Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME XCVIII

SEPTEMBER, 1916, to FEBRUARY, 1917.

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

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

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

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

THURSDAY, SEPTEMBER 7, 1916.

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 10*s.* 6*d.* 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 3*s.* 6*d.* 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 2s. 6d. per head; and colony houses at about 2l. each (p. 39) also seems scarcely sufficient.

We like the author's capital charge of 1l. 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 photo-electric method, and have obtained definite indications of the presence of radiations having wave-lengths close to 600 and to 400 Ångstrom units respectively.

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C. B. BAZZONI.

Wheatstone Laboratory,
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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.

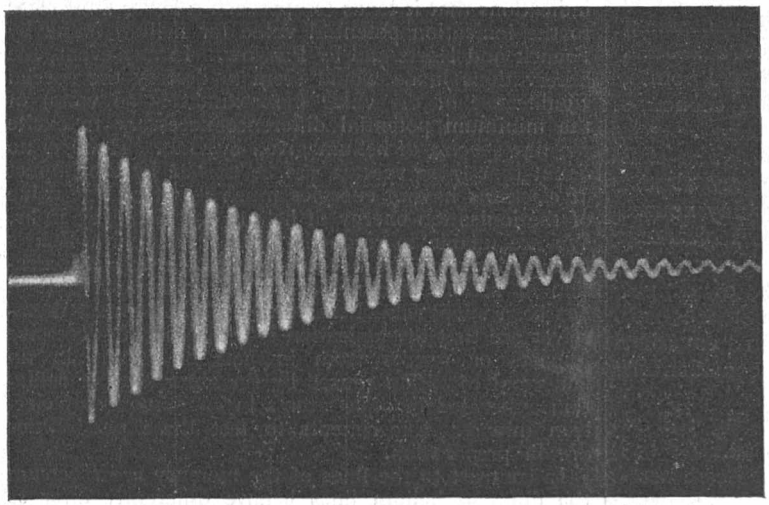

FIG. 1.—Damped Oscillatory Discharge. Photographed by Prof. J. Zenneck. From "A Treatise on Electricity."

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.

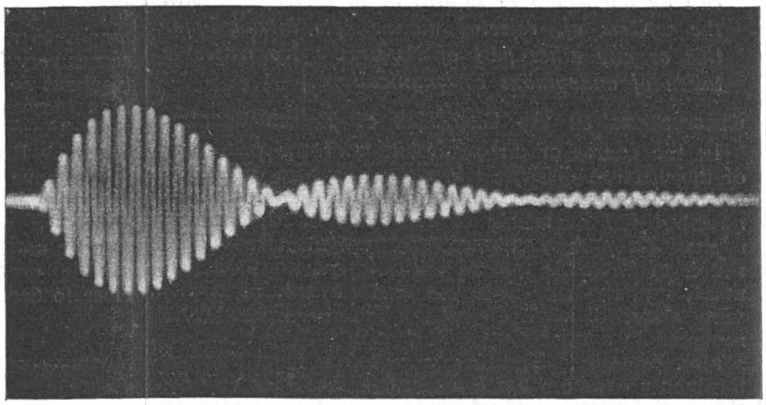

FIG. 2.—Beats in the Oscillatory Discharge of the Secondary of a Coupled Circuit. From a photograph by Prof. J. Zenneck. From "A Treatise on Electricity."

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 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

Double zodiac of the French Archæological Institute at Cairo.

"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 3*s.* 6*d.* 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 co-operation 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 con-

tact 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 textbook 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 of 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 co-operation 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, *viâ* 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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Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

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