol. xxx., No. cxix., p. 383, July, 1916.
[5] *Le Médecin* (Brussels), October 31, 1913, and January 15, 1914.

and to inquire, as I did, of the experts whether this were so, and what the actual effect might be expected to be.

D'Arcy W. Thompson.

February 1.

Alpine Strain in the Bengali People.

In the concluding paragraph of a short notice of my book, "The Indo-Aryan Races," part i., published in Nature, November 23, 1916, the reviewer writes:—

"The author might with advantage return in his next venture to the original problem of the origin of the Bengalis. He should probably discard Risley's theory of Mongoloid infusion in favour of some early entry of an Alpine strain. If he can establish this doctrine he would do useful service to Indian ethnology" (p. 227).

This is exactly what I have endeavoured to do in chap. ii., entitled "Indo-Aryans of the Outer Countries." After giving my arguments for discarding Risley's classification of the Gujratis, Marathas, and Coorgs as Scytho-Dravidian in type, and the Bengalis and Oriyas as Mongolo-Dravidian, I trace the broad-headed elements among these peoples to one common source, the *Homo alpinus* of the Pamirs and Chinese Turkestan (pp. 65–71), and later on try to reconstruct the history of the gradual migration of the Alpine invaders from Central Asia over Gujarat, Deccan, Bihar, and Bengal (pp. 75–78). How far I have succeeded in my attempts is for others to judge. I may take this opportunity of adducing fresh evidences relating to the presence of *Homo alpinus* in Central Asia and of Alpine strain in the Bengali people. In his account of "A Third Journey of Exploration in Central Asia, 1913–16" (from the *Geographical Journal* of August and September, 1916, p. 29), Sir Aurel Stein writes of the bodies of men and women dug out of graves in the ruins of the Lon-lan site:—

"It was a strange sensation to look down on figures which, but for the parched skin, seemed like those of men asleep, and to feel brought face to face with people who inhabited, and no doubt liked, this dreary Lop-nor region in the first centuries A.D. The features of the heads closely recalled the *Homo alpinus* type, which, judging from my anthropometric records, worked up by Mr. T. A. Joyce, still supplies the prevalent element in the racial constitution of the indigenous population of Chinese Turkestan, and is seen in its purest form in the Iranian-speaking tribes near the Pamirs."

During the last Christmas holidays, while excavating an old monument near Balurghat, in the Dinajpur district in Bengal, I and my colleagues of the Varendra Research Society had an excellent opportunity of comparing different ethnic types in Bengal. Every day there was a large gathering of men, including high-caste Hindus, Musulmans, Rajbamsis, Mundas, and Santals. The Rajbamsis of the locality are easily distinguished from the rest by their Mongoloid physiognomy, and the Rajbamsis, Mundas, and Santals are all distinguished from the other Hindus and Musulmans by scanty hair on the face. It is, therefore, not possible to explain the origin of the bulk of the Bengalis from an admixture of Mongoloid invaders like the Rajbamsis of Varendra and the Mundas, Santals, and other allied tribes classed by Risley as Dravidian and myself as Nisada. Two other elements in the Indian population, the Hindusthani and the Dravidian of southern India, are both long-headed. So, to explain the presence of broad-heads among the Bengalis, we may very well postulate an Alpine strain. The newly discovered Aryan languages of Turkestan will throw fresh light on the problem.

Ramaprasad Chanda.

Varendra Research Society, Rajshahi, Bengal.

SHAKESPEARE'S ENGLAND.[1]

"Shakespeare's England" is a very remarkable book, and a credit to our time. It could have been produced in no other. Indeed, it could only have been produced within the last few years, so much is it the outcome of the research in ever so many directions which has been going on of late. It is sad, of course, that it should make its appearance in the middle of the great war, and yet there is something fine and fitting about this. It does not to-day jostle with a motley crowd of ephemeral, flimsy, and flashy tributes. And it has a solemn majesty and solidity which make it worth while, even at such a time, and in virtue of which it will survive even these heavy troubles.

As the first words of the preface justly say, the description of "Shakespeare's England" was a task worth carrying through, even if Shakespeare had never lived. But it is also a contribution of great importance to the understanding of Shakespeare. If Shakespeare was in one sense "not of an age, but for all time," in another he was most essentially of his age. He is emphatically Elizabethan. He could not have been what he was, or written as he did, either a very little earlier or a very little later; either in the days of Wyatt and Surrey, or in those of Milton and Marvell; either in the storm of the Reformation, or in the storm of the Civil War; either before the Tudor expansions, or after the Stuart disillusionments.

To understand him we require to understand his age, and though even a complete knowledge of that marvellous time will not give us Shakespeare, yet it will greatly aid, condition, and correct our ideas of him. And these two remarkably ample and learned volumes tell us how full and exhaustive our knowledge must be. They form, perhaps, the greatest tribute ever paid to Shakespeare. They are wonderfully complete and, for what they give, wonderfully cheap.

To produce them, the labour of a host of specialists has been laid under contribution. All the greater and lesser arts and sciences are dealt with in turn: Theology, Law, Medicine, Poetry, Music, Painting, Acting, Dancing. "The Court, the Camp, the Schools," the Navy, the Army, Sport, Learning and Commerce, Heraldry and Coinage, Rogues and Vagabonds, Bulls and Bears (not of the Stock Exchange, it is true, but of the ring), Astronomy, Astrology, Alchemy—each has its chapter or its section. The illustrations, which are abundant, are excellently chosen and reproduced, and are in themselves at once a delight and an illumination. *Ex pede Herculem.* One of these appears with this article.

It is not possible within the compass of a brief review even to indicate or inventory half of the wealth to be found in this ample thesaurus. Readers of Nature will perhaps turn to what is said of the Sciences and of Medicine, of Agricuture and of Gardening. If Bacon had really

[1] "Shakespeare's England: An Account of the Life and Manners of his Age." Vol. i., pp. xviii + 546. Vol. ii., pp. x + 610. (Oxford: At the Clarendon Press, 1916.) Price, two vols., 25s. net.

written Shakespeare's plays, we might perhaps have expected even more under some of these heads, while we should have expected less under others. But it is just because Shakespeare is Shakespeare that we get so much under all. Nothing seems to escape his "bland and universal eye" or his world-embracing interest.

Medicine, as all know, plays a large part in Shakespeare. He is acquainted with the "congregated College"—*i.e.* the College of Physicians brought into existence by Wolsey and Linacre only some fifty years before his own time. He was a contemporary of Harvey. His own son-in-law was a distinguished physician with a large and "genteel" practice. It is interesting to be told that mental disease is handled by Shakespeare more skilfully than any other, though it will be no surprise to those who remember their Hamlet; but he shows also a large acquaintance with both maladies and remedies of very varied kinds. His love of technical terms anticipates that of Rudyard Kipling himself.

In Astronomy he was still dominated, it seems, by the Ptolemaic system, and he knew neither that of Copernicus nor that of Bacon, who had his own theory—which Mr. Knobel pronounces to be "mere futility." Alchemy was much encouraged by Queen Elizabeth, but Shakespeare shows only a superficial acquaintance with it.

In the realm of Zoology Shakespeare seems to have been specially interested in birds. Picturesque creatures, even if imaginary—the phœnix, the unicorn, the salamander, the basilisk, and the cockatrice—naturally find favour with him, as with all poets. Specially interesting and masterly is Sir William Thiselton-Dyer's account of Shakespeare's knowledge of Plants. If Shakespeare introduces a plant, he says, he does it "with faultless inspiration born of observation which no art can supply." England has always possessed a traditional botany, and Shakespeare is here characteristic of England. If he used any book it was probably the "Niewe Herball" of Henry Lyte of Lyte's-Cary. But, as Canon Ellacombe points out, he is curiously distinct from his contemporaries in the use he makes of popular, not literary, botany.

FIG. 1.—An alchemist at work. By Pieter Breughel, 1558. From "Shakespeare's England."

But there are two portions which all must read. Fortunately they come first, and are not likely to escape attention: Sir Walter Raleigh's Preface on the Age of Elizabeth and the Poet Laureate's noble prefatory Ode.

"The age of Elizabeth, the most glorious and in some ways the most significant period of English history," so Sir Walter Raleigh writes of it. What was it like? We of all men ought to understand it. Our hope is we may come to do so yet more fully. For it was the age of the

Armada and its sequel, an age of menace and peril, of intrigue and then of openly attempted invasion, followed by victory and safety and peaceful expansion. Shakespeare's boyhood knew the first, his flowering and fruiting time coincided with the second. May our young folks find the same experience! That is the theme of Dr. Bridges's Ode. It is a stately, original piece, severe, yet full of chaste beauty, a true British "Pindaric," with the massive masonry and the large, firm ornament of Pindar.

The second movement, to which the first leads up, is splendidly and surprisingly effective. Suddenly towering before us, it seems to scale up and up, higher and higher still, into the empyrean of speculation and philosophy. Then, by a swift but easy turn, it comes to earth again and closes on a quiet, strong, human note, neither exaggerating nor belittling, neither fulsome nor faint-hearted, but just, true, beautiful:—

But ye, dear Youth, who lightly in the day of fury
  Put on England's glory as a common coat,
And in your stature of masking grace
  Stood forth warriors complete,
No praise o'ershadoweth yours to-day,
  Walking out of the home of love
To match the deeds of all the dead.—
  Alas! Alas! fair Peace,
These were thy blossoming roses,
  Look on thy shame, fair Peace, thy tearful shame!
Turn to thine isle, fair Peace; return thou and guard it well!

A cry of the heart, an invocation natural to our time, it will hereafter be its monument and memorial, and no unworthy one. It will wear well, with the book it graces so fitly to-day.

Herbert Warren.

THE FUTURE OF FRENCH METALLURGY.

The October, 1916, issue of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* contains the reprint of three lectures delivered under the auspices of that society by Dr. Léon Guillet, the distinguished French metallurgist.

The first lecture is a comparative study of the metallurgy of iron and steel in France and foreign countries; the second deals similarly with the metallurgy of the principal industrial non-ferrous metals; and the third treats of the application of science to metallurgical industry. It appears from Dr. Guillet's summary that in 1913 France's position in reference to world output was as follows:—Fourth in steel, eighth in copper and lead, fifth in zinc, fourth in nickel, and second in aluminium production. Her output of tin is very small indeed.

It is natural that considerable anxiety should be felt in France as to the future of her iron and steel production, which is much the most important of her metal industries. By the Treaty of Frankfort, which followed on the Franco-German War of 1870–71, Germany obtained, as is well known, the province of Alsace and the greater part of Lorraine. It is not, however, so well known that the particular frontier adjustment ultimately adopted in the latter province was based very largely on the evidence furnished by an exact knowledge of its mineral resources possessed by the German Government. As a result of it Germany obtained nineteen iron-mine, sixteen coal-mine, and fourteen other mine concessions, together with the most famous metallurgical establishments of the Moselle basin, and there is little doubt that it was anticipated that a blow was thus being struck at French iron and steel metallurgy from which it would never recover. So little, however, did Thiers realise this that, in addressing the National Assembly, he said:—"Du Fer, il y en a partout en France, d'aussi bon qu'en Suède, et la prospérité de l'industrie métallurgique dans l'Est est une *pure illusion* qui ne durera pas éternellement."

As a result of these frontier rectifications a considerable proportion of the vast "minette" iron-ore deposits which had hitherto been entirely in French territory, apart from the small quantity in Luxemburg, passed into German hands. As their name indicates, they were regarded not merely as worthless, but actually with contempt. This was principally owing to their very high phosphorus content, which rendered them insusceptible of conversion into steel by the acid process, the only one at that time known. In 1878, however, Thomas and Gilchrist, two Englishmen, invented and introduced the "basic" process, by which steel can be dephosphorised. The importance of this discovery to Germany cannot be overrated. It immediately rendered available for steel production the immense resources of "minette" ores which had passed into her hands, and in the highly phosphoric basic slag, which is a by-product in the steel production, she obtained a most valuable agricultural fertiliser. Statues erected to Thomas and Gilchrist in Düsseldorf prove that the German steel manufacturers recognised their debt to these men.

Since 1878 the commercial exploitation of the "minette" ores in French Lorraine, annexed Lorraine, and Luxemburg has proceeded very actively. These deposits constitute by far the largest source of iron and steel production in Europe. Dr. Guillet states that in 1912 the Meurthe and Moselle basin produced 90·7 per cent. of the French iron-ore minerals; in the same year 78·9 per cent. of the German and Luxemburg iron-ore production was derived from the "minette" ores under their control. Had the Thomas-Gilchrist process been invented eight years earlier there is little doubt that the boundary between France and Germany in the Lorraine "minette" area would have been drawn still farther west.

These facts throw considerable light on the course adopted by Germany at the beginning of the present war. By invading Belgium and pressing on through north-east France in the early weeks of the campaign, the German army *obtained possession of that part of France which* *produces upwards of 70 per cent. of the steel of that country.* That army was brought to action and defeated at the battle of the Marne, but, owing to the trench war which developed shortly afterwards, it remained in possession—*and still does*—of by far the greater part of that particular area in France which produced steel before the war. In other words, Germany, though defeated in a military sense, achieved a metallurgical victory of stupendous value. Metallurgists have never been in any doubt why Germany invaded France through Belgium. By obtaining possession of nearly three-fourths of the French production of steel, Germany struck a blow from which it must be considered as very remarkable that France was able to recover. The price in blood has been terrible; in money, enormous. But under M. Albert Thomas, the Minister of Munitions, a new steel industry has been created. Ores in the fields remaining to France have been exploited to the utmost, new works have been erected, and the most modern methods adopted. The results are such as to elicit the highest admiration for the way in which, under the stress of necessity, very great difficulties have been overcome.

Can it be wondered at if France is deeply anxious as to the future of that portion of Lorraine which was annexed by Germany in 1871? If she recovers it she obtains almost complete possession of the most important iron-ore deposits in Europe that are being worked at the present time, a source of enormous wealth both in steel and in phosphate fertiliser. Thereby also she becomes second in the list of the steel-producing countries of the world, with most pregnant consequences to her future as an industrial nation.

Limits of space do not permit any reference to the other metallurgical industries with which Dr. Guillet's lectures deal. They will repay study by those who are interested in the future of French metallurgy.

H. C. H. CARPENTER.

THE DEVELOPMENT OF BRITISH OIL-SHALE RESOURCES.

THE rapid expansion in the use of liquid and gaseous fuels during recent years, as a result of the introduction of the internal-combustion engine and the replacement of coal by oil and gas in many of the industries, has easily kept pace with the world's production of these materials. There is no doubt that this production will continue to expand for some time as new sources are tapped in excess of those which are giving out; but it is equally certain that the world's needs will continue to grow enormously. Thus the production of hydrocarbon fuels is becoming a more and more vital factor in the industries as their utilisation is extended, and those countries which are well favoured in the possession of fuels of these types are extremely fortunate.

Although the British Isles have been plentifully endowed with coal and iron, our resources in free liquid and gaseous fuels are poor in the extreme; one might almost say they are non-existent. However, if there are practically no commercial supplies of free hydrocarbons, there are abundant stores of materials from which these fuels can be produced, and it is our business to see that these resources are developed to the utmost and with rigid economy in the near future. There is no doubt that the day is not far distant when an important step will be taken in the conservation of our coal supplies; the present wasteful method of burning in open fires will be abandoned, and the energy of the coal will be utilised in the form of oil, gas, coke, and other valuable products. Similarly the large areas of peat, at present of so little value, are immense reservoirs of energy which will be utilised in the same way. But it is to the question of the extent and utilisation of our oil-shale resources that attention is here directed.[1]

Oil-shales—that is to say, shales which when subjected to destructive distillation will yield oil and gas (as well as other products like ammonia)—have been worked in Scotland for more than fifty years. It is not our intention to follow the history of the industry through its various vicissitudes; it is the future that matters. This Scotch shale industry has maintained its own, and is producing almost 2,000,000 barrels of crude oil per annum. Yet when we realise that the world's output of oil in 1912 was approximately 351,000,000 barrels, the smallness of Britain's quota becomes painfully obvious. The shale bands which form the source of the products in Scotland occur in the Lower Carboniferous of the Lothians, and the ultimate extent of the producing areas is limited. No great expansion of the output in the future can be foreseen, and it behoves us to look farther afield.

A survey of the geological column will suggest some of the measures of the Carboniferous, as well as the Jurassic beds of the North of Scotland as possible oil-producers, but at present the most probable horizons lie in the Kimmeridge shales of England. These series of shales extend as a belt of discontinuous outcrops from Dorsetshire to Yorkshire, varying in thickness up to 1000 ft. or more. Eastward and south-eastward they dip gently under the overlying Upper Jurassic and Cretaceous horizons, so that, apart from the effects of early Cretaceous erosion, which has locally removed the series, they extend as a broad sheet under the eastern and south-eastern counties. However, it is only a very small proportion of the whole thickness which is economically valuable as a possible source of oil, probably not more than 12 ft.; and, in addition, the lateral extent of these rich beds is at present unknown. They have been located over more or less widespread areas in South Dorsetshire and West Norfolk, and have been proved in some of the Wealden borings; but in each case the lateral extent of the proved area is limited not so much because the shales do not exist farther afield as that they have not been

[1] "The Norfolk Oil-Shales." By W. F. Leslie. Read before the Institution of Petroleum Technologists on October 17, 1916.

traced. The horizons are not conspicuous lithologically, and it is not easy to detect them except in a country of good exposures—a feature which is not usually found in areas covered by Kimmeridge Clay.

The lateral extent of these oil-shales is certainly greater than the present evidence will allow us to assert with any definiteness, but they will probably be found to vary in richness when traced along their strike and dip, and, in addition, the unconformably overlying Lower Greensands will have eliminated them in certain areas. But when the technical difficulties in the purification of the oil have been overcome, there is every prospect of an industry of important dimensions springing up in Dorsetshire and West Norfolk, and perhaps being linked up by similar industries in Berkshire, Oxfordshire, etc.

The one great drawback, which is at present prohibitive to the general use of this Kimmeridge shale oil, is the abnormal percentage of sulphur present. This exists in a very stable form, and has baffled the commercial attempts to eliminate it; but there is little doubt that a solution will be found, and it is suggested that it will probably lie in changed methods of retorting. The fact that the shale yields upwards of 60 gallons of oil per ton, more than twice the average yield in Scotland, indicates that when the difficulty of the sulphur content has been overcome it will become an important asset in the economic development of the country.

V. C. I.

NOTES.

A Board of Fuel Research has been appointed by the Committee of the Privy Council for Scientific and Industrial Research on the recommendation of their Advisory Council. Sir George Beilby will act as director of the new organisation, and be assisted by the Hon. Sir C. Parsons, Mr. R. Threlfall, and Sir R. Redmayne as members of the board. By arrangement with the governors of the Imperial College of Science and Technology, Prof. W. A. Bone will be retained as consultant to the Board of Fuel Research under the Department of Scientific and Industrial Research, continuing to hold his chair at the Imperial College.

Sir Arthur Lee has been appointed by the President of the Board of Agriculture Director-General of Food Production; the Hon. E. G. Strutt and Mr. A. D. Hall will, for the period of the war, be additional Agricultural Adviser and Scientific Technical Expert respectively, and the Duke of Marlborough has been appointed Joint Parliamentary Secretary to the Board of Agriculture, representing the department in the House of Lords. All the posts named are unpaid.

The Board of Trade is taking possession of all the coal mines in the United Kingdom for the period of the war, and a new department is being set up to control the mines and to deal with production, output, distribution, finance, wages, and the price of coal. Mr. Guy Calthrop, general manager of the London and North-Western Railway Company, has been appointed head of the new department, and is designated Controller of Coal Mines. He will be assisted by Sir R. Redmayne, H.M. Chief Inspector of Mines, and an advisory committee consisting of persons selected to represent coal-owners and coal-miners. Mr. Walker, the Deputy Chief Inspector of Mines, will act as Chief Inspector for the period of the war.

Sir Bamfylde Fuller has undertaken the charge of the department of the War Office which is dealing with the supply of timber for the use of the Army; the control of the use of timber in the United Kingdom with the view of effecting economy in its use for all purposes; the regulation of the purchase of such timber as may be imported from sources outside the United Kingdom, whether on Government or private account; and the stimulation of the felling of timber in the United Kingdom. Sir B. Fuller will be assisted by an Advisory Committee, composed of timber merchants chosen by the Timber Federation, and by others representing firms of repute which do not belong to the federation. The address of the department is Caxton House, Tothill Street, Westminster.

Sir Robert Hadfield is succeeding the Rt. Hon. H. E. Duke, K.C., M.P., as president of the Society of British Gas Industries.

We regret to learn of the death, on February 17, at the age of sixty-seven years, of Mr. George Massee, formerly of the Royal Botanic Gardens, Kew.

From Königsberg comes the news of the death of Dr. Friedrich Hahn, who occupied the chair of geography at the University there. He was born in 1852, began his academic career at Leipzig in 1879, and went to Königsberg in 1885. Hahn was a great traveller, having visited Australia, Polynesia, and Africa. He was a prolific writer, his principal work being the great collection, "Die landeskundliche Literatur der Provinzen Ost- und Westpreussen." Among his other books may be mentioned "Ueber Aufsteigen und Sinken der Küsten" (1879), "Inselstudien" (1883), "Die Städte der norddeutschen Tiefebene" (1885), and "Topographischer Führer durch Nordwest-Deutschland" (1895).

A meeting of the Refractory Materials Section of the Ceramic Society will be held at the University, Leeds, on March 13 and 14, when the following papers will be read:—"The Dressler Kiln," Mr. Dressler; "The Spalling of Magnesite Bricks," Dr. J. W. Mellor; "A Process of Manufacturing Heavy Fireclay and Similar Articles," Mr. B. J. Allan; "Geology of Clays of Central Yorkshire," Prof. Kendall and Mr. Gilligan; "The Use of Zirconia as a Refractory Material," Mr. J. A. Audley; and "Temperature Measurements on Clay Works Practice," Prof. Cobb.

Mr. A. Chaston Chapman will deliver a lecture, entitled "Some Main Lines of Advance in the Domain of Modern Analytical Chemistry," to the Chemical Society on March 15, and Dr. Horace T. Brown will lecture on "The Principles of Diffusion: their Analogies and Applications" on May 17. The following changes in the officers and council of the Chemical Society for 1917–18 have been proposed by the council:—*President*, Prof. W. Jackson Pope; *New Vice-Presidents*, Col. A. Smithells and Prof. Sydney Young; *New Ordinary Members of Council*, Prof. H. C. H. Carpenter, Prof. A. Findlay, Prof. A. Harden, and Dr. T. A. Henry.

Sir Alfred Keogh, Director-General of the Army Medical Service, presiding at a lecture at the Royal Institute of Public Health on February 14, stated that in France at that moment there were only five cases of enteric fever and eighteen cases of paratyphoid fever, with seventy or eighty doubtful cases. He attributed this result to inoculation, and the general good health of the Army to good food, in addition to careful sanitation. The health of the Army at all our fronts to-day is better than the ordinary health of the Army in peace-time.

THE Amsterdam correspondent of the *Times*, in the issue for February 15, directs attention to the declining birth-rate in Germany. In the week ending December 30 the number of births in Berlin was 376, and in Amsterdam 331, although the population of the former city is only 80,000 short of three times that of Amsterdam. In Leipzig, with a population 50,000 more than that of Amsterdam, the births are less than half those in the latter city. The marriage-rate in Berlin has also been declining, while the death-rate has increased.

IN 1813 Dr. Matthew Baillie and Sir Everard Home, "being desirous of showing a lasting mark of respect to the memory of the late John Hunter," endowed an oration, to be called "the Hunterian oration," now given biennially, on the anniversary of Hunter's birthday, February 13. The orator for the present year, Surgeon-General Sir George H. Makins, took as his subject "The Influence Exerted by the Military Experience of John Hunter on Himself and the Military Surgeon of To-day." In 1760 Hunter went as surgeon on the staff to Belleisle and Portugal, and was on active service for two years. At a later date he recorded his experience in two lectures on "The Treatment of Gunshot Wounds." The orator contrasted the surgical practices there recorded with the methods which surgeons have been led to adopt in the present war, concluding that modern experience had, in the main, justified the principles adopted by the great surgeon. Hunter recognised that there was in every wound a strong natural tendency to heal, and that the surgeon's attitude must be expectant. In the present war, however, experience had justified the operative, not the expectant, treatment of gunshot injuries of the abdomen and of the skull. In concluding, the orator drew an interesting comparison between Hunter and his great successor—Joseph Lister.

FEW races are more influenced by the belief that they are surrounded by numbers of malignant spirits than the people of Korea. To their influence they attribute every ill, all bad luck, official malevolence, loss of power or position, and especially sickness. According to a bulletin of the Smithsonian Institution recently published, these spirits are divided into two classes: demons, self-existent malcontent spirits of departed impoverished people who died in distress; and spirits whose natures are partly kindly, which include the ghosts of prosperous and good people; but even the latter appear to be easily offended and are extraordinarily capricious. To cope with these demons and spirits two classes of sorcerers are employed—fortune-tellers, known as Pansu, and the Mutang, usually a woman, who claims the power of being possessed by, and of controlling, the spirits. Many of the Pansu are blind men, perhaps owing to the common belief among primitive peoples that those who have been deprived of physical sight possess an inner spiritual vision. The paper concludes with a full account of the methods employed by these two classes of officiants.

THE Congress of Archæological Societies issues the report for 1916 of the Committee on Ancient Earthworks and Fortified Enclosures. Vandalism, due to carelessness or ignorance, is always to be feared and must constantly be guarded against. By the vigilance of local archæologists the danger to earthworks and other remains in the neighbourhood of Stonehenge, due to military operations, has been averted. A more serious problem arose regarding the protection of Cannington Park Camp in Somerset, owing to mining operations. "This case," the committee observes, "brings out forcibly a weak point in the Ancient Monuments Consolidation and Amendment Act, viz. that there exists no power to give compensation, or to acquire a site, where the destruction of an earthwork or other ancient monument would be to the pecuniary advantage of its owner or tenant. It remains to be seen how far the Legislature will be willing in such a case to put in force the compulsory power of preservation that now exists."

THE Smithsonian Institution has recently issued a bulletin describing the collection of Sioux songs by Miss Frances Densmore. "The Indians," she writes, "do not keep a regular rhythm throughout a song, but frequently alternate double and triple measures in a way that appears absolutely erratic, yet the song as a whole will have rhythmic completeness: in other words, the rhythm makes sense." Some of the most interesting songs recorded by her have this irregularity of measure-lengths, and she has found, by analysing the structure of about 600 songs, that the melodic form was connected with the idea. This she has followed with a test of the rhythm, by which it has been found that the peculiar alternating of the double and triple measures, into which the songs are divided, expresses the idea of the song. In developing this theory Miss Densmore has been assisted by Signor Alberto Bimboni, an Italian composer and conductor, with whose aid about 1100 Indian songs have been recorded on the specially constructed phonograph which she takes into the field.

ALL who were privileged to claim the friendship of the late Capt. F. C. Selous will applaud the fine appreciation of his achievements as a naturalist and Empire-builder, by Mr. Abel Chapman in *British Birds* for February, than whom none knew, or understood, him better. Mr. Chapman reviews both Selous's work in Africa and his hunting expeditions in various parts of Europe, Asia Minor, and North America, in all of which he added materially not merely to our knowledge of the birds and beasts of the country, but also to its geographical features, a fact which has been generally missed by those who have contributed obituary notices to the Press.

IN our issue of January 11, on p. 376, it was stated that the Bill for the introduction of protective measures designed to save some of the more interesting birds of Malta from extermination had been, at least temporarily, shelved. We are glad to be able to say that in making this announcement our correspondent was mistaken. A letter has just reached us from the Lieutenant-Governor's Office pointing out that the regulations issued in October last by the Government, designed to protect birds against wanton and senseless destruction, are actually in force. What was shelved was a motion for the appointment of a Commission to study and suggest amendments to the regulations. Since the object of the motion was to undo what the Government had done, the defeat of the scheme will cause the greatest satisfaction to all interested in the protection of birds.

THE report of the Department of Fisheries of the Province of Bengal and Bihar and Orissa deals, among other matters, with the scientific investigation of the fishes of these parts of India. The deputy-director, Mr. Southwell, points out that "the real development of the fisheries of the province depends almost wholly upon scientific research." Reference is made to a number of papers giving the results of inspections, statistical inquiries, and investigations into fish parasites and diseases. The fresh-water fishes are of particular importance, and a good deal of work relative to the life-history of the Indian carp and other species has been undertaken and is in progress. Artificial cultivation of the carp has been carried on for some time, and arrangements have been made for the distribution of fry. Considerable difficulty has been experienced with regard to the best practice of obtaining the fertilised eggs of the species cultivated, and these difficulties are the object of investigation. So far, little has been done with regard to the marine and estuarine species of fishes, and there do not appear to be opportunities for the active prosecution of research in this direction. Some attention is being directed to the possibility of developing the fresh-water mussel fisheries by cultural methods. Co-operative work with regard to distribution is also mentioned in the report.

The ravages produced in the olive crop in Italy by the attacks of the fly *Dacus oleae* caused Dr. F. Silvestri to initiate a series of investigations on the parasites of this insect, with the view of thus checking the destruction. The *Atti dei Lincei*, xxv. (2), 11, contains a preliminary note on the extension of these observations to India. Previously they were undertaken in the Italian colonies of Erythrea and Tripoli, where they resulted in the discovery of the hymenopterous parasite known as *Opius concolor*. The Indian observations were made in conjunction with the Government entomologist, Mr. T. B. Fletcher, and although the first samples yielded no flies, further investigation showed the existence of a fly and a parasite differing from those found in the Italian colonies. The Indian fly is now described by Dr. Silvestri under the name *Dacus oleae*, var. *asiatica*, and differs only in colour from the African form, but the new parasite is considered to be a fresh species, to be called *Opius ponerophagus*, as it possesses morphological differences in the shape of the discoidal and second cubital cells of the wings and elsewhere.

From the annual report of the Department of Agriculture, Uganda, for the year ended March 31, 1916, it is interesting to note that the coffee on the plantation has shown a marked improvement. The leaf disease due to the well-known fungus, *Hemileia vastatrix*, which was causing some anxiety, appears to be well in hand owing to the measures taken by the officers of the department. The prevalence of the disease shows marked fluctuations, the commencement of an outbreak coinciding with the beginning of the rains about the end of February, and its termination with the drought. From August, 1915, to February, 1916, there was a long spell of partial immunity.

The annual report of the Agricultural Department, St. Vincent, for 1915–16 is a record of steady progress. In addition to the usual work, experiments on cotton-breeding are being made at the experiment station, which, if they can be fully carried out, should yield valuable results. Plants possessing resistance to angular spot and boll-rot have been selected, and an effort is being made to breed from them resistant strains. Selection for lint characters is also being undertaken. Should varieties be produced capable of resisting the attacks of the cotton stainer—the main cause of boll trouble—the cotton yield would be nearly doubled. Work of this kind emphasises the great need for the establishment of properly equipped agricultural research stations in the tropics in order that plant-breeding experiments needing many years of careful research may be undertaken without interruption and hindrance.

A useful publication on medicinal plants has been published as Bulletin No. 78 of the West of Scotland Agricultural College. The cultivation, drying, yield, and prices of the various herbs are considered in the opening pages at sufficient length, and particular attention is paid to those suitable for Scotland. This is followed by a list of hardy herbs, trees, and shrubs used in medicine. The list is very well compiled, the botanical and common names and natural family of each plant being given, then its duration—annual, biennial, or perennial—the part used occupies the next column, then the time when it should be collected, and, finally, general information as to its soil requirements, situation, etc. This and Miss Teetgen's recently published book on "Profitable Herb Growing and Collecting" should be studied by those who are interesting themselves in the growing and collecting of medicinal plants.

The Board of Agriculture and Fisheries has issued an order, dated January 15, which came into force on February 1, with regard to the wart disease of potatoes. It is forbidden to plant potatoes on any land on which potatoes affected with wart disease have been grown during the previous year, unless such planting be duly authorised by the Board or the local authority. A person convicted is liable to a penalty not exceeding 10*l*., unless he can prove to the satisfaction of the court that he was unaware that affected potatoes had been grown on the land in a previous year.

The thirtieth annual report of the Liverpool Marine Biology Committee, drawn up by Prof. Herdman, and dealing with the work of the Marine Biological Station at Port Erin for the year 1916, shows that the usual Easter vacation course in marine biology was carried on and was attended by fifteen students, that five research workers have occupied tables, and that in the fish hatchery nearly eight millions of plaice larvæ were hatched and set free. The curator (Mr. Chadwick) records observations on the rapidity with which specimens of the brittle star *Ophiocoma nigra* react to the presence of food; they detected in 15 seconds the presence of a small piece of mussel suspended out of their reach in the water of the table-tank on the bottom of which they were living. Mr. Chadwick has directed attention in previous reports to the obstruction of the pipes supplying the aquarium caused by the growth therein of various invertebrates. In the present report he notes two tube-building Polychætes—a single large specimen of *Sabella pavonia* and a vigorous colony of *Salmacina dysteri*—as the causes of such obstruction, and remarks that, although the colony of Salmacina had grown in the absolute darkness of the interior of the pipe, the worms were deeply tinged with the bright orange-red pigment characteristic of the species. He records the presence on one occasion of hundreds of large specimens of *Aplysia punctata* among seaweeds which thickly strewed the area between tide-marks and had been thrown ashore by a fresh westerly breeze. The report also contains an interesting address (32 pp.), given to the Biological Society of Liverpool by Prof. Herdman, on Sir Wyville Thomson and the *Challenger* expedition.

Many years ago the late Prof. O. C. Marsh obtained from the Cretaceous rocks of Colorado, U.S.A., the hind foot of a running dinosaur constructed like that of a young struthious bird. He named the reptile accordingly Ornithomimus. A nearly complete skeleton of a closely related new genus, Struthiomimus, has now been received by the American Museum of Natural History from the Cretaceous Belly River Formation of Alberta, Canada, and is described by

Prof. H. F. Osborn in the Museum's *Bulletin* (vol. xxxv., art. xliii., January, 1917). Instead of being a raptorial carnivore, as at first seemed probable, it proves to be one of the strangest and most unexpected of dinosaurs, and represents an entirely new group. The jaws are toothless and must have been sheathed in narrow, horny beaks, much like those of an ostrich; but the quadrate and other bones of the skull preserved are distinctly dinosaurian. Compared with the trunk, the head is remarkably small, for although the skull is only one-third longer than that of an ordinary ostrich, it is attached to a backbone more than 13 ft. in length. The long and powerful neck must have been as flexible as in a bird. The small fore limb is long and slender, with three clawed fingers closely pressed together and of nearly equal length. On the whole, it suggests functions like those of the fore-limb of a sloth. The reptile could obviously run rapidly on its three-toed hind-limbs, with the raised forequarters balanced by the long tail. Its habits are very difficult to determine, but Prof. Osborn thinks that it lived much like an ostrich, on a mixed diet, with little power of grasping living or actively moving prey. This conclusion is interesting, for Struthiomimus and Ornithomimus bear many close resemblances to the typical carnivorous dinosaurs, with which they must have had a common ancestry.

A "CATALOGUE of the Collection of Meteorites" in the Field Museum of Natural History at Chicago is given by the curator, Dr. O. C. Farrington, in Publication 188 of that museum (Chicago, 1916, Geol. Ser., vol. iii., pp. 231–312). It is interesting to recall that two other catalogues of meteorite collections, namely, those at Washington and Calcutta, were also published during the latter part of last year. The Chicago collection was greatly augmented in 1912 by the purchase of the famous Ward-Coonley collection, which had already absorbed the large private collections of Mr. J. R. Gregory, of London, and of Count Simashko, of Petrograd; and since the last catalogue of 1903 it has been almost trebled in size. Containing representatives of 657 falls and a total weight of 7566 kilograms (about 7½ tons) of meteoritic material, it now ranks as the foremost collection in the world. The present catalogue gives particulars of the individual specimens, arranged alphabetically under the geographical names of the falls. A few general notes pointing out prominent features of the collection are also given. The largest mass is the Quinn Cañon (Nevada) iron of 1450 kg. The Cañon Diablo (Arizona) iron is represented by 122 individuals, the largest weighing 460 kg., and the total weight being 2306 kg. The Forest City (Iowa) shower of stones is represented by 722 complete individuals, ranging in weight from 3 to 4308 grams. There are some inconsistencies in the transliteration of Russian geographical names, Germanised forms of which seem difficult to eliminate. For example, Government Saratov appears correctly on p. 295, but on p. 288 as Saratowsk, the latter being the German rendering of the Russian adjectival form.

THE Paris correspondent of the *Times*, in the issue for February 10, describes what France has achieved in "war chemistry." Before the war France obtained her coal-tar products—benzene, toluene, xylene, naphthalene, anthracene, phenol, etc.—from Germany, and there was only one factory in the country capable of producing certain colouring matters. Since the latter and explosives have the same starting point, viz. the nitration of hydrocarbons, the position was extremely grave. As quickly as possible nitration plant was laid down in many new works, both private and belonging to the State, arrangements were made for the supply of enormous quantities of benzene and toluene, and shells were soon being manufactured in ever-increasing numbers. France's position as regards sulphuric acid will be excellent; in fact, there may be a difficulty in utilising all that produced. From the product of the phosphate mines of Tunisia and Algeria, together with the superabundant sulphuric acid, it will be possible to supply French farmers with cheap superphosphate, and also to compete in the foreign markets. The Germans probably knew, when in May, 1915, they first made use of asphyxiating gases as a weapon of war, that liquid chlorine was not produced in France. But within a year several works had commenced liquefying the gas. After the war these works will be established, and can be employed for the manufacture of bleaching powder, certain colouring matters, and various pharmaceutical products which France has hitherto had to import.

AN article appears in the *Quarterly Review* for January, under the title "Aircraft Politics in War Time," which gives an exceedingly clear account of the causes and results of the attack on Government-designed aeroplanes which was started by Mr. Pemberton Billing in July, 1916. The writer traces the real cause of this attack to the position in which manufacturers were placed by the rapid changes in the type of machines required. These changes were directly consequent upon the experimental work done at the Royal Aircraft Factory and at the National Physical Laboratory, and prevented the "trade" from making arrangements for repetition work in quantity, thus reducing efficiency from the commercial point of view. The article in question gives strong support to the excellence of the machines designed at the R.A.F., and quotes the case of the "Fokker" to show how easily wrong conclusions as to a machine's performance can be drawn in a moment of excitement. The "Fokker," when captured and tested by our own men, proved inferior to our own machines of similar type in all particulars, and was found to be thoroughly unstable. This is not surprising, since it is well known that the question of aeroplane stability was not understood in Germany as it was in this country at the time war broke out. The progress that has been made since the war started, in regard both to stability and to general aerodynamics, has been truly astonishing, and this scientific progress has had much to do with the altered relations between the "trade" and the Government designers which now exist. Far from discrediting experimental work in aeronautics in favour of the "rule of thumb" method, the private firms are now only too eager to obtain the results of such research and to use them to the utmost in their new designs. The article devotes a considerable amount of space to the purely commercial relations between the private manufacturer and the Government, but it is, nevertheless, well worth reading by those interested in the scientific development of aeronautics.

OUR ASTRONOMICAL COLUMN.

THE SPECTRA OF CEPHEID VARIABLES.—The detailed results of an extensive series of spectroscopic observations of twenty Cepheid variables have been published by Dr. Shapley (*Astrophysical Journal*, xliv., 273). The data indicate that regular changes in spectral type accompany the periodic variations in light, and constitute one of the general and fundamental properties of variable stars of this class. It is somewhat disconcerting to read that, in spite of the great number of observations of the magnitudes of such stars, no really precise information as to maximum magnitude and range of variation is yet available. The data, however, are sufficient to show that the earlier spectral types are associated with the shorter periods. Among the twenty stars in question, the earliest type at maximum is that shown by RS Boötis, which is B8, passing to F0 at minimum. The most advanced type at maximum is shown by U Vulpeculæ, which is F7, and passes to G5 at minimum. The periods of these two stars are respectively 0·377 day and 7·990 days. No Cepheid variable hitherto observed has failed to show variability of the spectrum, and it is probable that all the variables of this class are subject to similar periodic disturbances of the radiating surfaces. Dr. Shapley has previously stated his reasons for rejecting attempted explanations which are based on a supposed binary character of the Cepheid variables, and for regarding the variations as arising from pulsations in a single body.

DAYLIGHT PHOTOGRAPHY OF STARS.—Some interesting experiments on the photography of stars in daylight have been made by Messrs. A. F. and F. A. Lindemann (*Monthly Notices*, R.A.S., vol. lxxvii., p. 140). Following the indications of a theoretical investigation as to the greatest contrast between sky and star, the photographs were taken on panchromatic plates through red filters, which only transmitted light of wave-length greater than 6700 Å. With the 6-in. refractor employed, it was found possible in this way to photograph stars down to third magnitude, at distances of 20° or 30° from the sun. It is thought that in a fine climate it might be possible to photograph stars even fainter than first or second magnitude when quite close to the sun. The object of the experiments was to ascertain the practicability of testing, without an eclipse, the slight deviation of a ray of light by the sun's attraction which is indicated by Einstein's theory.

REPORT OF THE CAPE OBSERVATORY.—The report of H.M. Astronomer at the Cape of Good Hope for the year 1915, which has recently been received, indicates that the work of the observatory was carried on in all departments with but little interference from war conditions. Besides the usual meridian observations with the reversible transit, 118 parallax stars were under observation with the 8-in. transit circle, with an average of five comparison stars for each. Photographs of the sun, supplementing those obtained at Greenwich, were taken on no fewer than 315 days. The arrangements made for the daily transmission of a wireless time-signal for the use of shipping in South African waters proved very satisfactory.

THE THEORY OF ISOSTASY AS APPLIED TO THE QUATERNARY OSCILLATIONS OF SEA-LEVEL.

IN view of the publication by the Geological Survey of Canada of a very important paper[1] dealing with the application of the theory of isostasy to the Quaternary oscillations of sea-level, it seems desirable to give here a short *résumé* of the theory, and to point out to what extent the newly recorded observations tend to place it on a firmer basis.

It will be recalled that this theory ascribes the raised and tilted shore-lines, which are found around the centres of glacial dispersal, to the sinking in of the earth's crust beneath the pressure of the ice-sheets and its subsequent recovery when the ice has melted away. The depression and recovery were greatest at the centres of dispersal, where the ice was thickest, with the consequence that the shore-lines are highest near these centres and descend gradually towards the margins of the glaciated districts. Before they actually reach these margins they pass beneath the present sea-level, so that there are no Late Glacial *raised* beaches in the peripheral part of the glaciated districts. The shore-lines which were formed during the retreat of the ice from these areas are all beneath the present sea-level.

Now the occurrence of this state of things in connection with all the Quaternary ice-sheets is very strong evidence of a general lowering of the ocean-level during the glaciation. Moreover, calculations based on the quantities of water which must have been bound up in these ice-sheets, and so removed from the ocean, seem to indicate that this cause is quite adequate to produce the observed effects.

We have, therefore, in seeking for an explanation of the Late Glacial changes in the relative level of land and sea, two factors to deal with. The first is the local isostatic recovery of the earth's crust, the second is the general raising of level of the ocean due to the melting of the ice-sheets. According as the first or second of these factors predominated, there occurred either emergence or submergence in the isostatically affected areas.

This appears to be the explanation of the curious fact established by W. C. Brøgger in the Christiania region, that the first change of level after the retreat of the ice was one of submergence, which, at a somewhat later stage of retreat, gave place to emergence. That this is the course of events to be expected from the interplay of the two factors mentioned is apparent from the following considerations.

(1) At the period of deposition of the earlier Late Glacial marine deposits from which Brogger drew his conclusions, about one-third to one-half of the total retreat of the ice margin had been accomplished; and it is roughly at this stage of retreat, when the climate had already considerably ameliorated, and there was at the same time a large body of ice still in existence, that the most rapid return of water to the ocean is to be expected.

(2) Brøgger has clearly established that the isostatic recovery progressed with a wave-like motion from south to north along the Cattegat, following up the retreating ice-margin. This seems to indicate that the recovery took some time to get under way, and did not attain its maximum rate until the neighbourhood was altogether clear of ice.

At this particular period of retreat, therefore, it would be natural to expect that the rise of the ocean level might be, for a time, faster than the isostatic recovery, and submergence would result. Later, when the isostatic recovery had gathered pace, and the amount of water returning to the ocean from the waning ice-sheets had become gradually less, we might expect the isostatic recovery to get the upper hand and give us progressive emergence.

Now the best test of the validity of this theory is its applicability to the isostatically affected areas of the British Isles and North America. Unfortunately in the British Isles the highest Late Glacial shore-line is only 100 ft. above the present sea-level, and within this small vertical range evidence of the kind utilised by Brøgger is not to be expected. In North America, until the appearance of the paper above mentioned, no investigation such as would bring to light a relation of this nature appears to have been placed on record. Johnston now brings forward evidence, of a nature similar to that adduced by Brøgger, to show that the Late Glacial changes of sea-level in the Ottawa valley were precisely the same as those established for the Christiania region, namely, that the sea first rose on the land as the glaciers retreated, and that it was not until a later date that emergence supervened. Moreover, he makes a further point of great importance

[1] W. A. Johnston: "Late Pleistocene Oscillations of Sea-level in the Ottawa Valley." Geological Survey of Canada. Museum Bulletin, No. 24. September 15, 1916.

in establishing the isostatic theory on a firm basis. This point, for which there is no direct evidence in the Norwegian case, is to the effect that the tilting of the Great Lakes region was in progress before and during the rise of the sea in the Ottawa valley, for, presumably from a comparison of contemporaneous ice-margins, it is concluded that "the Ottawa valley must have been, in part at least, occupied by the ice-sheet during the existence of Lakes Iroquois and Algonquin, and at least a small amount of uplift affected the region at the foot of Lake Ontario during the life of Lake Iroquois. Uplift also affected the northern portion of the Great Lakes region, and probably included the upper portion of the Ottawa valley near Mattawa during the existence of Lake Algonquin, and while the ice-sheet still occupied the upper portion of the Ottawa valley." Further, it is not a case of alternating elevation and depression, "for the result of investigations by numerous geologists of the raised beaches of the Great Lakes region has shown that differential uplift took place almost continuously as the ice withdrew."

We have thus direct proof that a district which was rising relatively to those around it was nevertheless undergoing submergence beneath the level of the sea. This remarkable phenomenon can have but one explanation, namely, that the isostatic recovery and the general rise of the ocean-level were in progress simultaneously, and that for a time the latter was the more rapid. Norway up to the present has only supplied a measure of the difference of these two motions. To presume their concerted action was a leap in the dark. Canada has now produced unexpected evidence of their individual existence.

There is now but one thing wanting to make the analogy between the isostatic phenomena of America and Europe perfect in every detail, and that is the discovery of a shore-line corresponding to the "Early Neolithic" or "Littorina-Tapes" raised beaches of Great Britain and Scandinavia. This should represent in the south a distinct resubmergence, and in the north a pronounced check or slowing down in the general emergence.

W. B. WRIGHT.

PLANT DISEASES.

THE *rôle* played by insects in the spread of plant diseases is well brought out in the case of the collar-rot of rubber trees (*Hevea brasiliensis*), recently investigated by Sharples (Bull. 25, Dept. of Agriculture, Federated Malay States, 1916). The disease is caused by the fungus *Ustulina zonata*, as Brooks (Bull. 22, F.M.S.) has already shown. Sharples finds that at the time when the trees in a young rubber plantation are thinned out, at the age of about six or seven years, attacks by boring beetles (*Xyleborus parvulus*) become very common. He shows that these insects easily enter trees the bark of which has been injured by the falling of one tree against another. Attacks by the above-mentioned fungus usually quickly follow the beetles which enter rubber trees, the tracks of the insects being convenient ports of entry for the wound-parasite, *U. zonata*. At the time of thinning a large amount of suitable food material for the fungus is available in the form of soft rubber wood. Owing to the increased development of the fungus under these conditions in conjunction with the greater prevalence of borer attacks during the same period, it follows that the thinning-out stage is the most dangerous one in the life of a plantation as regards the attacks of this fungus on rubber trees.

To No. 10 of the twelfth volume of the *South African Journal of Science*, published in May of the present year, Dr. Ethel M. Doidge contributes a paper on the occurrence in South Africa of *Bacterium campestre*, the organism which causes the black-rot disease of the cabbage and other cruciferous crops. This organism had formerly been recorded only from Europe, America, and New Zealand, but Miss Doidge's investigations showed that the disease caused by it was quite common in the neighbourhood of Pretoria. The most interesting point about the communication is that it seems clear that the organism in the case under consideration was introduced into South Africa on cabbage seed which came from England. From cabbage seeds imported by the nuseryman to whose premises the diseased plants first observed by Miss Doidge were traced, the organism was isolated and its virulence proved by the successful artificial inoculation of two healthy cabbage plants. It was suggested nearly twenty years ago by Stewart in America that this disease was probably disseminated by seedsmen, but actual proof was then wanting. Soon after this the organism was isolated by Harding from the surface of cabbage seed produced by diseased plants in Long Island; and now Miss Doidge has shown that by such means the disease may be carried from one continent to another. Soaking suspected seed for fifteen minutes in 1 : 240 formalin or in 1 : 1000 mercuric chloride is recommended as a suitable method of treatment.

The cause of the serious disease of the potato known as the "Blattrollkrankheit" (leaf-roll disease) has been a matter of considerable controversy. The earlier investigators regarded the disease as being due to the choking of the wood-vessels of the plant with fungus mycelium. Recent researches, however, have shown that plants suffering from the choking of their vessels (*hadromycosis*) are not to be confounded with those affected with the true leaf-roll disease in which mycelium is absent. Quanjer, in 1913, found necrosis of the phloem to be a characteristic symptom of true leaf-roll in Holland; and in his most recent publication (*Med. van d. Rijks Hoogere Land-, Tuin- en Boschbouwschool*, Deel x., Wageningen, 1916) this author claims to have proved that the disease is due to a transmissible virus. Since attempts made to infect healthy potato plants by means of injections of the sap of diseased plants did not succeed, it might be thought that the claim is not justified. However, successful transmission of the disease was brought about in grafting experiments both with stalks and with tubers. Further evidence in favour of the virus is claimed to be afforded by the failure to isolate any parasitic organisms from affected plants, by the method of spread of the disease, by the uncertain results of selection as a means of raising healthy stocks of plants, and by the infection of healthy plants when transferred to diseased surroundings either through the agency of the soil (in which it is believed that the virus is often present) or from neighbouring diseased plants. It would seem that further research is necessary in order to supply absolutely convincing proof of the virus theory of the origin of this disease. Should it turn out to be a correct one, this disease, which has already made its appearance in some parts of Great Britain, will probably become more or less widespread in a few years unless some measures are taken to check it. The publication referred to is published in both the Dutch and the English languages.

COAL AND ITS ECONOMIC UTILISATION.[1]

THE economic importance of coal we perhaps realise. It is the only raw material we produce in great quantity; the value of our total mineral output in 1913 was above 160,000,000*l.*; of this the value of the coal at the mine was above 145,500,000*l.*

Our output of coal and our home consumption in

[1] Abridged from the Howard Lectures delivered before the Royal Society of Arts on November 27, December 4, and December 11, 1916, by Prof J. S. S. Brame.

the year 1913, a period undisturbed by domestic troubles or by the war, touched high-water mark in production and in consumption, with an output of 287,430,000 tons, of which 189,000,000 tons were retained for home use. The number of employees was 1,110,884, which gave an output per head of 259 tons.

In 1914 the output fell to $265\frac{1}{2}$ million tons; in 1915 to 253 million tons. The demand for coal, however, increased with the enormous activity in the production of munitions, but the home consumption in 1914 was $184\frac{1}{2}$ million tons, and about the same figure for 1915. It was therefore the export trade which suffered.

In the period of forty-two years, from 1873 to 1914, we have raised 8,206,243,000 tons, and exported 2,012,796,000 tons, or more than $24\frac{1}{2}$ per cent. The value of the coal raised was equal to more than 84 per cent. of the value of our whole mineral output.

The questions arise naturally, What stocks have we? What inroads have we made on them? and How long will the stocks last? The last is too highly speculative and has too little real bearing on the question of economy to justify more than mention of the insuperable difficulties of making such an estimate.

Estimates of stock can, however, be made with some approximation.

The following estimate was made by the Royal Commission (1905), the figures being in million tons.

Estimated Coal Reserves, Royal Commission, 1905.

	Not exceeding 4000 ft.	From 4000–10,000 ft.
Proved	100,914 ...	5,239
Unproved	40,721 ...	—
Totals ...	141,635 ...	5,239

A few words may prove of interest about the Kent field, which was not included in the above estimate, and is of particular interest to us in London and of wider importance because of its geographical situation in relation to the North Sea and the Channel.

From borings which have gone to 2500 ft., Prof. H. S. Jevons considers it is established that over an area of 150 square miles the total thickness of the seams (of 18 in. and above) is from 30 to 40 ft. If the area is no greater than this—and there is reason to believe it is much more extensive—the reserves would be some 6000 million tons.

The composition of one class is very close to the average composition of the high-class Welsh smokeless coals. If the burning qualities of the coal are as good, and the seams are workable, the occurrence of such coal so conveniently situated in relation to several important naval bases may prove a valuable asset to the Royal Navy.

Comparison may be made between our reserves and those of other countries.

Of the European reserves, Germany possesses 54 per cent. of the whole; Great Britain 24 per cent.; Russia and Austria-Hungary about 7·6 per cent. each; and France 2·1 per cent.

Of the world's probable reserves, North America can claim nearly 69 per cent., of which approximately 40 per cent. lies in the United States. Asia comes next with 17·3 per cent., leaving Europe a poor third with about 10·5 per cent.

Not only are we exhausting our supplies at a far higher proportionate rate than our nearest commercial rivals, but we are retaining for our home use a much smaller proportion of the output.

It is clear that if Great Britain is to maintain her place among the great nations she must remain a great manufacturing centre, and this depends entirely on cheap fuel. The necessity for economy in place of waste is apparent, and enormous economies are undoubtedly possible.

One very important and very difficult question is that of export. It cannot be denied that in our export trade we have, to a large extent, developed our industrial greatness. But we must look at this question of export on a wider front than the immediate present or the immediate future. If, as our political economists tell us, our export is essential to our well-being, we must realise that it is at the cost of bringing the day rapidly nearer when industries will be hampered by dear coal—in other words, mortgaging the interests of posterity in the interest of the present and possibly a few succeeding generations.

The suggestion which has been made for the re-imposition of a duty on export coal, the proceeds from which should be applied to the investigation of our coals and the development of schemes for the more economical utilisation of the coal we consume, would appear very sound.

As Prof. H. S. Jevons so aptly puts it: "Englishmen must take heed in the future to rely less upon exploiting our vast stores of national wealth, and more upon the resources which scientific skill and practical education can place at our disposal."

The economic use of coal is closely associated with the question of the by-products—ammonium compounds and the tar—many important chemical industries being dependent on the latter, whilst the small quantity of nitrogen in coal—averaging about 1·4 per cent.—furnishes our principal supplies of ammonia compounds. The sulphate of ammonia alone is a most important material as a fertiliser, and its importance to agriculture can scarcely be over-estimated. In the increased production of home-grown foodstuffs, generally admitted to be a pressing question, it must undoubtedly prove an important factor. It is one of the romances of science that by means of sulphate of ammonia we are actually returning to plant life nitrogen derived from a previous vegetation which flourished millions of years ago.

The tar is the most important of the by-products obtained, and certainly no substance has yielded so many valuable products for the service of man. All the vast number of beautiful dyes, of valuable drugs, disinfectants, flavouring essences and perfumes, and photographic developers are the outcome of the work of the chemist on the raw materials furnished by the tar.

Benzene, the most important of the hydrocarbons obtained from the tar, has proved a valuable fuel for motor engines. In addition to that derived from the tar, further quantities may be obtained by washing the gas with heavy oils which dissolve the benzene and yield it up again on distillation.

The importance of benzene as a fuel in lieu of petrol is very great; ample supplies of such a home product would do much to check artificial prices for petrol. It has been estimated that it would be possible to produce annually some twelve million gallons from gas-works and sixty million gallons from coke ovens, if all coal were treated in recovery plant.

Benzene is also employed for cleaning purposes (cloth, fabrics, etc.), and quantities are now converted to synthetic phenol (carbolic acid), from which picric acid (lyddite) is prepared.

Another hydrocarbon closely allied to benzene is toluene, for which there is a great present demand for conversion into trinitrotoluene (T.N.T.), the powerful high explosive. Quantities are now obtained by oil scrubbing of the gas and also synthetically from benzene.

Phenol (carbolic acid) can be extracted directly from the light oil and carbolic oils by washing with caustic soda; also the closely allied cresylic acids. All yield high explosives on nitration.

Consideration may now be given to the more economical utilisation of our coal, and the natural course will be to deal first with wastage in production. In the past coal-mining has been characterised by the little regard which has been paid to wastage of good coal, often, of course, through financial considerations.

Many of the losses in mining coal are unavoidable—for example, by reason of the small dirty coal produced—but a great deal of really good coal is often wasted because it does not pay to bring it to bank.

With the introduction of coking plants, of briquetting plants, and of sizing and washing plants, the amount of small coal wasted has been very materially reduced, and the increased price for such prepared coals has proved an important factor in the economy of coal.

Turning now to economy in use, with our present knowledge of methods of getting power from coal, the best utilisation we are likely to effect (by gasification and use directly in gas-engines) will be about equal to 20 per cent. of the available energy.

Economy in operating can be obtained by more attention to combustion, and the combination of the purchase of coal on a scientific basis with scientific control of combustion leads to very considerable economies.

In the whole scheme of coal economy it will obviously be desirable to employ the form of plant which gives the highest thermal efficiency, for by such plant the lowest fuel consumption will be attained; but many other considerations besides thermal efficiency will be taken into account. It was to gaseous fuel that the Royal Commission (1905) looked for the realisation of enormous economies in coal consumption. Since that date, however, the steam turbine has developed and, although inferior as a heat-engine to the gas-engine, has proved a more serviceable power unit for large-scale power production than the gas-producer and gas-engine. For power production and distribution as electrical energy on a large scale the turbine has practically completely supplanted the gas-producer in the opinion of engineers.

Producer-gas plants with gas-engines, however, have their proper sphere in the economy of coal, and have contributed very largely to economy. Another important point is that a class of coal totally unsuited to use for steam raising can be employed in a producer, so that good steam-raising coal is economised.

The introduction of suction gas plants has also been a great advance, because such plants have almost invariably been installed in place of moderate and small-sized steam plants, the latter being notoriously inefficient as power units.

There are two very important industrial operations where great saving is possible, even although considerable progress has been made in reducing this waste. These are the waste of heat in blast-furnace and coke-oven practice.

The available surplus power from blast-furnaces amounts to a very large figure. Approximately, for every ton of iron produced, 150,000 cub. ft. of gas of a calorific value per cubic foot of 90 to 100 B.Th.U. are obtained. After heating the blast stoves and operating the plant with gas-driven engines, a surplus of 65,000 cub. ft. may result, this being equivalent to an output of about 650 b.h.p.

The surplus gas available in coke-ovens per ton of coal carbonised is about 5000 cub. ft., and its calorific value about 550 B.Th.U. per cub. ft., so that a coke-oven plant carbonising 400 tons per day and giving the above amount of surplus gas will, with the consumption of 21 cub. ft. per b.h.p., operate a power plant with an output of 4000 b.h.p. per hour.

Surplus coke-oven gas is being utilised as a source of power for the supply of the collieries, or in connection with a "waste-heat" scheme, in admixture with producer gas for steel-making, and as supplementing the supply of coal gas in the neighbourhood.

In the field of fuel economy, great as savings would be which can be realised by individual action, they are small as compared with what might be realised by collective action throughout a district, and the extensive scheme which has been in operation on the North-East Coast for some years is an object-lesson in what can be accomplished.

The underlying principle is to have a uniform collecting and, therefore, distributing electric system. Waste heat from coke-ovens and blast-furnaces, and exhaust steam from blowing engines (through low-pressure turbines), are utilised continuously at maximum electrical output, and the supply supplemented as necessary from steam-operated turbine sets at a limited number of stations.

The area covered by the scheme is 1400 square miles; the length of the district (north to south) is seventy miles; and the present total horse-power generated, 343,000. Collieries with an output of more than twenty million tons now depend on this supply, and show a saving of about 75 per cent. in coal consumption (equal to one million tons of coal); the suburban railways are supplied with electric power for eighty miles of single track; heavy freight haulage is carried out on fifty miles of track; tramway systems are supplied with current. In addition, lighting is provided in towns with an aggregate population of 700,000. Another important feature is the development of new industries, notably electro-chemical.

There can be no question that enormous economies are possible on similar lines in the great industrial centres, because existing conditions are generally favourable. There has been a natural concentration of industries and population in the vicinities of our coalfields; the principal sources of waste heat—iron smelting, with its complement, coke manufacture—have developed naturally in the same areas. There is the large demand for power for industries, for locomotion, and for the general supply of heat and light to a large population.

London is in a special and unique position as regards such a general-power scheme; it is far removed from coal-producing districts (at least, until there has been considerable development in Kent); it has an enormous population and big demands for power, although no large individual demands which compare with the big industrial concerns in the North; and enormous demands for lighting and domestic heating.

Waste heat is not available in the London area, and current would have to be generated at large stations situated below London, necessarily on the riverside, so as to secure the advantages of sea-borne coal and ample water supply. For the most efficient scheme I feel convinced that the gas companies and future low-temperature carbonising concerns will have to supplement the directly generated current, the former being linked in by utilising surplus coke in producers and the producer-gas in gas-engines coupled with generators, the latter through their surplus gas, to be mixed with poor producer-gas (possibly the coke-gas referred to). The gas companies already have their distributing system and market for gas; the low-temperature coke will find the best market in the country at hand.

In this way three important concerns, which would handle coal as their main raw material, could be linked up through the medium of the future uniform system of electricity distribution in the metropolis to the very great advantage of the community, providing cheap electricity and smokeless fuel, and retaining coal-gas with its many advantages.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—On February 20 Congregation took in consideration certain amendments to the statute establishing the status of advanced student, the preamble of which was passed on February 6. An amendment substituting the title of Doctor of Philosophy for that of Doctor of Letters or Doctor of Science, in the case of the degree to be obtained under the statute, was proposed by Mr. Ball, fellow of St. John's College, and Prof. A. C. Clark, Corpus professor of Latin. It was supported by Mr. Barker, fellow of New College, and opposed by Mr. Walker, fellow of Queen's, and Dr. Marett, reader in anthropology. On a division it was carried by eighty-nine to nineteen. Another amendment, proposed by Dr. Schiller, fellow of Corpus, and Dr. Grenfell, fellow of Queen's, which would have had the effect of abolishing a written examination for the new degree, was rejected by thirty-seven to fourteen. Under the former amendment the existing degrees of D.Sc. and D.Litt. will remain unaffected by the new enactment.

SIR JOHN BLAND-SUTTON has been appointed to deliver the next Bradshaw lecture at the Royal College of Surgeons of England.

DR. J. M. PURSER has been appointed Regius professor of physic in the University of Dublin, in succession to the late Prof. J. Little.

THE title of associate professor has been conferred by the council of the University of Liverpool upon Mr. J. Wemyss Anderson, lecturer in engineering design and drawing and in refrigeration, and dean of the faculty of engineering, in the University.

IT has been decided to make the erection of new science buildings for the University College of North Wales, Bangor, the North Wales memorial to men fallen in the war. The cost of the scheme will be 150,000*l*.

MR. D. M FORBES, who died on December 13 last, has bequeathed to the University of Edinburgh his books relating to the Philippine Islands, and the residue of his property, which, with the property abroad, will amount, it is understood, to about 100,000*l*., for the purposes of education.

A NEW chair of "social providence and assistance" has been established in connection with the Collège de France, the funds for the maintenance of which will be provided by the Municipal Council of Paris and the General Council of the Seine. The teaching given from the chair will deal largely with sickness assurance, invalidism, old age, and infant protection.

THE following courses of lectures are announced for delivery at the Royal College of Physicians of London:—The Milroy lectures, by Dr. W. J. Howarth, on "Meat Inspection," on February 22, 27, and March 1; the Lumleian lectures, by Dr. G. A. Sutherland, on "Modern Aspects of Heart Disease," on March 13, 15, and 20; and the Goulstonian lectures, by Dr. C. H. Miller, on "Paratyphoid Infections," on March 22, 27, and 29.

THE Department of Agriculture and Technical Instruction for Ireland has issued its programme of summer courses of instruction for teachers to be held during the present year. With the exception of the course in rural science, which begins on August 7, all the courses will commence on July 3 and close on July 27. Teachers who attend the courses regularly and punctually will be allowed 3*l*. 10*s*. towards their expenses while living at the instruction centre, and third-class railway fare for one return journey. The courses are open only to teachers who are more than twenty years of age and engaged by local committees of technical instruction or in schools receiving grants from the Department. Among the subjects in which instruction is offered may be mentioned wool dyes and dyeing, internal-combustion engines, housewifery, hygiene and sick-nursing, manual training (woodwork), and rural science (including school gardening).

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 8.—Sir J. J. Thomson, president, in the chair.—Lord **Rayleigh**: The dynamics of revolving fluids. The fluid is supposed to be devoid of viscosity and the motion to be at all times symmetrical about an axis. In accordance with Kelvin's general theorem the circulation remains constant for each ring of fluid. In equilibrium the rings of fluid must be so arranged that the circulation is in cylindrical layers, and if the equilibrium is to be stable the circulation must increase outwards. An example is taken from fluid originally rotating like a solid and enclosed by coaxial cylindrical walls. If these close in, a simple vortex motion of increasing intensity is superposed, and the difference of pressures at the walls also increases. When the motion is in three dimensions, exact solutions are scarcely practicable, but some general considerations are appended, suggested by a recent paper of Dr. Aitken.—Prof. H. **Lamb**: The deflection of the vertical by tidal loading of the earth's surface. This subject has of late excited renewed attention owing to its bearing on observations of lunar disturbance of gravity. The present paper, after discussing a few typical problems, goes on to examine the effect of one or two considerations which have been hitherto left out of account, so far as the author is aware, in such calculations. In the first place, owing to the deformation of the surface and the altered distribution of density, an additional horizontal component of force on the pendulum is introduced. A more important point is that the action of gravity in resisting the deformation is ignored. It is true that the corrections involved are under certain conditions negligible, but they are of some theoretical interest, and it is found that at great distances from the load, and therefore in all cases of a widely distributed load, they may attain considerable relative importance. In attempting to estimate the effect of gravity it has been found convenient, in order to avoid difficulties not altogether of a mathematical kind, to limit the investigation to the case of incompressibility. In the first instance, also, the disturbance in the field of gravity has been neglected in calculating the strains. When the alteration of the field is taken into account a curious point arises. For mathematical simplicity the "earth" has been regarded, as is usual in such investigations, as flat and infinitely extended. It appears that in such a case the surface would be unstable, whatever the degree of rigidity, for disturbances exceeding a certain wave-length. This critical wave-length is, however, enormous, and reasons are given for the view that inferences can legitimately be drawn from the results as to the character of the effects actually produced.—C. F. **Brush** and Sir R. **Hadfield**: Spontaneous generation of heat in recently hardened steel. Steel specimens of different composition were hardened and then placed in Dewar vacuum jars so arranged as to have equal thermal insulating efficiency. These were placed inside an air-tight cylinder of thin copper embedded in granulated coke placed in another box surrounded by an air space and a further box. The special apparatus employed is fully described in the paper. Carbon steel, also nickel-chromium steel specially susceptible to hardening, and other steels were then quenched from hardening temperatures, and when cold placed in the vacuum jars and the temperatures carefully recorded in the manner described in the paper. It was found that there was an evolution of heat of minute but appreciable quantity. As regards the bearing of this research as applied to industrial practice, whilst the rise of temperature is minute and may not have any direct bearing upon hardening results, the curious phenomenon noticed throws light upon the series stresses and strained condition of the material produced in large masses of steel during hardening operations.

Royal Microscopical Society, January 17.—Mr. E. Heron-Allen, president, in the chair.—The report of the council for the year was read.—E. **Heron-Allen**: Presidential address: Alcide d'Orbigny, his life and his work.

Mathematical Society, February 1.—Prof. H. M. Macdonald, president, in the chair.—Major **MacMahon**: (i) The significance of a certain algebraic fraction in the theory of distributions. (ii) The number of ways of pairing off the members of two identical sets of different quantities. W. H. **Salmon**: Curves of constant torsion. Informal communications were made by Lt.-Col. A. Cunningham and Messrs. E. H. Neville and L. J. Mordell.

BOOKS RECEIVED.

The Correct Arms of Kingston-upon-Hull. By T. Sheppard. Pp. vii+47. (Hull: A. Brown and Sons, Ltd.) 2s. 6d. net.

General Chemistry for Colleges. By Prof. A. Smith. Second edition. Pp. x+662. (London: G. Bell and Sons, Ltd.) 6s. 6d. net.

One Hundred Chemical Problems. By E. A. Mason. Pp. 8. (London: G. Bell and Sons, Ltd.) 6d. net.

Hawaiian Legends of Volcanoes (Mythology). Collected and translated from the Hawaiian by W. D. Westervelt. Pp. xv+205. (Boston, Mass.: Ellis Press; London: Constable and Co., Ltd.) 6s. net.

Herbert Spencer. ("Makers of the Nineteenth Century Series.") By H. E. Elliot. Pp. 330. (London: Constable and Co., Ltd.) 6s. net.

Chemical Bacteriology and Hæmatology for Practitioners. By Prof. W. D'Este Emery. Fifth edition. Pp. xiii+310+plates and figs. (London. H. K. Lewis and Co., Ltd.) 9s. net.

The Cambridge History of English Literature. Vol. xiv. Pp. xii+658. (Cambridge: At the University Press.) 9s net.

Life and Habit. By S. Butler. New edition. Pp. x+310. (London: A. C. Fifield.) 5s. net.

Memoirs of the Geological Survey, Scotland. The Economic Geology of the Central Coalfield of Scotland, including Parts of the Counties of Lanark, Stirling, Renfrew, Linlithgow, Dumbarton, and Edinburgh. Description of Area V. By C. T. Clough and others. (Edinburgh: H.M.S.O.: London: E. Stanford, Ltd., and others.) 4s. 6d.

Revision Papers in Arithmetic. By W. G. Borchardt. Pp. viii+156+xxxii. (London: Rivingtons.) 2s., with Answers.

The Pennatulacea of the *Siboga* Expedition, with a General Survey of the Order. By Prof. S. J. Hickson. 10 plates, 45 text figs., 1 chart+pp. x+265. (Leyden: E. J. Brill.) 13.50 francs.

DIARY OF SOCIETIES.

THURSDAY, February 22.

Royal Society, at 4.30.—The Fossil Human Skull found at Talgai, Queensland: S. A. Smith.—The Magnetic Storm of August 22, 1916: Dr C. Chree.—The Ordinary Convergence of Restricted Fourier Series: Prof. W. H. Young.

Royal Institution, at 3.—Memorial Art in History: Prof. E. S. Prior.

Royal Geographical Society, at 5.—The Origin and Growth of the Dry Lakes in Western Australia: J. T. Jutson.

FRIDAY, February 23.

Royal Institution, at 5.30.—Some Guarantees of Liberty: H. Wickham Steed.

SATURDAY, February 24.

Royal Institution, at 3.—The Pronunciation of Languages in General: Daniel Jones.

TUESDAY, February 27.

Royal Institution, at 3.—Strength and Structure of Metals: Prof. W. E. Dalby.

Royal Society of Arts, at 4.30.—Imperial Assets, and How to Use Them: Alfred Bigland, M.P.

Royal Anthropological Institute, at 5.—The Criminal in the Western Punjab. (Epidiascope): Major A. J. O'Brien.

WEDNESDAY, February 28.

Geological Society, at 5.30.—Fourth Note on the Piltdown Gravel, with Evidence of a Second Skull of *Eoanthropus dawsoni*: Dr. A. Smith Woodward.

Royal Society of Arts, at 4.30.—The War and Our Supply of Drugs: Francis A. Hocking.

THURSDAY, March 1.

Royal Institution, at 3.—Memorial Art To-day: Prof. E. S. Prior.

Mathematical Society, at 5.30.

FRIDAY, March 2.

Royal Institution, at 5.30.—Cellulose and Chemical Industry (1866–1916): C. F. Cross.

SATURDAY, March 3.

Royal Institution, at 3.—The Pronunciation of English at the Time of Shakespeare. (Lecture II.): Daniel Jones.

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