THURSDAY, MARCH 30, 1916.

EARLY EMBRYOLOGY OF THE WORKER BEE.

The Embryology of the Honey-Bee. By Dr. J. A. Nelson. Pp. 282. (Princeton: University Press; London: Oxford University Press, 1915.) Price 8*s.* 6*d.* net.

THE author of this book describes himself as Expert in Bee Culture Investigation, Bureau of Entomology, U.S. Department of Agriculture. From such an expert one would naturally expect a book full of interesting particulars about the modifications of development in the bee induced by the social habits of this insect and its method of feeding its young. The reader who entertains any such expectation will be severely disappointed; the book deals only with the early development of the egg of the worker bee, and carries the life-history only to the stage when the bee escapes from the egg-shell and begins its life as a grub inside a cell of the honeycomb.

The book, therefore, is almost without significance for the bee-culturist, but from the point of view of the student of comparative embryology it is a production of very great interest, and is to be warmly commended. It comprises a most painstaking and detailed study of the processes of segmentation and "formation of the layers" in the bee's egg, followed by a full and satisfactory description of the development of the nervous system, of the respiratory system, muscles, heart, genital organs, etc. It might, indeed, be regarded as a first-class elementary text-book on insect embryology were it not for the obvious fact that the bee is not a very good choice as a type of insect development. But the comparative embryologist must often choose the types which he can get, not those which he would prefer, and as the first pre-requisite of sound embryology is to obtain abundant material comprising stages separated by very short intervals, it must be admitted the bee offers a better opportunity of accomplishing this end than many more primitive insects. The segmentation of the mesoderm is, however, much less marked in the bee-embryo than in the lower types, and no vestiges of abdominal appendages appear in the course of the development.

On practically every point the author confirms the conclusions arrived at by Hirschler in his study of the development of the beetle Donacia, which is by far the most thorough and satisfactory investigation of the development of any insect which had appeared up to the date of its publication (1909). All our ideas on the early stages of insect development had been thrown into confusion by Heymons. This author asserted that in the higher insect the endoderm, which in the lower types forms the epithelium of the mid-gut, had totally disappeared, and that in these higher types this epithelium was formed from two bands of cells of ectodermic origin attached to the inner ends of the stomodæum and proctodæum respectively. These conclusions of Heymons were frequently used to discredit the doctrine of the fundamental importance of the distinction between the germ-layers, a doctrine which all recent and careful research has tended to re-establish and extend. Hirschler showed that Heymons had confounded an earlier pair of invaginations of the outer cells into the yolk, which can be compared to the process of gastrulation in less yolky eggs, with a later and totally distinct pair of similar invaginations which give rise to the stomodæum and proctodæum. The reader will find that Hirschler's statement receives valuable and convincing confirmation in the volume before us.

The book is well illustrated, most of the figures being interspersed with the text in the vicinity of the portions to which they refer, whilst some plates giving excellent representations of the whole egg in various stages of development are collected at the end. The book will prove to be an indispensable adjunct to every zoological library.

E. W. M.

SOCIOLOGY AS A SCIENCE.

Outlines of Sociology. By Prof. F. W. Blackmar and Prof. J. L. Gillin. Pp. viii + 586. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 8*s.* 6*d.* net.

THE ancient academic problem of "free will" is always with us; the study of it is never barren, for its meaning changes with the development of society and of social intelligence. As compared with the state of the problem in the time of Hume, for example, the present-day aspect of it is decidedly more clear and scientific. It may be put in Cooley's words: "no man really acts independently of the influences of his fellow men." "Everywhere," so Profs. Blackmar and Gillin put it, "there is a social life, setting limitations and predominatingly influencing individual action. In government, in religion, in industry, in education, in family association—in everything that builds up modern life, men are co-operating. They work together, combine and organise for specific purposes, *so that no man lives to himself.*"

Sociology has often been derided as a pseudo-science; but in its early stages every science has received the same contumelious treatment. Chemistry was once alchemy; astronomy was once astrology. But British, American, French, and German thought has sealed the success, or at least the usefulness, of the youngest of the sciences, which, after all, is one of the oldest; Plato's "Republic" is a sociological investigation. And, *a priori,* if there is order in the process of society-building; if "through it all runs a constant purpose, a social trend; if there are laws controlling the movement of human society; forces in continual action impelling it forward in well-defined lines"—then there is clearly a mass of facts capable of classification, social phenomena more or less frequently recurring, and movements

more or less regular, which admit of scientific study and analysis. As for the relation of sociology to other social sciences, "while economics, political science, or ethics may deal with specific laws relating to parts of society, sociology deals with the general laws which apply to the whole structure"; "it occupies much the same position with reference to the social sciences that biology holds to the natural sciences dealing with organic phenomena."

Sociology is essentially a co-operative study; no great individual genius can epitomise it and stamp it with his own theory. What the "social mind" is to society, sociology, in a sense, is to the social sciences; and, as Ellwood says, "the term social mind is a convenient term to express the unity of our mental life." One danger that may threaten sociological science is the possibility of becoming academic. Few studies have more inducements for the armchair philosopher. The cure for this tendency is in the highest ideal of sociology, viz., creative work in the amelioration of social pathology. The only sphere for the realisation of this ideal is field-work, the study of living conditions. To this all antiquarianism and historical investigation must be subordinated. For instance, an investigation into the causes of poverty in a particular country, carried out personally, would be a valuable factor for progress. It is just in this kind of creative work that the State can make use of the science, as it is beginning to do, while the science should place itself at the service of the State. This is true of every science. But the duty of the State is no less plain: it must encourage, organise, and subsidise all the sciences, without the cumbrous pomp and delays of Royal Commissions, but on simple business lines.

The war has begun to drive home this elementary truth. At the stage of civilisation now attained, it is preposterous that the State should not realise its function and duty—that is, to secure the increasing well-being of the society and the individuals over whom it presides. To effect this result is impossible on merely political and legal bases; science is the only sane foundation of national prosperity and progress, and therefore the main concern of the State should be with science. And sociology is a sort of middle-man between the sciences and their utilisation by the State. There is probably not a single department, either of the social or individual life (the political counts merely as a phase of the social, artificially maintained in relation to the State) which is not more or less haphazard in its theory and practice. We do not want to substitute for painful experience and rule-of-thumb any theoretical fads, but we may certainly claim, in a scientific age, that the best results of applied science should form the material for State-development of the national possibilities. Otherwise we are left with the barbarous creed of *laissez-faire*, of which "muddle through" is the proper and most apt translation.

Everything of the best in recent sociological interpretation seems to be included in this text-book of Profs. Blackmar and Gillin; it is quite the most impartial, reasoned, and sound of *résumés* of the subject, most of which, by the way, together with original theory, has recently emanated from America.

To illustrate the needs of a relation between sociology and the State, the authors' remarks on "social surveys" are in point. They mention the great work of Mr. Charles Booth, "who devoted his fortune and a great part of his later life to a study of social conditions in London," also Mr. Rowntree's study of York, Miss Jane Addams's "Hull House Maps and Papers," and others. "A number of places have introduced this method of social stocktaking." But "as practised at the present time by the professional, social, and educational surveyor, it is liable to be brought into disrepute." "There is great need of a standardisation of methods and a perfecting of technique." In other words, there is needed for this, as for every other sociological survey and any practical application of science to national purposes, a central organisation. Such can only be supplied by the State, but there is always the danger of that *corruptio optimi*, red tape, of which, however, the best cure is scientific training.

A. E. CRAWLEY.

EUCLID'S BOOK ON DIVISIONS OF FIGURES.

Euclid's Book on Divisions of Figures, with a Restoration based on Woepcke's Text and on the "Practica Geometriae" of Leonardo Pisano. By Prof. R. C. Archibald. Pp. viii–88. (Cambridge: At the University Press, 1915.) Price 6*s.* net.

A TYPICAL problem of the *Divisions* is "to cut off a certain fraction from a given triangle by a line drawn from a given point within the triangle." Of the thirty-six propositions of the book, six are auxiliary, two deal with areas the boundaries of which are partly or wholly circular; the rest are concerned with the division of triangles and quadrilaterals. For several reasons the treatise is very interesting; it is apparently complete, the Arabic text[1] translated by Woepcke (*Journ. As.*, 1851) seems to represent Euclid's text, and although the same cannot be said about the proofs supplied by Leonardo of Pisa (Fibonacci), they retain a great deal of the old Greek style. The peculiar fact that shows how, even early in the thirteenth century, geometry, as understood by the ancient Greeks, had become infected by arithmetic, is that Leonardo constantly gives numerical illustrations, and even refers (p. 41, note) to segments defining a given ratio as "numbers," which we may be sure Euclid would not do in this context. Since the editor's translation of Leonardo is not absolutely literal, we must not lay stress on the passage (p. 61):—"Apply a rectangle equal to the rectangle $zb \cdot bi$

[1] This contains the enunciations only.

to the line *bi*, but exceeding by a square; that is, to *bi* apply a line such that when multiplied by itself and by *bi* the sum will be equal to the product of *zb* and *bi*," the explanatory clause being possibly Dr. Archibald's; but however that may be, this sentence is a good illustration of the contrast between Greek methods and others.

The editor's work seems to be very well done. There is a historical introduction (pp. 1–28); the restoration of the treatise (pp. 30–77), which gives a translation of Woepcke's version of the Arabic, and a close paraphrase of Leonardo's proofs when they exist, with supplementary matter by the editor indicated by brackets or different type; and a bibliography (1539–1911) which gives references to works on "division" problems covering a very wide range—some, for instance, leading to transcendental equations.

If the Cambridge Press would issue this work, to teachers at any rate, in a paper wrapper at half-a-crown, it might have a larger circulation. The book deserves to be well known on account of its ingenuity and the light which its history throws on the different phases of geometrical theory. G. B. M.

OUR BOOKSHELF.

A Laboratory Manual for Work in General Science. By O. W. Caldwell, W. L. Eikenberry and C. J. Pieper. Pp. xi+134. (London: Ginn and Co., 1915.) Price 2*s.* 6*d.*

THIS little manual, emanating from the School of Education of the University of Chicago, gives outlines of experiments and demonstrations for use "in the first year of the high school." The experiments adopted are stated to be the "result of the co-operative work of several high school teachers through a period of years." Their purpose is "to direct the pupils into the habit of finding out about many kinds of common problems in science." Useful as some of the experiments are to create a healthy interest in everyday phenomena, the course described covers so many different fields and the experiments follow each other with so little regard to sequence, that the net result would probably be to impart very unreal and superficial knowledge. In successive experiments we have such abrupt transitions as the following: No. 23. Does a liquid fill all the space which it appears to fill? No. 24. What are the parts of a flame? And, again, No. 43. How do bacteria act on milk, and how may milk be preserved? No. 44. What changes in volume take place when water freezes? No. 49. Does water evaporate in a plant? No. 50. How does a siphon work?

Exercises such as No. 61. What is the relation between water supply and disease? No. 61*a*. What is the significance of the local death-rate from typhoid? No. 62. How is sewage disposed of in your community? are examples of later problems. These are followed by exercises dealing with the use of pulleys and machines, experiments on the soil, the growth of plants, the nature of foods, and so on. Finally we have a statistical study of the question, "Are variations in parents transmitted to offspring?"

In the reviewer's opinion, far too much is attempted in the course laid down for it to be of much real educative value. W. A. D.

Archaic Sculpturings: Notes on Art, Philosophy, and Religion in Britain, 2000 B.C. *to* 900 A.D. By L. M. Mann. Pp. 52. (London: W. Hodge and Co., 1915.) Price 2*s.* 6*d.* net.

THE object of this pamphlet, reprinted from the Proceedings of the Dumfries and Galloway Natural History and Antiquarian Society, is to examine three groups of sculptures in that district: Pagan, consisting of cup and ring markings of the Neolithic and Bronze Ages, and diagrams on slate of the Middle Bronze Age; transitional designs, mostly of the Iron Age; and the earliest Christian monuments. The scheme is wide, probably too wide for treatment within the limits of a single paper. The most interesting part of it is the investigation of cup and ring markings. The current theories of their origin and purport being far from satisfactory, Mr. Mann tells us that some years ago he began to recognise that these figures, when plotted on paper, were found to be "arranged in a most precise, mathematical, and geometrical manner." He recognises two main systems of lines fitting into the salient parts of the sculpturing. "One system narrowly misses coinciding with the other. One is related apparently to the actual pole, and the other to the pole star of that period." He believes that many of them "embody primitive astronomical motives mixed up with ideas of worship of a Supreme Central Force which were widespread over most parts of Europe during the first, probably the second, if not also the third millennium before Christ."

The scheme is worked out with considerable ingenuity. But the student will probably demand further evidence, beyond the carvings themselves, to show that these beliefs were current among the sculptors, some precise dating of the ornamentation, and a more extended survey of similar markings beyond the area treated in this paper. The theory is, at any rate, interesting, and those who are in a position to examine these stones might bear it in mind.

Warwickshire. By J. Harvey Bloom. Pp. xi+144. (Cambridge: At the University Press, 1916.) Price 1*s.* 6*d.* net.

THIS little volume exhibits all the excellences we have learnt to associate with the Cambridge county geographies. Visitors to Warwickshire will find here a concise and well-illustrated account of the relief, geology, natural history, climate, and industries of the county, in addition to other interesting particulars about one of the most beautiful parts of England. The coloured orographical and geological maps add greatly to the value of the guide.

LETTERS TO THE EDITOR.

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

Optical Glass: an Historical Note.

THE subject of optical glass is, at the present time, one of such paramount importance that no apology is needed for introducing it to the attention of your readers. As is well known, the Rev. Vernon Harcourt and Sir George Gabriel Stokes, in the earlier half of last century, laboured together for more than twenty-five years with the object of adding to our stock, new varieties of optical glass, but without success. Their labours, however, were afterwards continued by Prof. Abbe and Dr. Schott, of Jena, who, in the course of some five years, were completely successful. As the result of a critical examination of the work of the English workers, Dr. Czapski—then the head of the firm of Carl Zeiss, of Jena—came to the conclusion that Harcourt and Stokes had failed simply because they had not at their disposal the services of a sympathetic and competent glass-maker.

I have quite recently, by the courtesy of a friend, enjoyed the privilege of reading a number of letters, I believe as yet unpublished, written by Prof. Abbe, during the period of his work on optical glass, to a well-known English microscopist, now dead. One of these letters, dated October 9, 1881, is very interesting because it sets out very clearly the high-water mark in optical construction attained by optical glasses commercially obtainable before the Jena glasses were produced. The relevant part of this letter reads as follows:—

"The Crown and Flint which is applied now by Zeiss—for objectives, prisms, etc.—is within the limits of 1·5017 and 1·8017 refractive index for the D-line. The dispersion of the former is 0·00798, and of the latter 0·03287, measured for the interval between lines C and F. The density of the said Crown is approximately 2·40, and of the said heavy flint 5·1. The Crown above is not the ordinary Crown, which yields $n_D = 1{\cdot}515 - 1{\cdot}520$ and $n_F - n_C = 0{\cdot}00850 - 0{\cdot}00900$; it is a special glass of Feil (of Paris). The Flint named above—also from Feil—is not perfectly white, but the colour (yellowish) is not very perceptible in smaller pieces (lenses or prisms). It may be usefully applied for many purposes, though it leaves a rather great residual of secondary chromatism.

"Feil has made still more refractive Flint, approaching 1·9 in index. But this is strongly coloured and not fit for use in my opinion. The common Flint, which is applied for telescope-objectives, has N_D between 1·60 and 1·63, and $N_F - N_C$ between 0·0165 and 0·0180. The strongest Flint, which is made by Chance Brothers, of Birmingham (*i.e.* 'double-extra-dense' Flint), has $N_D = 1{\cdot}71 - 1{\cdot}72$ and $N_F - N_C$ between 0·0239 and 0·0241.

"All taken together, we have eighteen different kinds of Crown and Flint in constant use at Dr. Zeiss's workshop."

It is interesting to note that at the time referred to in the above letter Zeiss was entirely dependent upon Chance Brothers, of Birmingham, and Feil, of Paris, for his supplies of optical glass.

The research work commenced by Abbe and Schott in 1881 on a laboratory scale was so far successful that Prof. Abbe, writing in a second letter on February 21, 1883, says:—

"Regarding the glass experiments, of which I have told you a year ago, I may say, that they have had a very satisfactory progress, as well in regard to the purely scientific aims, for which the research had been undertaken, as in regard to the practical results which are obtained. We are now satisfied that the utilisation of these results for the fabrication of optical glass will be the basis of a good progress of practical optics in several respects. The question is now only how to introduce the results of the experimental research into the fabrication; for all that can be done in the laboratory is settled now, or nearly settled. For that other aim I have had already, during several months, long and troublesome negotiations in order to obtain for my fellow-labourer that assistance which could enable him to undertake the practical application of the long research. Even now, however, it is not yet settled that this will be possible—at least in the manner as it has been planned until now, and within a moderate time. But at all events, the quick utilisation of the research in favour of microscopic optics will not be questionable; we have obtained already, or will obtain within the next time, by mere laboratory operations, sufficient quantities of the new glasses, which are of interest for the microscope, for enabling Zeiss to begin with the practical application in this year (which notice, however, I request you to consider as a private one at present, because it would not be agreeable, to have this matter spoken of long before it is a matter of fact)."

This letter is very interesting, because it shows that at the time in question, so far as the comparatively small quantities of special glasses required for the production of microscope objectives was concerned, the laboratory output was sufficient to enable the work to be done. This fact at once points to the possibility of meeting the demand at the present time for very special glasses required in small quantities only, as, for example, the production of microscope objectives by laboratory rather than by factory methods.

The production of glass on a manufacturing scale was commenced at Jena in 1884, and was brought to a successful conclusion in 1886, when the first catalogue of the Jena glasses was issued.

The third letter written by Prof. Abbe is dated March 4, 1886, and was accompanied by one of the first—if not the first—homogeneous immersion apochromatic microscope objectives made. The letter reads as follows:—

"This is a homog. immersion of 1·40 apert. and 3·0 mm. focal-length, constructed by means of new kinds of optical glass which have been produced on the base of a systematical research into the optical qualities of the various elements admitting of vitrification. This research has been conducted through about three years in the way of laboratory work, chemical and optical, by myself and a fellow-labourer of the chemical and technical line (Dr. Schott) with the continuous assistance of two younger scholars, chemists and physicists; and has afterwards—nearly two years ago—induced the foundation—at Jena—of a technical establishment for the regular fabrication of all kinds of optical glass for general use. This glass-manufactory (which has been set up in 1884 by Dr. Schott, Messrs. Zeiss, and myself, with the aid of a subsidy of the Prussian Government) has taken up, and continued, the former experiments on the scale of fabricatory work, in order to make the results available for the various branches of practical optics. This is going on still—some tasks being settled (the production of the silicious glasses, which is in a regular fabrication since last summertime), other tasks being brought near to the aim. In the meanwhile, I have gone to work with theoretical research and computation; in order to find the proper formulas for the utilisation of the new

kinds of glass in the construction of telescope objectives and microscope objectives.

"Regarding the latter aim, a series of objectives adjusted for the short continental tube is nearly finished; another series for your English microscopes —which requires different formulas—has been begun; and you and Mr. —— have at hand the first specimens of that series.

"The optical features of the new constructions, which are represented by this 1/8th of 1·4 ap., may be defined in that way; the various corrections are of a higher order than could be obtained formerly (or, more strictly spoken, the residuals of the various corrections, *i.e.* the defects of collection of the rays, are of a higher order according to mathematical terminology. (1) With the old kinds of crown and flint glass two different colours only could be collected to one focus, a secondary spectre remaining uncorrected. With the new glass those different colours unite at one point, a tertiary deviation being left only. (2) Formerly the spherical correction was confined to the rays of one colour; this correction being made for the middle part of the spectrum, the systems remained undercorrected, spherically, for the red rays, and overcorrected for the blue rays. Now the correction of sph. aberr. is obtained for two different rays of the spectrum at the same time, and the objective shows the same degree of chromatical correction for the central as for the marginal part of the aperture. (Of course, this higher degree of correction is not given by the glass from itself—it requires a very careful utilisation of the optical properties of the various kinds of glass at disposal, in order to fulfil all those conditions, and this was not even possible except by means of a greater complication of the constructions; I was obliged to introduce five separate lenses (for the aperture 1·4) instead of the four applied hitherto).

"The objective at hand is constructed on the single-front-type. It contains ten single lenses in five separate parts. Two only of these ten lenses contain silicious acid; the glasses of the other eight are phosphates and borates—the Crown and Flint glass which has been used by the opticians hitherto, does not contain, as essential constituents, more than six chemical elements, O, Si, K, Na, Ca, Pb; the lenses of the 1/8th contain, as essential components of the glass, not less than fourteen elements."

"I did not introduce a greater aperture than 1·40 in order to preserve a convenient working distance—which, in fact, is =0·25 mm.=1/100 in. The two oculars sent with the objective are constructed with the aim to compensate certain aberrations outside the axis, which cannot be got rid of in the objectives (of wide aperture). The whole series of objectives, high and low powers, shall be so arranged, that this compensation is always obtained by the same series of oculars."

This last letter, I think, will be acepted as setting out *inter alia* in a remarkably lucid way the optical advantages obtained by the introduction and employment of the Jena glass in optical constructions.

F. J. CHESHIRE.

Hamilton and the "Quantification of the Predicate."

IN NATURE for March 23, p. 78, in a review of De Morgan's "Budget of Paradoxes," re-issued by the Open Court Publishing Co., there is an allusion to Sir William Hamilton's "famous theory of the quantification of the predicate."

This theory was first set out by George Bentham, a nephew of Jeremy Bentham, in 1827, in his "Outlines of Logic," reviewed by Hamilton in the *Edinburgh Review* in 1833, and again raised by Mr. Warlow in the *Athenaeum* at the end of 1850, as may be read in the *Contemporary Review*, May, 1873, pp. 821–24.

Although Bentham never pushed his theory, it is clear that it came into Hamilton's mind from Bentham's book, and, as so often happens, the actual originator has been overlooked. B. D. J.

THE ARCHÆOLOGICAL SURVEY OF NUBIA.[1]

IN the accounts of the preceding reports which have been published in NATURE attention has been directed to the exceptional thoroughness of the work, both of excavation and surveying, and the completeness of the presentment of the new information brought to light in this important archæological survey, which has been carried out by the Egyptian Survey Department.

In the present report Mr. Firth has fully maintained the high standard of excellence; and the complete and lucid statement of the facts, the liberal supply of text-figures, and especially the admirable collotypes, enable the reader almost to see and fully to understand the whole of the work, without the discomfort of living in a Nubian camp.

It is a matter for congratulation that this important and difficult investigation was carried out with such insight and thoroughness, for the flooding of the country makes it impossible ever to survey Lower Nubia again for archæological information. Without the knowledge so acquired the door would have been shut for ever upon a proper understanding of the early history of the Sudan, which is now being revealed by Prof. Reisner's excavations in the Kerma basin. Moreover, many of the difficulties in interpreting the story of Egypt would have been quite insurmountable without this information to make clear what was happening south of the First Cataract.

Most of the volume is devoted to the primary object of such a report, viz., the detailed and impartial statement of all the facts brought to light. It includes a brief account of the town site of Pselchis, and a full account of the mode of construction and contents of every grave.

The special importance of this report, however, depends upon the fact that it deals so largely with the remains of the distinctively Nubian culture, of which, from the circumstances of the case, it must represent for all time the chief source of information. In the introductory twenty-four pages Mr. Firth gives a well-balanced and illuminating survey of the early movements of people in the Nile valley, in which he clearly defines the position and the distinctive cultural relations of the Middle Nubian people (the "C-group"). The only criticism that I have to make of his account of this interesting people is the wholly unwarrantable suggestion of "the possibility that the C-group represents an immigration from the south-west of a mixed Negro and Libyan stock from

1 "The Archæological Survey of Nubia." Report for 1909–10. By C. M. Firth. (Cairo: Government Press, 1915.) Price L.E. 2.

Darfur (or Kordofan) at the close of the Old Kingdom" (p. 20).

There is no reason whatsoever for labelling these people "Libyan." In prehistoric times there were groups of kindred peoples scattered along the Nile valley like beads upon a string, which reached from the Mediterranean to Abyssinia. The Predynastic Egyptians formed one of these groups and the Middle Nubians another; but there was a buffer-population, the "B-group" of the archæologists, between them to hinder free admixture either of blood or culture, but which itself was affected most intimately—in other words, was virtually enslaved—by the more powerful Egyptian people. The Egyptians themselves were subjected to the stimulating influence of contact with more virile races in the north, and advanced rapidly along the paths of material progress. The Middle Nubians were affected by the retarding influence of Negro admixture, and incidentally retained for many centuries and with relatively slight changes the arts and crafts which originally were the common heritage of both Egyptians and Nubians.

FIG. 1.—Pottery deposit near Canteen or Customs House, Romano-Nubian period. From "The Archæological Survey of Nubia."

FIG. 2.—Later C-group period. Large jar of black polished ware with incised and coloured patterns in imitation of basket-work. Cemetery 101, grave 38. Scale 1:6. From "The Archæological Survey of Nubia."

The archæological evidence relating to this instructive history has been set forth in a most lucid way by Mr. Firth.

The excellence of the way in which the Survey Department has carried out this work of archæological research and of the publication of its results makes one wish that the newly-established British Protectorate of Egypt may use the knowledge to put in order its Antiquities Department, which is not only intimately related in a variety of ways to the proper financial administration of the country, but also has responsibilities for the proper care of monuments by which posterity will judge of the success or otherwise of British rule in Egypt.

G. ELLIOT SMITH.

THE SHACKLETON ANTARCTIC EXPEDITION.

THE news that arrived at the end of last week from the Shackleton Antarctic Expedition was of an unexpected nature. The *Aurora*, during a severe gale, broke loose from her moorings early in May, 1915, and drifted in the pack ice, suffering severe damage, until March 14, 1916, when she got free in 64° 30′ S. 161° E., and is now on her way to New Zealand. When the *Aurora* broke adrift, a number of officers and men were ashore, including Captain Macintosh, and were unable to rejoin the ship. The wireless telegrams received seem to indicate that ten men are thus left stranded at the Ross Sea base near Cape Evans. They were probably engaged in depôt-laying over the barrier in preparation for the arrival of Sir Ernest Shackleton and his party in their trans-continental march.

News received during the winter from South Georgia had already warned us that Sir Ernest Shackleton had been unlucky in meeting with an unfavourable season, and the weather in Australia suggests that the exceptionally severe conditions extend to the area of Antarctica south of Australasia. The ice in the Weddell Sea is known to be exceptionally variable in extent; and success in the exploration of that region will probably always be largely determined by the good or ill fortune of the explorers in regard to the ice conditions. An expedition which found the Weddell Sea as Weddell found it could do more in one season than in ten years under average conditions.

The continued absence of news from the *Endurance*—the ship which took the trans-continental party to the Weddell Sea—is disappointing, as it is thus still doubtful whether Sir Ernest Shackleton has begun his daring trans-Antarctic sledge journey, and whether a favourable base was established on the shore of the Weddell Sea. But the *Endurance* may well have delayed her voyage back as late as possible on the chance of Shackleton's return to the western base, and to allow the Weddell Sea parties to have a full season's work. No anxiety regarding the *Endurance* need be felt for another fortnight, and news of her safe arrival at the Falkland Islands may be received any day.

The news from the Ross Sea demands more immediate preparation; for though the latest dispatch from the *Aurora* shows that she is seaworthy, she is admittedly so badly strained that it is possible that she may be too injured to be trusted with the relief of the party left at Macmurdo Sound. The explorers left there should be quite safe. They have two huts, both of which appear to be sound. Half the heating arrangements of the *Discovery* hut were left behind in New Zealand, and it was not lined with the insulating material taken out to render it heat-proof. But either hut would furnish safe shelter, and the stores left at this base must be ample for the men left ashore, and for Sir Ernest Shackleton and his party. Moreover, plenty of penguins and seals can be found. It is, however, clear that unless the *Aurora* can be repaired in Australasia, another ship must be sent out; for a relief expedition must go to the Ross Sea next season.

The absence of news from the *Endurance* is embarrassing, as it may be that another or even two other relief expeditions may be required. If the *Endurance* does not return within a fortnight, arrangements will have to be made for the dispatch of a relief ship to the Weddell Sea. Probably one of the South Georgia whalers might be sent on this mission; but as the South Atlantic is so much nearer than the Ross Sea there would be ample time to send out a suitable ship from this country. It must also be remembered that if Sir Ernest Shackleton started on his daring journey and has not reached either Macmurdo Sound or returned to his Weddell Sea base, it will be necessary to search for him; for he may have reached some place on the coast, where he could live through the winter on seal and penguin. No final decision can be made until time has been allowed for the return of the *Endurance*, but a full scheme of operations should be ready for definite action shortly after the arrival of the *Aurora* and the last day upon which we may reasonably expect this season the return of the *Endurance*.

RICHARD DEDEKIND.

THE death of Dedekind deserves more than a passing notice because he belonged to that small class of profound and original mathematicians typified by such men as Hermite, Kronecker, and H. J. S. Smith. In at least four great branches of pure mathematics he made contributions of the highest importance, and, as a tribute to his memory, a brief account of them will be given here.

It is now becoming a matter of common knowledge that the very foundations of all mathematics have been reconstructed in such a way as to make the science like symbolical logic, and, in theory, independent of all intuition whatever. The beginning of this revolution was the acquirement of a precise conception of irrational numbers, and of the nature of the arithmetical continuum. Dedekind shares with Heine, Kronecker, and Cantor the glory of making this theory complete. His own exposition is contained in the two tracts, "Was sind u. was sollen die Zahlen?" and "Ueber Stetigkeit u. irrationale Zahlen," and in some ways is the simplest and most philosophical of all that have been devised. It may be remarked also that he did this novel work without inventing more than one new symbol. He also shares with Cantor the credit of pointing out that, if we are to assume that the uniform motion of a point along a segment AB is an exact image of a real numerical variable increasing from a to b, we must introduce an axiom of some sort. This axiom, known as the Cantor-Dedekind axiom, may be put into various equivalent forms; one of them is that any definite segment of a straight line must be terminated by two definite points.

Another great modern theory is that of elliptic modular functions, with its development, that of automorphic functions. In a letter to Borchardt ("Crelle," vol. lxxxiii. (1877)) Dedekind pointed out the importance of the function he calls the *Valenz*; essentially this is no other than the modular function $j(\omega)$, which enjoys the property that $j(\omega)=j(\omega^1)$ if, and only if, $\omega^1=(\alpha\omega+\beta)/(\gamma\omega+\delta)$ where α, β, γ, δ are real integers such that $\alpha\delta-\beta\gamma=1$. This introduction of j as fundamental, instead of Hermite's ϕ, ψ functions, marks an epoch in the theory; it should be noted, however, that H. J. S. Smith had practically reached similar results as early as 1865 (see his report on the Theory of Numbers, Arts. 125 ff.).

We now pass on to Dedekind's work in the theory of numbers. Gauss extended the theory so as to include complex integers $m+ni$, and proved that all the usual rules, especially that of the unique resolution of an integer into prime factors, still remained valid. Kummer investigated algebraic integers derived from the period-equations of cyclotomy, and was confronted by the vexatious fact that the theorem about prime factors broke down; thus we might have $\alpha\beta=\gamma\delta$ with α, β, γ, δ all integral, each irresolvable in the field considered (and in that sense prime), yet γ essentially differing from α, β by having a different norm. By the invention of ideal primes, Kummer overcame the difficulty, so far as these cyclotomic integers were concerned. His discoveries naturally suggested a definition of an algebraic integer in general, and the problem of defining its prime factors. Dedekind first gave a complete solution in supplement xi. of the third edition (1879) of Dirichlet's "Zahlentheorie"; this is undoubtedly one of the finest mathematical works that have ever been written, and although in the fourth edition (1894) the method is simplified, the original exposition should always be read, and in some ways is unsurpassed, not to say unsurpassable. Briefly, the author establishes the notions of corpus (or field), ideals and their bases, discriminants, including that of the field considered; he proves the general laws of divisibility for every field, and in particular shows how to factorise the real integral prime factors of the discriminant of the corpus—one of the main difficulties of the theory. Besides this, he discusses systems of units, the composition and equivalence of ideals, their connection with the theory of forms, and the problem of finding the number of non-equivalent classes for a given field. All these results are of the highest generality and importance; and every arithmetician, who wishes to advance the theory, must be familiar with them.

In conjunction with H. Weber, Dedekind published in "Crelle," vol. xcii. (1882), a long and important memoir on algebraic functions of one variable. The main feature is the discussion of "algebraic divisors," which play much the same part here as ideals do in an arithmetical field. They allow us to gain a precise conception of a "place" on a Riemann surface, and lead in a remarkably simple way to proofs of the invariance of the *deficiency* (*genre, Geschlecht*) of the surface, the Reimann-Roch theorem, and so on. Consideration of expansions in a variable t is reduced to a minimum, though (as pointed out by Weierstrass) it cannot be avoided altogether. The methods of this memoir have been developed by Hensel and Landsberg in their treatise on algebraic functions; it seems to us that they form a happy mean between merely heuristic methods and the very dry presentation of the Weierstrassian school.

Another subject on which Dedekind wrote some valuable notes is the theory of groups; however, this is not the place to give a list of his writings. It is to be hoped that they will be published in a collected form, as some of them are not easily accessible; they are not voluminous, and, so far as our experience goes, they are remarkably accurate, so there is no reason for delay. G. B. M.

NOTES.

A CONFERENCE convened by the president and council of the Royal Society was held at Burlington House on Wednesday, March 22, to consider the desirability of establishing a Conjoint Board of Scientific Societies for the purpose of organising scientific effort in this country. Delegates from the following societies attended to confer with the president and council of the Royal Society:—Royal Society of Edinburgh, Royal Society of Arts, Royal Anthropological Institute, Royal Astronomical Society, Royal College of Physicians, Royal College of Surgeons, Royal Geographical Society, Royal Institution, Institution of Civil Engineers, Institution of Electrical Engineers, Institution of Mechanical Engineers, Institution of Mining Engineers, Institution of Naval Architects, Institute of Chemistry, Society of Chemical Industry, British Association, Chemical Society, Geological Society, Linnean Society, London Mathematical Society, Physical Society, Physiological Society, Zoological Society. The following resolution was passed unanimously, and a committee was appointed to draft a scheme for giving effect to the resolution and to report thereon to a future meeting, viz.:—"This meeting considers that it is desirable to establish a Conjoint Board of Scientific Societies for the purpose of (1) promoting the co-operation of those interested in pure or applied science; (2) supplying a means by which the scientific opinion of the country may, on matters relating to science, industry, and education, find effective expression; (3) taking such action as may be necessary to promote the application of science to our industries and to the service of the nation; (4) discussing scientific questions in which international co-operation seems advisable."—We are glad that the Royal Society has taken this step towards the organisation of scientific activities for the promotion of national welfare. The necessity for the unity of effort contemplated in the principles embodied in the foregoing resolution led to the establishment of the British Science Guild in 1905; and Sir Ronald Ross, in the *Times* of March 29, expresses the opinion that the business affairs of science would be better entrusted to such a separate body as the guild than to a board of scientific societies, the members of which are chiefly interested in the publication and discussion of scientific papers.

ON February 23 the French Academy of Agriculture held its annual meeting. There is always a touch

of style and of charm in French men of science, and the meeting was made into a little festival. A bust of Pasteur was installed in the place of honour, a prize was decreed to M. Schloesing, that veteran of the Académie des Sciences, who is now in his ninety-second year, and a most admirable address was given by M. Gaston Bonnier. It is true that English men of science, likewise, are well able to instal busts, decree prizes, and give addresses. But France does it better, for she is not afraid, as we are, of magniloquent oratory. And M. Bonnier not only gave his audience an address, but also read them a poem, "A la gloire de Pasteur"—a poem which won the Grand Prix of the Académie Française last year, the work of M. Charles Richet, professor of medicine in Paris, a man honoured by all physiologists in France and over here. This noble poem is published, with M. Bonnier's address, in the *Revue Scientifique*, March 11–18. The reference to Lister is delightful:—

> Honneur à toi, Lister, qui, seul dans cette foule,
> T'opposant aux clameurs des savants et des sots,
> Pendant qu'un vain torrent de critiques s'écoule,
> En admirant Pasteur, sus dompter nos fléaux.

But the whole poem deserves study. Truly, a pleasant little festival of gratitude, goodwill, and reverence; and while these quiet men of science were celebrating in Paris the glory of Pasteur, the batteries of Verdun were thundering out the everlasting glory of France.

THE *Times* and other London daily papers recently made reference to Dussaud's invention of the so-called "cold light" which, it was suggested, was being used for the searchlights mounted on Zeppelins. So far as we have been able to ascertain, the device rests on the plan of overrunning a metallic filament lamp at anything from 50 to 150 per cent. higher voltage than the normal. The candle-power of a filament lamp progresses approximately as the 3·6th power of the voltage, and the efficiency of an overrun lamp is high. The safety of the filament is secured by applying the current only momentarily, and the flicker of the light is avoided by employing a nest of lamps, which are lighted in succession by the use of a motor-driven rotary switch provided with the appropriate number of contacts. The British patent specification speaks of "low-voltage lamps" (less than 25 volts), which restriction may be conditioned by the length of time required to raise the filament to incandescence. The device has been applied to kinematograph lanterns, the interval between the excitation of two successive lamps being arranged to correspond with the interval between successive pictures.

AN article on recent Zeppelins appears in the *Times* of March 25, under the name of Mr. George Prade. It appears to be the most trustworthy statement yet available, and is based on an examination of the remains of LZ. 77, brought down by French artillery near Révigny. Super-Zeppelins are dismissed as products of the imagination, and the latest Zeppelin proves to be a very natural outcome of the results of prior experience. LZ. 77 appears to have weighed 32 to 33 tons, and to have carried 1½ tons of bombs. Its defensive armament consisted of six machine-guns, used in pairs on the top and two cars, and nothing in the nature of cannon was found on the airship. From the dimensions, length 525ft. and diameter 55 ft., it appears unlikely that the highest speed attainable with the engines developing the full 900 to 1000 h.p. would exceed 65 m.p.h., a speed much below that of recent aeroplanes. It may be doubted whether the pointed tail now adopted is intended to reduce resistance, and the form is more probably due to considerations relating to manœuvring and control. The height of the airship at the beginning of its flight is said to be 6000 ft.; the burning of fuel on the outward journey, together with the discharge of bombs, would give 10,000 ft., the last 2000 of which would occur at a great rate. Germany is estimated to have about forty Zeppelins at the present time, and to be producing new ones at a rate of perhaps thirty-five per year. Most of the existing airships are used for patrolling and scouting over the North Sea, this being their legitimate offensive function.

A MEETING was recently held in Manchester, under the presidency of the Lord Mayor, of engineers and others called together by the Council for the Organisation of British Engineering Industry, to hear an address by Mr. T. C. Elder, of the British Electrical and Allied Manufacturers' Association. It was pointed out that whilst we are now engaged in a deadly military struggle with Germany, we are also engaged in a scarcely less vital economic strife which is going on now, and will increase in intensity after the struggle of arms has ceased. The measures of defence mainly suggested were chiefly of a fiscal and preventive character such as one speaker suggested, namely, that of putting "a ring fence round Germany." So long, however, as our manufacturers choose to look for a remedy in purely fiscal changes, so long will they fail of any effective defence against German productive enterprise, for it is clear to any impartial inquirer that her industrial position is due to her lavish educational provision for all grades of education and to the encouragement given to pure and applied science more than to any other cause. Many important "key" industries are in her hands because of the perfection to which the products required have been brought. Amongst these, dye products stand pre-eminent with an annual importation of nearly two millions, of which 1,800,000*l.* come from Germany, vitally affecting an industry, that of textiles, valued at 200,000,000*l.*, and employing about one and a half million people. The plain truth of the matter is, as a writer dealing with the history of "British Dyes, Ltd.," recently stated, "that the Germans held the coal-tar colour industry in their hands because they deserved it," and until we take like far-seeing educational measures, our triumph in this rivalry will not be gained.

WE regret to learn of the death of Prof. O. Lignier, professor of botany in the University of Caen, and of distinguished eminence by his work in palæobotany.

THE family of Lieut.-Col. C. Stonham, whose death was announced in NATURE of February 24, has presented his collection of British birds to his old school, the King's School, Canterbury.

IN the course of a review in last week's NATURE, "G. B. M." referred to a report that the library of the Patent Office had been closed as a war economy. We are glad to be assured that this is not the case; and in the interests of those who find the library of value we hasten to announce that it will remain open as usual.

THE *Lancet* announces that the annual oration of the Medical Society of London is to be given this year by Sir St. Clair Thomson, who has selected for his subject "Shakespeare and Medicine." The date has been fixed for Monday, May 1, so as to bring the oration into line with the official Shakespearean celebrations.

WE are very glad to be able to record that Prof. Mark Baldwin, who was reported to have been lost by the torpedoing of the cross-Channel steamer *Sussex* on Friday last, is safe at Wimereux, with Mrs.

Baldwin. Their daughter has, however, been seriously injured, and is in hospital. Prof. Baldwin was on his way to Paris, after delivering the Herbert Spencer lecture at Oxford, summarised in last week's NATURE (p. 93).

THE *Times* correspondent in the Balkan Peninsula reports that the substitution of the Gregorian Calendar for the Julian or Eastern has been voted by the Bulgarian Chamber. He adds:—"The adoption of this change, which has been long delayed on account of the opposition of the Russian Heirarchy, is naturally a demonstration against Russia, and will be generally attributed to a desire to widen the chasm separating the two States."

AT the third annual general meeting of the Institution of Petroleum Technologists, held on March 22, Sir Boverton Redwood, Bart., retired from the presidency in conformity with the by-laws (after two years' tenure of that office), and was succeeded by Prof. J. Cadman. The vice-presidents and council for the ensuing year are:—*Vice-Presidents*: The Rt. Hon. Lord Cowdray of Midhurst, Sir Thomas H. Holland, and Sir Boverton Redwood, Bart. *Council*: A. C. Adams, H. Allen, Sir Robert Balfour, Bart., Capt. R. W. Barnett, H. Barringer, Dr. G. T. Beilby, E. R. Blundstone, A. Campbell, J. T. Cargill, Major A. Cooper-Key, E. H. Cunningham Craig, A. W. Eastlake, C. Greenway, T. C. Palmer, Dr. F. Mollwo Perkin, and R. Redwood.

THE Christiania correspondent of the *Morning Post* reports that Capt. Roald Amundsen, who traversed the north-west passage in the *Gjoa* and led the Norwegian Expedition to the South Pole, has resumed his preparations for an expedition to the North Pole, which were suspended on the outbreak of the war. A short time before that event the Storthing voted 12,000*l.* as a subscription towards the expenses of the enterprise, but having regard to the war, Capt. Amundsen did not accept the money. He thinks, however, that the time has now come to make arrangements to start next summer. He proposes to leave Point Barrow, North Alaska, and to drive with the ice over the polar basin.

MORE detailed accounts of the report of the South African Government Committee on the Rand earth-tremors have now reached this country. The shocks are described as consisting practically of a single sharp vibration, the sensation being similar to that produced by the fall of a heavy body on the ground. On the surface, the shocks were sometimes strong enough to open cracks in house walls. Underground, the effects were occasionally disastrous, causing loss of life and damage to the mines. Yet the distance to which the shocks were felt was small, only rarely amounting to as much as seven miles. This implies a slight depth of origin, and the conclusion at which the committee arrives scarcely admits of doubt that the shocks are due to mining operations and not to natural causes. The committee considers that the pillars left have not been strong enough to support the roof, and that their sudden crushing gives rise to the shocks. Some of the slighter tremors are attributed also to the fracture and settling of the overlying strata.

THE President of the Board of Trade has decided to appoint committees to consider the position of certain important British industries after the war, especially in relation to international competition, and to report what measures, if any, are necessary or desirable in order to safeguard that position. The following committees have accordingly been constituted:—For the iron, steel, and engineering industries: Sir Clarendon Hyde (chairman), Mr. A. Balfour, Sir Hugh Bell, Bart., Mr. A. J. Hobson, Sir Hallewell Rogers, and Mr. D. Vickers. For the shipping and shipbuilding industries:—Sir A. A. Booth, Bart. (chairman), Prof. W. S. Abell, Sir Archibald Denny, Bart., Sir Edward Hain, Capt. H. B. Hooper, Mr. J. Readhead, Mr. O. Sanderson. All communications relating to the above committees should be addressed to Mr. Percy Ashley, the Board of Trade, S.W. The constitution of a committee for the textile industries will be announced shortly.

WE record with much regret that 2nd Lieut. Kenneth R. Lewin, protozoologist to the Rothamsted Experimental Station, was killed in France on March 9. Mr. Lewin took the Natural Science Tripos at Cambridge, and, influenced by Prof. Sedgwick, chose protozoology as the special subject of his life-work. After his course at Cambridge, he spent some months at Munich under Prof. Hertwig, and at the Naples Biological Station. On his return he became assistant to Prof. Nuttall, and then in 1913 he was appointed protozoologist to the Rothamsted Experimental Station, where his work speedily justified the promise of his college days. His investigations were made in conjunction with C. H. Martin, who also lost his life in Flanders last May, and the combination proved most happy. The problem presented to Lewin at Rothamsted was to find out first of all whether there was a trophic protozoan fauna in the soil, and, secondly, what was its mode of life. He began with Martin's film method, the details of which he improved, and later introduced a bubbling method, both of which he used with considerable success on certain types of soil. The results are given in two papers published jointly with Martin, one in the Phil. Trans. for 1914, the other in the *Journal of Agricultural Science*. This last paper was finished just after the outbreak of the war. So soon as it was done, Lewin returned to Cambridge and joined the O.T. Corps, afterwards obtaining a commission in the 6th D.C.L.I. An able zoologist with abundant vigour of thought and freshness of outlook, and at the same time much kindliness and sympathy towards all with whom he had to deal, it is deplorable that the distinguished scientific career which was before Lewin has been abruptly ended by his death.

MR. SELOUS, in the *Zoologist* for February, continues his diary of ornithological observations made in Iceland during June and July, 1912. He has much that is worth recording to tell of the curious courtship displays of the red-necked phalarope, and incidentally of the habits of many other birds frequenting the same haunts. One is compelled, however, to hunt laboriously for these good things amid a mass of quite unnecessary detail. We further venture to think that Mr. Selous would have seen much more of the courtship displays of the birds he was more especially interested in if he had commenced his observations at daybreak, for it is at this time and onwards for the next hour or so that their greatest intensity is developed.

A VIVID insight into the habits of the waterhen, coot, redshank, ringed plover, and lapwing, especially during the reproductive period, is given by Miss E. L. Turner in *British Birds* for March. In a series of impressionist pictures, delightfully flippant, and illustrated with admirable photographs, Miss Turner describes the courtship displays of these birds and their desperate jealousies in regard to their territorial rights during the breeding season. The scene of her studies was the Mere in Holy Island, and here, between

March and June, she achieved some really useful work. The unneighbourly character of the waterhen has long been recognised, but few, probably, realise the pugnacity it displays when fighting for territory or when driving off trespassers when that estate has been won. The true character and the importance of this aggressiveness has only recently been realised, having been first clearly demonstrated in the case of the British warblers by Mr. H. Eliot Howard. Until then the battles between males had always been regarded as contests between rival males for the possession of females. Miss Turner's observations in this article entirely bear out the newer interpretation.

IN the forest of Soigne, at the gates of Brussels, Belgium possesses two Government arboretums, arranged on the group system, planted with exotic trees under forest conditions. These were founded about twenty-five years ago, and, conditions being very similar to those which obtain in England, they afford useful object-lessons, possibly very little known, which should be studied by British foresters. Fortunately, these arboretums were visited by Mr. D. E. Hutchins, formerly principal forest officer in British East Africa, in the summer of 1913, and his account is published in the Transactions of the Royal Scottish Arboricultural Society, vol. xxx., pt. 1, of January, 1916. Among trees which will not grow in Belgium may be mentioned *Sequoia sempervirens* and many Japanese trees which require a heavy rainfall. Douglas fir is the fastest-growing conifer in both arboretums, and among the oaks *Quercus rubra* has given the best results. Details of the growth of the various trees, with girth measurements and age, are given in all cases.

PROF. A. HENRY contributes an illustrated article on the black poplars to the Transactions of the Royal Scottish Arboricultural Society, vol. xxx., January, 1916. He deals especially with the wild European and east North American species and their various forms and hybrids. The American species *Populus deltoidea* bears cilia on the margins of the leaves, and glands on the base of the leaf in front, and the flowers have 40–60 stamens and 3–4 stigmas. In the European poplar *P. nigra* the leaf characters of the American plants are absent, and the stamens are only 12–25 and stigmas 2. It is remarkable that the European species, though well known to the pre-Linnæan British botanists, was named by Michaux from introduced species growing on the banks of the Hudson and in New York City. The Lombardy poplar is only a sport from this species, and originated probably as a single tree between 1700 and 1720 in Lombardy, and practically all the examples are males. The only known female Lombardy is at Kew, and its history is unknown. The numerous hybrid poplars are described in detail, and their value as timber trees is discussed. Some vigorous hybrids—*e.g.*, *P. generosa*—have been produced by Prof. Henry.

MR. CARLOS AMEGHINO has contributed to *Physis* (vol. ii., No. 9, pp. 36–9) a useful French abstract of his important memoir on a femur of the extinct ungulate Toxodon, which seems to have been penetrated during life by an implement of quartzite, and suggests the great antiquity of man in the Argentine region of South America. The Toxodon is considered to be of a small species, older than the Pampean formation, perhaps even Pliocene, and the bone was found in a deposit at Miramar, which may well be of this age. The quartzite implement is actually embedded in the great trochanter of the femur, where the growth of bone has partly enveloped it.

PROF. R. A. DALY, of Harvard, has stated his views as to the "Origin of the iron ores of Kiruna" in a memoir issued by the Nordiska Bokhandel of Stockholm as part of the *Vetenskapliga och praktiska undersökningar i Lappland* (1915). The visit of many members of the International Geological Congress of 1910 to the magnetite mountain of Kiirunavaara, under the guidance of Herr Lundbohm, aroused wide interest in the theoretical questions connected with the massive band of ore. Prof. Daly expresses himself with caution, but he regards the porphyritic igneous rocks as originally intrusive in the form of a laccolite, the uptilting of their sheets being due to later earth-movement. The magnetite became separated, probably by gravitation, from the igneous magma, and even the small and often angular blocks of magnetite in the quartz-porphyry are held by the author to be local segregations, akin to the main ore body, and not inclusions.

ON October 3, 1915, a great earthquake was recorded shortly after 7 a.m. at Eskdalemuir and other observatories in this country. The epicentre was estimated to lie in one of the western United States. It now appears that this earthquake must have been one which occurred in Pleasant Valley, Nevada, at 10.54 p.m. (Pacific standard time) on October 2, and is described by Mr. J. Claude Jones in the Bulletin of the Seismological Society of America (vol. v., 1915, pp. 190–205). If it had occurred in a populous district, the earthquake would have ranked as one of the destructive earthquakes of the world. It disturbed an area 800 miles long, from north to south, and 650 miles in width, an area which does not differ much in extent from that affected by the Californian earthquake of 1906. Pleasant Valley runs in a southerly direction from about 40 miles south of Winnemucca. On the east side, it is bounded by the southern half of the Sonoma Range, along the base of which, for a distance of 22 miles, Mr. Jones traced a fresh fault-scarp, nearly vertical, and varying in height from 5 to 15 ft. The movement along this fault, which caused the earthquake, was the latest of a series responsible for the elevation of this part of the Sonoma Range.

MESSRS. EDWARD STANFORD, LTD., have just added two new maps (Nos. 16 and 17) to their series of war maps. No. 17 is a map of the British front in France and Flanders, and is on a scale of half an inch to a mile; it extends from Boesinghe beyond Ypres on the north to Bray-sur-Somme on the south, and is coloured on the layer system, contours being shown at 125 and 250 ft. It thus contains the whole of the 70 miles line of front now held by us. The other map (No. 16), also coloured on the layer system, embraces the whole of the troubled districts in the Balkan Peninsula, including the mouths of the Danube and Constantinople, Salonica, Belgrade, and Serajevo. The scale is 18 English miles to 1 in.

THE relation between cirrus directions as observed in Melbourne and the approach of various storm systems affecting Victoria is the subject of Bulletin No. 10 of the Commonwealth Bureau of Meteorology. Mr. E. T. Quayle records the direction of movement of cirrus clouds in advance of the various types of cyclonic depressions which affect Victoria, and finds close correlations between these and the distance of the trough of the depression. Thus, in the case of the commonest type of depression in Victoria, the so-called Antarctic depression, observations indicate that cirrus movements to the south of west are associated with a trough more than 700 miles away, and north of west

with a trough fewer than 700 miles away. Further, the author contends that his results are of value in forecasting rain. Taking the normal cirrus direction as west, a departure of 8° to the north was associated with general rains, 4° to the south with partial rains, and 12° to the south with a failure in rain. Mr. Quayle contends his results show that cirrus movements can be used as guides in forecasting the weather, and gives some general rules in application to the weather of Melbourne.

THE usual method of cartographical representation of density of population based on the consideration of each census district as a whole has many drawbacks. Not only does it entail frequent sudden breaks in continuity when a district with a high degree of density adjoins one with a low, but it has the fatal objection of being founded on purely arbitrary political divisions. A new and far more scientific method has been worked out by Mr. B. C. Wallis, and described, with specimen maps of Hungary, in the *Geographical Journal* for March, 1916 (vol. xlvii., No. 3). Mr. Wallis has taken the average density for each commune, the smallest area for which there are returns, and, using these figures as "spot heights," applied the principles of contour lines. The result is a justification of the method. In like manner, Mr. Wallis has applied this method to illustrate the distribution of nationalities in Hungary, and has produced an instructive map, which is of far greater usefulness than the old-fashioned and rather meaningless chart in which the percentage of each nationality is given in figures of different colours in each commune. The paper goes on to deal with some of the results of the distribution which the map illustrates.

CALCULATING machines form the principal subject of a paper by M. Leonardo Torres y Quevedo in the *Revue générale des Sciences* (xxvi., 21), under the title, "Essais sur l'Automatique." It deals with the construction and principle of devices, mainly electrical, for performing arithmetical and other operations without human intervention. A possible cause of error, namely, the production of electric sparks, is considered, and a method of obviating this risk is suggested.

RESULTS of magnetical, meteorological, and seismological observations for the month of August, 1915, and the annual report for 1914, of the Royal Alfred Observatory, Mauritius, show that an exceedingly valuable series of results is being secured under the directorship of Mr. A. Walter. A table is given of the means and extremes of the principal meteorological elements for the year compared with previous results from about 1875. Other tables give the monthly departures from average of the various meteorological elements, also the mean hourly velocity of the wind for the eight five-year periods from 1876 to 1914, and other information of a meteorological, magnetical, and seismological character. During the visit of the German cruiser *Emden* to the station at Cocos Island the meteorological instruments were destroyed. Much valuable information is secured by the observatory staff from the logs of ships traversing the Indian Ocean, and by this means details are obtained relative to the formation and movement of cyclones over the Indian Ocean.

ON July 15, 1896, the Pacific coast of Japan was attacked by a tremendous ocean wave, the sea off the coast of Miyato rising and falling alternately. The second crest reached the maximum height, and the oscillation then decayed rapidly. The hypothesis that this disturbance was due to a sudden depression of the sea-bottom over a limited area forms the subject of a hydrodynamical investigation of the wave motion theoretically produced by such a disturbing cause. This theory, which assumes the sea-bottom to be of uniform depth and the depression to be circular, appears to give results according with those of observation to a reasonable degree of closeness. The times from the beginning of the earthquake to the first wave, the interval between the first and second, and the fact that the second is the highest, are results in which theoretical calculations accord fairly well with results of observation. The paper, which is by Keizó Sano and Kea Hasegama, is published in the Proceedings of the Tokyo Mathematico-Physical Society, viii., 7.

IN pamphlet No. 20 of *Mededeelingen en Verhandelingen* of the *Koninklyk Nederlandsch Meteorologisch Instituut* (Utrecht, 1915, pp. 24), P. H. Gallé discusses steamer routes from Durban and Cape Agulhas to various parts of the Dutch East Indies. This subject has recently attracted a certain amount of attention on account of the increase of shipping between these points, and since the paper was written Dutch East Indian passenger liners have started going round by the Cape instead of through the Suez Canal. The factors affecting a choice of routes are:—(1) The equatorial counter-current and other easterly currents near the equator; (2) the south equatorial current and the easterly drift south of lat. 35° S.; (3) the West Australian current; (4) the N.E. and S.W. monsoons; (5) the S.E. trade winds; (6) easterly winds south of lat. 30° S.; and (7) westerly winds S. of lat. 35° S. Various charts indicate a region round the Cocos Islands, between lat. 10° and 20° S. and between long. 90° and 105° E. as being more or less free from cyclones, but according to the author the existence of this region is doubtful, and requires further investigation. The publication is chiefly of nautical interest.

THE annual report of the director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington for 1915 shows the large amount of work which has been done by the department both on land and at sea. We have referred as occasion has offered to the magnetic survey work at sea carried out on board the *Carnegie*, which last year devoted herself to the Pacific. The present report announces that the following land surveys have been completed:—Through Central Brazil from Rio de Janeiro to Para; interior of southern China and Mongolia; general magnetic survey of Australia; Australasian and West Pacific Islands; the Belgian Congo and Angola and the south-west coast of Africa. At Washington itself the new buildings have been brought into use, and a considerable amount of reconstruction and improvement of instruments has been accomplished, especially in relation to measurements of atmospheric electricity. Abstracts of thirteen papers which have been published by the staff during the year are appended to the report, which contains a record of work for the good of the world on which the Carnegie Institution may justly pride itself.

A PAPER on the Rangoon River Training Works, by Sir George Cunningham Buchanan, read before the Institution of Civil Engineers on March 21, contains some interesting details of an engineering undertaking of considerable importance. The Port of Rangoon, to-day the third port of the Indian Empire, is situated on the left bank of the river of the same name, which constitutes one of the deltaic mouths of the Irrawaddy, at a distance of about 28 miles from the sea. At this point, which also marks its junction with two other effluents, the stream assumes a very sinuous course, and, swinging round a bend in front

of the town, has for a long time past produced very marked erosion of the right, or concave, bank, with corresponding accretion on the other. It was realised that unless this action could be checked the channel would ultimately be deflected away from the town and the existence of the port jeopardised. The remedial work consisted of a training wall, 13,000 ft. long, constructed of stone rubble laid on a brushwood mattress foundation, with a reinforced concrete superstructure finishing at high-water level of neap tides. The work was begun in 1910 and completed in the spring of 1914, at a total cost of 921,783*l*. The stone —a porphyritic diorite—was mainly obtained from quarries specially opened out on an uninhabited island, some 135 miles distant from Rangoon, situated in the open sea off the Tenasserim coast. The total quantity of stone used amounted to nearly 28 million cubic feet. The mattresses for the foundation absorbed $5\frac{1}{2}$ million bundles of brushwood from local jungles.

THE Institution of Electrical Engineers has issued a new edition of its rules for the electric wiring of buildings. They differ chiefly in points of detail from the code issued in 1911. One of the modifications relates to the arrangement of switches and fuses on installations connected to three-wire networks with earthed neutrals, to ensure that the connection to the neutral main shall not be interrupted before those to the outer conductors. Another calls for double-pole switches on all electric heaters rated above 1 kw. The rules are now adopted by fifty insurance companies.

MESSRS. W. HEFFER AND SONS, LTD., Cambridge, announce for early publication "Methods in Practical Petrology," by H. B. Milner and G. M. Part. The work is intended for petrological students and others who wish to make their own rock slices, and will contain chapters on the preparation of rock slices, examination of rock slices, microchemical methods (staining), and mounting of sands and crushed rock material, with an appendix on the preparation of stains.

A NEW monthly periodical entitled *Physiological Abstracts* is about to be issued by Messrs. H. K. Lewis and Co., Ltd., under the editorship of Prof. W. D. Halliburton. We understand that the term "physiological" is used in a wide sense, and that the journal will contain important papers in allied sciences which have physiological bearings; thus, abstracts will be given of papers in comparative physiology and biochemistry, as well as in physiology proper. It is not proposed to print original communications unless there be special reasons for so doing.

OUR ASTRONOMICAL COLUMN.

THE PLANET VENUS.—The nearest approach to the Pleiades will occur about 6 p.m. on Tuesday, April 4. Venus will then appear approximately $2\frac{1}{2}°$ distant from Alcyone, the brightest star of the cluster.

NEW LINES IN THE SPECTRUM OF SILICON.—Prof. A. Fowler, in a paper communicated to the Royal Astronomical Society (*Monthly Notices*, lxxvi., pp. 196–7), gives the following lines in the spark spectrum of silicon, most of them observed and identified for the first time. λλ 5740·2 (int. = 10), 4829·4 (4), 4820·1 (3), 4813·7 (2), 3590·5, and 3487·1. All have been found to show the laboratory behaviour characteristic of Lockyer's Group IV. lines (*i.e.* brought out by the strongest condensed discharges), and the four less refrangible also appear in the Harvard reduction of the spectrum of β Crucis (B1, Cru.), which also shows the previously known lines of Group IV., λλ 4089 and 4116·5.

DEFINITIVE ORBIT OF COMET 1802.—First observed by Pons on August 26, 1802, this comet was observed 140 times during a period of forty-one days, describing heliocentrically an arc of 46°. On the basis of the orbit calculated by Olbers from his own observations K. Lundmark has derived the following elements by the method of Schonfeld:—$T = 1802{\cdot}69$; epoch, 1900; $\omega = 21° 51{\cdot}7'$; $\Omega = 310° 54{\cdot}6'$; $i = 56° 59{\cdot}9'$; log q, 0·0391. Perturbations have not been calculated, as the comet was observed for so short a period, and, moreover, a graphical examination showed that the comet in its path through the solar system had nowhere approached the major planets. Identity with comet 1909 I. would give a period of 106·734 years, and the next earlier apparition would be 1695, but the orbit of the comet of that year is not known with the requisite accuracy to establish identity.

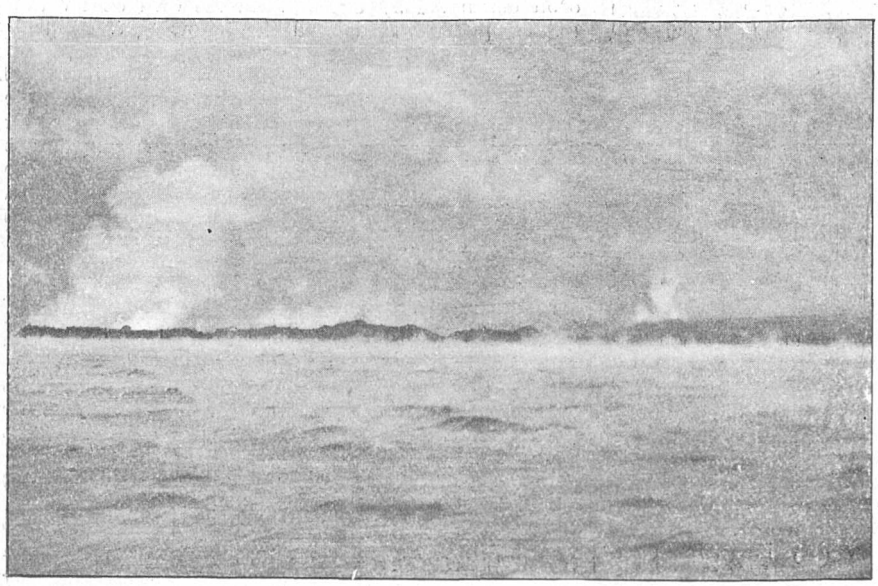
A NEW METHOD FOR THE DETERMINATION OF LATITUDE.—The solution of the outstanding problems connected with the variation of latitude is now being sought in variety of methods as contrasted with the uniformity of the international latitude service. In this connection attention is merited by a method proposed and successfully employed by Dr. G. Zappa (*Atti R. Accademia dei Lincei*, vol. iii., p. 69, 1916). The new method is a modification of Struve's, in which high altitude stars are observed in the prime vertical, and the essential improvement consists in the employment of pairs of stars, one E. the other W., chosen so that the observation of both can be made in a short interval of time. It is claimed to afford results comparable with those given by the Horrebow-Talcott method, and may thus possibly serve to clear up the mystery of the Kimura term. The mean error of a latitude deduced from nine pairs of stars (Boss, P.G.C.) is ±0·10″, whilst the latitude of the Observatory of Capodimonte has been determined with a mean error of ±0·35″, but the relevant number of observations is not stated. The "Carpe" premium has been awarded to Dr. Zappa for his memoir.

THE PLANE OF THE SOLAR MOTION.—A further paper by Prof. von S. Oppenheim on the subject of stellar motions appears in *Astronomische Nachrichten*, No. 4830, and nominally concerns the plane of the solar motion. Shortly after Kobold's well-known memoir on this subject was published, Harzer showed that the method reduced to the solution of a cubic equation giving the axes of what Prof. Oppenheim now terms the "momenten-ellipsoid." Although the Bessel-Kobold method gave a good value for the right ascension it failed to determine the declination of the apex, and no further attention appears to have been given to the Harzer ellipsoid. Prof. Oppenheim has now found the possible significance of the remaining axes by an application to the case of the geocentric motions of the minor planets. In a recent paper (see NATURE, October 21, p. 209) he employed the Bessel-Kobold method to investigate the plane of the solar motion, and incidentally found that the Charlier sectors were divided into two groups, about half giving the normal value for the Ω, whilst for the others the value was found to be $360° - \Omega$, as though direct and retrograde stellar motions had been discriminated. The two groups have now been treated separately, and it is stated that the momenten-ellipsoids are enantiomorphous. One axis of each is, of course, directed towards the solar apex; by analogy with the minor planets it appears that the second axis points to the pole of the plane of the solar motion, whilst the third is directed to the ideal centre of the stellar orbital movements.

A NEW VOLCANO IN THE KIVU COUNTRY.

A JOURNEY in the eastern part of the Belgian Congo and in German East Africa is described in the *Geographical Journal* for January (vol. xlvii., No. 1) by Sir Alfred Sharpe, who was accompanied by the Hon. Mountstuart Elphinstone. The journey, which was made in 1912–13, included a visit to the little-known regions west of Lake Kivu, around the Lukulu river, but the travellers' most remarkable experience was the sight of a volcanic action in the region north of Lake Kivu. From the southern end of the lake a dull-red glare in the night sky became stronger as they went north, and there were dense black clouds by day in the same direction. From Bobandana, at the north-west corner of the lake, a splendid view was obtained of the erupting volcano seven miles away.

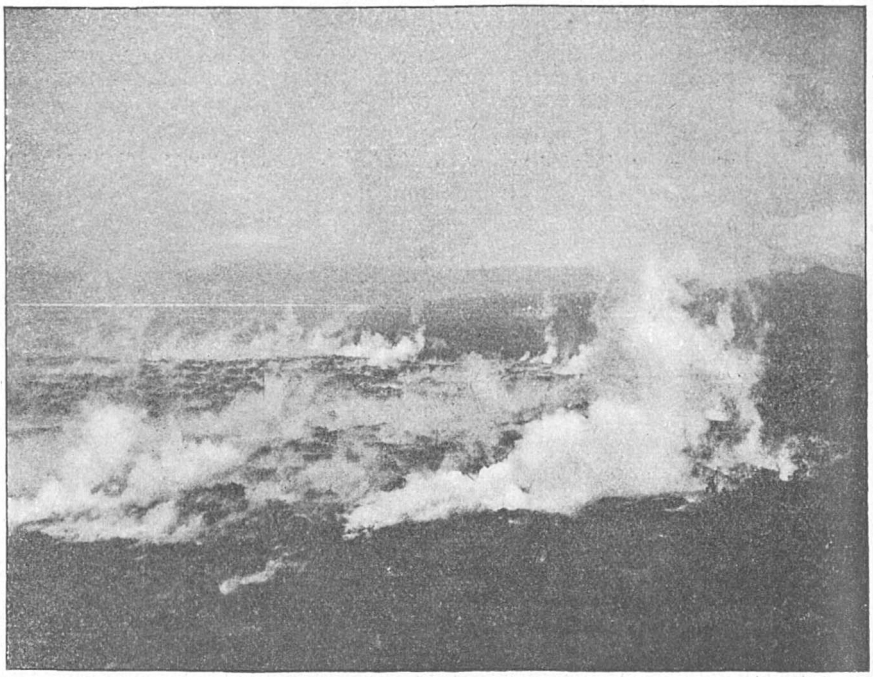
The floor of the rift valley north of Lake Kivu is crossed by the volcanic belt of the Mufumbiro Mountains, containing many cones of all sizes. At the time of Sir Alfred Sharpe's visit two of these were active: Nyamlagira, which was throwing out vast volumes of black cloud, with occasional showers of mud, and the newly-opened one, christened Katarusi by the Belgian officials, which was in more active eruption. In eleven days Katarusi had built a cone 600 ft. in height with a crater of 600 yards in diameter, arising from an ancient field of lava, no doubt derived from Nyamlagira, and long covered with open savanna.



Photo] [*The Hon. M. W. Elphinstone.*

FIG. 1.—North-west corner of lake, almost boiling. From the *Geographical Journal*.

Sir Alfred Sharpe describes a broad, swift river of lava flowing into the Kabino inlet of Lake Kivu, three miles from the volcano. The water in that part of the lake was heated to boiling point. The prevailing wind, from the east, was carrying clouds of steam, smoke, and ashes to the west. A large bay in the northern part of the Kabino inlet was filled with lava, and the natives were fleeing from the country after the destruction of their villages and crops. At least one canoe load of natives, overcome by steam and black clouds, was carried into boiling water and sank. Thousands of dead fish were floating in the northern end of Lake Kivu. Twelves miles from the volcano the water was too hot to bathe in. Later on the travellers passed over some of the country devastated by the volcano. For miles the land was black, with no green leaf or blade to be seen, and many dead birds and small mammals were found, evidently killed by the showers of volcanic material. Hundreds of natives were killed. The eruption was audible at Beni, 140 miles away to the north, and at Bukoba, on the Victoria Nyanza, 190 miles east, while ashes fell heavily for two days at Walikali, in the Congo forest, 100 miles to the west



Photo] [*The Hon. M. W. Elphinstone.*

FIG. 2.—Lava filling Kabino Inlet, Lake Kivu. From the *Geographical Journal*.

BRITISH LABORATORY GLASS-WARE.

AT the outbreak of the war the manufacture of glass for chemical and physical purposes was practically a monopoly of "the Central Powers," and, since most British apparatus dealers replenish their stocks in the summer, the supply available in August, 1914, was very limited. Realising the gravity of the situation, the British Science Guild and the Association of Public School Science Masters approached the leading educational authorities asking them to undertake to buy only glass of British manufacture during the war and for three years after it ended; the response was very satisfactory, and more than 75 per cent. of the schools represented on the Headmasters' Conference gave the required promise.

While this action was being taken the majority of the firms of apparatus dealers formed "The British Laboratory Ware Association," which enlarged some of the existing glass houses, and has placed some very satisfactory material on the market. Messrs. Baird and Tatlock decided, however, to open new glass houses of their own at Walthamstow, instead of joining the association; these houses are now in full working order, and the firm has just issued a catalogue. The glass is of two qualities: (1) a hard, boro-silicate glass of practically the same composition as Jena, from which they manufacture flasks, beakers, etc.; and (2) a soda glass, which is principally used for drawing tubing. We have used apparatus made from each material, and find it thoroughly satisfactory in every respect; their "Duroglass" beakers and flasks stand sudden changes of temperature fully as well as did those made abroad, whilst their shape compares very favourably with the early attempts of the British glass-blowers; their soda glass tubing is easy to work, as it shows no sign of devitrifying in the flame, a property which will be much appreciated by those who experimented with British glass tubing fifteen months ago.

Unfortunately the prices charged by both the British Laboratory Ware Association and Messrs. Baird and Tatlock are considerably higher than those charged for Bohemian glass before the war; and if the trade is to remain in this country it will be necessary for a substantial reduction to be made when conditions are once more normal. Without entering upon the political aspect of the case, we sincerely trust some means will be devised for preventing our works and laboratories again becoming dependent upon foreign supplies.

SCIENTIFIC AND INDUSTRIAL RESEARCH.

WORK OF THE ADVISORY COUNCIL.

IN order that the Advisory Council may be in a position to do justice to the branches of industry concerned in proposed researches of great importance which have been submitted to the council by institutions and individuals, it has decided to appoint standing committees of experts. Strong committees in mining and metallurgy have already been constituted, consisting both of scientific men and of leaders of the industries concerned. The Mining Committee will have two sections, dealing respectively with the mining of non-metals and the mining of metals. Sir William Garforth, the well-known coalowner, has accepted the chairmanship of the committee and of the non-metals section; and Mr. Edgar Taylor, of the firm of John Taylor and Sons, owners and managers of metalliferous mines in various parts of the world, has accepted the chairmanship of the metals section. The Metallurgy Committee will also have two sections, dealing in this case with ferrous and non-ferrous metals respectively. Sir Gerald Muntz, Bart., of Muntz Metal Co., Ltd., Birmingham, has accepted the chairmanship of the committee and of the non-ferrous section; and Sir Robert Hadfield, of Hadfield's, Ltd., Sheffield, has accepted the chairmanship of the ferrous section. The Advisory Council hopes at an early date to constitute a similar committee for engineering.

Up to the present the council has been engaged in work which is mainly initiatory and preparatory in character. For example, in order that investigations already in progress should so far as possible be carried on in spite of the war, scientific and professional societies were invited to submit applications for aid to continue researches for which the necessary staff and equipment were obtainable. Grants have already been made, or will shortly be made, to the Institution of Mechanical Engineers (hardness tests and the properties and composition of alloys), to the Institution of Electrical Engineers (heating of buried cables and the properties of insulating oils), to the Institute of Chemistry (laboratory glass and optical glass), to the Institution of Mining and Metallurgy (methods of extracting tin and tungsten), to the Institute of Metals (corrosion of non-ferrous metals), to the Institution of Gas Engineers (refractory materials), to the Manchester Association of Engineers (tool steel experiments), and to the National Physical Laboratory (optical glass). Other proposals of the same type are still under consideration. Timely and valuable results have been quite recently obtained from the researches carried out by Prof. Herbert Jackson under the auspices of the Institute of Chemistry and from the researches carried out at the National Physical Laboratory by Dr. Rosenhain. The Advisory Council has also recommended a grant in aid of an important new research into the manufacture of hard porcelain, especially for domestic purposes. This has been undertaken by the governing body of the Stoke-on-Trent Central School of Science and Technology, in conjunction with the Staffordshire Potteries Manufacturers' Association, with a view to the establishment of the manufacture of hard porcelain in this country.

Particulars have been obtained of the research work not only of the scientific and professional societies, but also of the universities and higher technical schools, with a view to the establishment of a register of research. The possibility of proceeding to collect in the near future information under seal of confidence as to the research work of particular firms is also being considered.

The training of an adequate supply of research workers will be an important branch of the Advisory Council's work, and the steps to be taken for that purpose will require much careful thought. It is impossible to announce definitive plans during the war, but the Advisory Council is so much alive to the urgency of the matter that it has thought it necessary to take immediate interim action, and has, therefore, made recommendations which, if adopted, will, it is believed, secure that all that is practicable in existing circumstances shall be done.

CHEMISTRY AND NATIONAL PROSPERITY.[1]

THE remark of a French *savant* that this was a country where the apothecaries call themselves chemists, might, as one of the consequences of the war, become less pointed than formerly. But it would be an even greater consequence if in future ours ceased to be a country where money was synonymous with

1 Abstract of an address to the Aberdeen Chamber of Commerce on February 8, by Prof. F. Soddy, F.R.S.

wealth. As regards the real wealth of the world, its matter and its energy, as man had found it so, largely, had he left it, until the beginning of last century. Eternally moralising and philosophising about himself, he left little behind him but a vast legacy of morbid introspection for the "education" of his children. Ignorant of the simplest principles which control absolutely his life from the cradle to the grave, he strove to entail upon his successors in perpetuity the conclusions of his preposterous self-examinations. The time had come when, as the result of a disastrous war, this entail had been broken. Henceforth it would be known that science had in its control the major physical factors of human existence. Already the attempt had been made to foist upon science the responsibility of the war. But science was neither the destroyer nor the upbuilder; it was the docile slave of its human masters. The use made of it depended upon whether they were awake to their position with regard to the external realities of nature, or whether they were still trying to compromise with the old mixed mythologies. After the war, whatever its outcome, science and its application could retrieve every disaster, and make good even the present seemingly irreparable destruction.

A change had come over the relations of man to matter and energy. No longer between these two, as between a steam-hammer and an anvil, he now had a hand on the valve. And if they examined the hand they would find that it was the hand of the chemist.

Just as the control of money was put into the hands of a properly authenticated banker, let them see to the hand in the control of their wealth. Let it not be the hand of the lawyer-politician, or of a hypnotised dreamer "born in the menagerie," as Mr. H. G. Wells had expressed it, whose intellectual faculties were in thrall to the past, nor even of the medical man, as, now too long, the exclusive public representative of science. Let it be in the hands of honest and well-trained chemists and similar representatives of the other physical sciences, and they would be surprised what unimagined wealth was rolling by unheeded, as Niagara used to do, but rarely as picturesquely and inoffensively. Let them not be frightened by those who would have them believe that science—the knowledge and control of the world outside and independent of themselves—was a monstrous materialism. Such people merely disclosed their ignorance of science, and all that it meant for humanity.

A chemist if he were genuine was rarely worldly-wise. To him secrecy and individualism were the antithesis of the spirit of science. He might be able to put on half a sheet of notepaper that which would keep a whole class in the community in prosperity for a generation. But he would be lucky if until the end he kept out of the poor-house, and still more lucky if in his old age he could still call any of his discoveries his own. But the real discovering type of chemist was a very rare bird, and it was scarcely necessary to say he was not the type specially catered for by university curricula. From a business point of view he was a thoroughly bad investment. He paid no more fees than his numerous fellows, his training was preposterously expensive, if he was to know his subject and not know about it, and, worst of all, when he was hatched, no one could be sure whether he was a swan or a goose. Obviously with universities, financially managed by business men, the good staple lines of chemical students are far more attractive. They can be turned out in large numbers relatively cheaply, their fees aggregate to a considerable sum and bear an appreciable proportion to the cost of their education, and their numbers speak for themselves.

But a chemist, gauging the relative chemical value to the nation of all this teaching, would rate it in the inverse ratio to that in which it would be regarded if numbers or revenue accruing to the university were the criterion. You need the small army of professionally trained students to keep the existing machine going. But a machine that just keeps its own cumbrous self going has no right to the title of a prime-mover. As much and more do you need the pioneers, those who are to stand erect for the first time and know their way, where all before have been befogged, in whose solitary footsteps the army *can follow*. A university that does not give of the best it can afford for these is oblivious to the more difficult and more repaying side of its dual function.

HIGH EXPLOSIVES AND THE CENTRAL NERVOUS SYSTEM.

MAJOR F. W. MOTT, who recently delivered the Lettsomian Lectures[1] to the Medical Society of London upon "The Effects of High Explosives on the Central Nervous System," pointed out that a new epoch in the medical history of war had arisen in consequence of trench warfare and the employment of projectiles containing large quantities of high explosives. In particular, he discussed the causation of death without visible injury, resulting from the detonation of large quantities of high explosives, *e.g.* trinitrotoluene contained in shells, as well as other projectiles, and mines. The central nervous system contained in the closed cranio-spinal cavity is suspended in a water-jacket of cerebro-spinal fluid, which, under ordinary conditions of shock, effectually protects the delicate nervous structures from commotion; and the large quantity of this fluid at the base of the skull serves particularly as a water-cushion protecting the vital centres of the medulla oblongata from the effects of concussion.

Major Mott discussed the possibility of the aerial force generated by detonation of 50–200 lb. of trinitrotoluene being so great as to be transmitted through the fluid to these vital centres, and cause death by instant arrest of the cardiac and respiratory centres. Considerable attention was given to the observations of a French civil engineer, M. Arnoux, who found that the effects of the explosion of a large shell upon an aneroid barometer were such that decompression experiments to produce similar effects on the barometer indicated that a pressure of 10,000 kilos per square metre must have been generated by the explosion. M. Arnoux inferred from this that the bursting of a large shell might cause such an intense atmospheric decompression as to liberate enough bubbles of air and CO_2 in the blood to prove fatal by the blocking of multiple small vessels (embolism). In support of this hypothesis, it was pointed out that multiple embolism is the cause of Caisson disease. Lord Sydenham expressed the opinion to Major Mott that the explosive force might cause death by the sudden pressure on the thorax and abdomen, arresting the action of the heart and lungs.

The possibility was also discussed of the production of noxious gases, *e.g.* CO, which would deoxygenate the blood by combining with the hæmoglobin, and thus cause the sudden death of groups of men who have been found in trenches and closed spaces without visible signs of injury and in the last attitude of life. In explanation thereof, he suggested that the muscles of fatigued men suddenly poisoned by inhalation of carbon monoxide in large quantities might pass rapidly

[1] The Lettsomian Lectures on "The Effects of High Explosives upon the Central Nervous System," delivered before the Medical Society of London by Dr. Fred W. Mott, F.R.S., Major, R.A.M.C. (T.), 4th London General Hospital. *Lancet*, February 12, 26, March 11, 1916.

into *rigor mortis*. In support of this hypothesis it may be mentioned that Major Mott received through Lord Sydenham information from the secretary of the War Trench Committee to the effect that imperfect detonation of 50–100 lb. of trinitrotoluene would produce sufficient carbon monoxide to cause poisoning.

In support of the opinion that carbon monoxide poisoning may account for some of the symptoms and the fatal termination of cases of "shell shock with burial," and without visible external energy, Major Mott showed photographs and photomicrographs of the brains of cases of carbon monoxide poisoning, and demonstrated the fact that the punctate multiple hæmorrhages found throughout the white matter of the brain corresponded with the appearances presented by the brain of a soldier who had been buried by the explosion of a shell. How long he had been buried was not known, as he was brought in comatose to the field ambulance station and remained so until death forty-eight hours later. Throughout this brain, especially in the white matter (as the photographs and photomicrographs demonstrated), there were multiple punctate hæmorrhages. There was no visible external injury to account for this condition of the brain, but, of course, it might have been the result of concussion by a sandbag; the lecturer adduced reasons against this assumption, and said the question whether carbon monoxide poisoning was a factor in the production of severe symptoms and fatal termination in "shell shock" could only be settled by examination of the blood of these cases. The lecturer thought that this would be worth doing, for he had seen numerous instances of shell shock with burial showing no visible injury, in which there was a complete loss of recollection and recognition, and from which the patients only slowly recovered. He narrated similar cases of profound loss of memory occurring as a result of carbon monoxide poisoning previous to the war.

Interesting photomicrographs of the spinal cord of a man who lived forty-eight hours after shell shock with burial were shown. The man retained consciousness to the end, but was paralysed in all four extremities; the intercostal muscles were also paralysed. The man was evacuated five minutes after the shell burst; therefore there was no time for him to be poisoned by carbon monoxide. Examination of the spinal column showed no visible sign of injury, but there were most extraordinary changes in the fourth and fifth segments of the spinal cord—notably hæmorrhage in the grey matter, sieve-like vacuolation of the fibres of the posterior column, and of one antero-lateral column; another striking feature was enormous swelling of many of the axis cylinders. The phrenic nucleus which innervates the diaphragm was destroyed with the exception of some of the cells in the third segment; these exhibited chromatolysis indicative of exhaustion. Sudden death would have been the result if the lesion had been half an inch higher, as the whole "nucleus diaphragmaticus" would have been destroyed by the spinal concussion, and respiration would have instantly ceased. How the spinal concussion was effected could not be ascertained; it was most probably due to a sandbag hurled from the parapet, for this man was partially buried. Still, it is difficult even then to account for the limitation of the lesion to an inch of the spinal cord except by transmission of the force to the cerebro-spinal fluid in which the spinal cord is suspended. The changes in the spinal cord were exactly similar to those described by Col. Gordon Holmes [2] as a result of concussion of the spinal cord caused by bullet wounds of the spinal column without penetration of the enclosing membranes.

Regarding the sieve-like vacuolation of the myelin fibres, and the enormously swollen axis cylinders, unlike that produced by ordinary fracture dislocation, it is of interest to note the opinion of Prof. Leonard Hill, who, in a letter to the lecturer, suggested that the shock may have been so great as to kill the axoplasm, for "a water pressure of between 300 and 400 atmospheres kills all protoplasm (excepting deep-sea fishes). Water enters into the muscle and swells it and turns it opaque. There are curious fractures produced in the muscle fibre. The myelin of nerve fibres is broken up by the water entering into these. In the case of a high-velocity bullet striking the spine, it seems possible that the cerebro-spinal fluid beneath the struck part may be instantly compressed and act as a solid body transmitting the blow to the cord. There cannot be time for the fluid to be displaced. There is, anyway, a water-pressure limit beyond which protoplasmic activity is destroyed, and I imagine bullets must produce this pressure, but I very much doubt whether air waves produced by shell bursts can reach to such pressures as 300–400 atmospheres."

It is quite possible, therefore, that a sandbag hurled against the neck could cause spinal concussion similar to that of a bullet wound, but without producing visible injury.

Major Mott then directed attention to the fact that while a large number of these patients were of a neurotic or of a neuropathic disposition, yet the strongest nervous system would eventually break down under the stress of continuous exposure to shell fire and trench warfare.

The varying groups of signs and symptoms indicative of loss of function or disorder of functions of the central nervous system arising from exposure to forces generated by the detonation of high explosives are classed under the term "shell shock." In a larger number of cases, although exhibiting no visible injury, shell shock is accompanied by "burial." The signs and symptoms, with the exception of the profound effects on consciousness and memory, accord in the main with those of the two common types of functional neurosis—neurasthenia and hysteria.

From the point of view of compensation or pension the War Office authorities very properly regard "shell shock" as a definite injury, although there may be no visible sign of it. This fact is of considerable importance, for, as in the case of pension or compensation for traumatic neurasthenia under the Employers' Liability Act, the notion of never recovering may become a *fixed idea*. The detection of conscious fraud is not easy in many cases of "shell shock" in which recovery might reasonably have been expected, for it is difficult in many cases to differentiate malingering from a functional neurosis due to a fixed idea. The first point is to be sure of your diagnosis that the disease is altogether functional, and being satisfied thereof to avoid all forms of suggestion of the possibility of non-recovery. A very great difficulty in the complete investigation of these cases arises from the fact that few or no notes, as a general rule, accompany the patient; one has therefore to rely upon the statements made by the patient himself, or perchance by a comrade, if he has no recollection of the events that happened. Most of the cases of "shell shock," however, are able to give satisfactory information of the events that preceded the shock; they even tell you they can call to mind the sound of the shell coming and see it in the mind's eye before it exploded; then there is a blank in the memory of variable duration. In some of the more severe cases, especially where there has been burial or physical concussion by a stone

[2] "Spinal Injuries of Warfare." Being the Goulstonian Lectures delivered before the Royal College of Physicians of London by Lt.-Col. Gordon Holmes. *Brit. Med. Journal*, November 27, December 4 and 15, 1915.

or a sandbag, or by falling heavily on the ground after being blown up in the air, there is a more or less complete retrograde amnesia of variable length of time. In a case of simple "shell shock" it is impossible to say whether the patient was unconscious during the whole period of time of which he has lost all recollection of the events that happened, or whether during the whole or a part of the time he was conscious, but owing to the "commotio cerebri" the chain of perceptual experiences was not fixed.

In the majority of cases "shell shock" affects only the higher cortical centres; in severe cases the vital centres, as in apoplexy, alone continue to function, and the patient is in a dazed condition, and he may automatically perform complex sensori-motor purposive actions of which he has no recollection whatever. Several cases of this kind have come under notice, one of the most trustworthy being a history obtained from an officer. His company had dug themselves in in a wood; he went out into the road to see if a convoy was coming, when a large shell burst near him. It was about two o'clock in the morning and quite dark; about 4.30 a.m. it was quite light, and he found himself being helped off a horse by two women who came out of a farm-house. He had no recollection of anything that happened between the bursting of the shell and this incident.

The frequency with which these cases of shell shock suffer from terrifying dreams at night and in the half-waking state points to the conclusion that a psychic trauma is exercising a powerful influence on the mind by the thoughts reverting to the terrifying experiences they have gone through, and their continuous influence on the subconscious mind may account partially for the terrified or vacant look of depression on the face, the cold blue hands, feeble pulse and respiration, sweats and tremors, some or all of which signs of fear the severer cases manifest. As these dreams cease to disturb sleep, so these manifestations of fear tend to pass off and give place to the sweet unconscious quiet of the mind. Occasionally during the waking state contemplation of the horrors seen provokes hallucinations or illusions which may lead to motor delirium or insane conduct. A number of striking illustrative cases were given.

Speech defects are a common symptom of "shell shock." Of these mutism is the most common; it may be associated with deafness. Unable to laugh or cough sonorously, to whistle, or to whisper, indeed, to produce any audible sound, mutes are able nevertheless to express their silent thoughts by writing. The cause of the muteness is due to loss of power of phonation. Major Mott discussed this subject very fully in a paper read before the Society of English Singers.[3] Besides mutism and aphonia, stuttering and stammering are not uncommon conditions. There is no difference between the mutism and aphonia met with in "shell shock" and that of hysteria; the manner in which it disappears is similar; even a trivial circumstance, in which attention is taken off its guard and the mute is surprised by an emotional shock, may cause the patient suddenly to speak.

A very interesting case was narrated of a grenadier who, when admitted, was blind, deaf, and mute; he was, however, extremely sensitive to skin impressions; indeed, it seemed as if the mind focused attention on the perceptual avenue which had not been functionally dissociated by the shock. His sight was restored to him quite suddenly, and he was then able to communicate his silent thoughts by writing. His power of recognition was good, but his recollection was a blank for the whole period of time he had been in France, and he could give no information regarding the circumstances which led to the condition he was in. A few days later he became very emotional, and suddenly recovered his hearing and speech.

Although mutes are unable to speak voluntarily, yet under the influence of terrifying dreams they often call out in their sleep. One man had been shouting in his sleep and was told this the next morning by a comrade; he was so surprised that he said, "I don't believe it."

Various functional paralyses are common, and an injury often determines the seat of the paralysis by suggestion; thus a man may be blown up and bruised on his hip or shoulder, and a fixed idea is engendered that the limb is paralysed. Functional paralysis of the lower extremities in consequence of injury of the back is a common condition; likewise various disorders of gait and station, tremors, coarse and fine, tics, and choreiform movements are other manifestations of motor functional disorders. Hyperæsthesia, or increased sensibility of the skin to stimuli, and anæsthesia are of frequent occurrence. One of the commonest and most troublesome symptoms is hyperacusis, or sensitiveness to noises; and when the Zeppelin raid occurred many serious relapses took place. It would take too long to detail the manifold symptoms that may arise in consequence of these functional neuroses.

Major Mott does not employ hypnosis or psycho-analysis; he considers these modes of treatment unnecessary, as he has cured numbers of cases by making a careful examination of the patient, and then assuring the paralysed, the tremulous, the mutes, and others that there is no organic disease, and that they will certainly recover. An atmosphere of cure is necessary; therefore when a patient with functional paralysis comes with crutches or sticks, the first thing he does is to order them to be taken away, for they are not required. Many men who had been paralysed weeks and months have thus been cured in a few hours or a few days. Massage and electricity, and all other treatment which suggests a disease, he deprecates. He strongly advocates diversion of the mind from the recollection of the late terrifying experiences by music, games, and amusements of all kinds, and he appealed to the charitable public to provide such for the new Maudsley Hospital of the London County Council, Denmark Hill, which has been recently taken over by the War Office for the treatment of 200 of such cases as those to which he referred.

[3] "The Psychic Mechanism of the Voice in Relation to the Emotions." *Brit. Med. Journal*, December 15, 1915.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Special Board for Biology and Geology have made the following grants from the Gordon Wigan Fund:—30*l.* to the Department of Geology towards meeting the deficit in the working of the department; 40*l.* to the Department of Botany for assistance to the curator of the herbarium in his work on the British flora; 30*l.* to Prof. Punnett, in order that the Botanic Garden Syndicate may continue to offer special facilities for plant-breeding experiments; 5*l.* to the curator in entomology for the care and development of the collections of insects; 15*l.* to Prof. Gardner for the provision of special lectures in parasitology in connection with the diagnosis of disease.

THE council of the Teachers' Guild has arranged for a conference on educational reform, to be held on Saturday, April 8. Specialists in various grades of education—university, technical, secondary, and

primary—have been invited, and also well-known leaders in industry and commerce. The chair will be taken by Sir Henry Miers, and the draft prepared to be submitted to the conference for approval suggests the following subjects to be dealt with by committees of experts:—(*a*) Reforms in administration, including co-ordination of various grades of education; (*b*) the relation of technical colleges, university courses, and research scholarships to manufactures; (*c*) training of women for professional, technical, and commercial occupations, and for domestic life; (*d*) improvements in the curricula of schools and in instructional materials and methods, so as to make them more purposeful and adaptable to after life; (*e*) extension of educational facilities to all juveniles after fourteen; (*f*) training and status of teachers, and research in education; (*g*) medical service and physical education; (*h*) character training and training for leisure; (*i*) reform of examinations, also of methods of selecting candidates for public appointments, and for promotion within educational institutions.

ARRANGEMENTS have been made for the usual short summer course at the Oxford School of Geography for teachers and others interested in geography; but the meeting will not take place this year unless a prescribed minimum number of applications is received by the middle of April. If this number is reached an introductory lecture will be given on the afternoon of August 3. There will be two lectures and at least one period of practical work or an excursion each day. There will be short courses on selected topics of physical, historical, and political geography (especially geographical problems affecting the war and the British Empire), on transport and trade routes, on the teaching of geography, and on the Oxford district. The fee will be 3*l.* for the whole course; a number of students will be accepted for lectures only at a fee of 2*l.* for the course, or of 2*s.* for single lectures. Further particulars will be issued as early as possible in May. Names cannot be sent in too soon, addressed to the Vacation Course Secretary, School of Geography, 40 Broad Street, Oxford, to whom, also, all requests for further information should be sent.

THE paper on "Part-time Education for Boys and Girls," which Mr. J. H. Reynolds read at the Conference of Educational Associations last January, has been circulated in pamphlet form. The paper is rich in impressive facts, which demand the earnest consideration of British statesmen. Mr. Reynolds points out there are 71,000 half-time children, chiefly in the textile districts of the north, to-day. There are some 193,000 children who have entirely left school on reaching the age of thirteen. The number of young people in England and Wales between the ages of fourteen and seventeen was, according to the last census, 2,030,195, to which must be added nearly 200,000 who had left school and entered into employment at thirteen, giving a total of at least 2¼ millions. About 436,000 of these were receiving some sort of education, leaving a net total of upwards of 1,800,000 young people who had ceased to continue their education at day or evening schools. There are in England and Wales 236,000 children below fourteen working half-time or full-time, and 200,000 more working for wages while attending school for full-time. As Mr. Reynolds urges, there is an imperative necessity for a compulsory system of continued education for all children leaving the elementary school at fourteen, who enter into employment, and it might extend from six to eight hours per week throughout the greater part of the year, meaning annually some 270 hours of systematic instruction extending over at least three years.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 23.—Sir J. J. Thomson, president, in the chair.—G. **Green**: The main crests of ship waves, and on waves in deep water due to the motion of submerged bodies. The fundamental problem of ship waves is to determine the wave disturbance produced by an arbitrary pressure system advancing over the free surface. The present paper gives a general method of obtaining the solution of the moving pressure problem in the form of an integral, and proceeds to the evaluation of the integral in some particular cases of ship waves.—E. H. **Nichols**: Investigation of atmospheric electrical variations at sunrise and sunset. Observations were made for a period of fifteen minutes before and fifteen minutes after both sunrise and sunset, using the Wilson compensating gold-leaf electroscope for conductivity and earth-air current, and two Ebert electrometers for measuring the positive and negative electric charges. The results show a decided uniform decrease in the value of electrical quantities throughout the sunset period, but the solar effect at sunrise is not at all pronounced. The potential curves for Kew Observatory were analysed for the years 1912 and 1914 for the 30-minute period at sunrise and sunset, and monthly means obtained for 5-minute intervals, these being corrected for diurnal variation. There is a general increase in the potential at both sunrise and sunset, being more noticeable in the winter months, but there is no evidence of any sudden change. It is possible that the electrical variations observed may be of assistance in elucidating the problems of wireless transmission.

PARIS.

Academy of Sciences, March 13.—M. Camille Jordan in the chair.—H. **Douvillé**: A family of Ammonites, the Desmoceratideæ: an attempt at a rational classification. The value and subordination of characters.—M. de la Vallée-Poussin was elected a correspondant for the section of geometry in the place of Félix Klein.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1915. Observations were possible on eighty-five days, of which fifty-one were consecutive, from July 24 to September 12.—Arnaud **Denjoy**: Differentiation and its inverse.—Grace Chisholm **Young**: Derived numbers of a function.—Maurice **Le Pen** and Jean **Villey**: The measurement of the power of motors.—C. **Dauzère**: The crystallisation of phenyl ether.—E. **Briner**: The mechanism of reactions in *aqua regia*. A study of the reaction $HNO_3+3HCl=NOCl+Cl_2+2H_2O$, which is shown to be reversible. The system was proved to be monovariant, three phases and two independent components.—Carl **Störmer**: The altitude of the aurora borealis observed from Bossekop (Norway) during the spring of the year 1913. A large number of simultaneous photographs of the aurora were taken from the extremities of a base line 27·5 kilometres long, leading to 2500 determinations of the height. The results are given, both in graphical and tabular form. The heights vary from 86 to 180 kilometres, with a maximum frequency at 105 to 106 kilometres.—Ph. **Flajolet**: Perturbations of the magnetic declination at Lyons (Saint Genis Laval) during the third quarter of 1915.—F. **Jadin** and A. **Astruc**: The manganese in some springs of the Pyrenees range. There is a certain relation between the amounts of manganese and total mineral matter in a water. Ferruginous waters usually contain a high proportion of manganese. It was noted that although sodium sulphide waters contain extremely minute proportions of manganese, yet the algæ growing round these springs contain this element in relatively high pro-

portions.—H. **Bouygues**: The tissues at the summit of the Phanerogam stem.—Lucien **Daniel**: The specific variations in the chemistry and structure provoked by grafting the tomato and the cabbage.—O. **Laurent**: The metallic suture in complicated fractures of the femur and humerus. Of the various methods used, wiring with one or two thick silver wires has proved the most satisfactory, details being given of the application of this treatment to several cases of fracture.—Jules **Amar**: Apparatus for prothesis of the upper limbs. Detailed description of two forms of mechanical arms.—R. **Ledoux-Lebard** and A. **Dauvillier**: Theoretical and experimental researches on the bases of the quantitave determination of the X-rays in radiotherapy.

BOOKS RECEIVED.

Rambles in the Vaudese Alps. By F. S. Salisbury. Pp. x+154. (London: J. M. Dent and Sons, Ltd.) 2*s*. 6*d*. net.

Department of the Interior. Weather Bureau. Annual Report of the Weather Bureau for the Year 1913. Part iii. Pp. 331. (Manila: Bureau of Printing.)

With Scott: the Silver Lining. By Dr. G. Taylor. Pp. xvi+464. (London: Smith, Elder and Co.) 18*s*. net.

Mathematical Papers for Admission to the Royal Military Academy and the Royal Military College for the Years 1906–15. (London: Macmillan and Co., Ltd.) 6*s*.

Macmillan's Geographical Exercise Books. Key to II., Europe, with questions by B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*. net.

Factories and Great Industries. By F. A. Farrar. Pp. 90. (Cambridge: At the University Press.) 1*s*. 6*d*.

Trade and Commerce. By A. J. Dicks. Pp. 94. (Cambridge: At the University Press.) 1*s*. 6*d*.

Ships, Shipping, and Fishing. By G. F. Bosworth. Pp. 86. (Cambridge: At the University Press.) 1*s*. 6*d*.

Icones Plantarum Formosanarum. By B. Hayata. Vol. v. Pp. vi+358+xvii plates. (Taihoku: Government of Formosa.)

Colour: a Handbook of the Theory of Colour. By G. H. Hurst. Second edition, revised by H. B. Stocks. Pp. vii+160. (London: Scott, Greenwood and Son.) 7*s*. 6*d*. net.

Stanford's War Maps, Nos. 16 and 17. (London: E. Stanford, Ltd.) 5*s*. and 3*s*.

DIARY OF SOCIETIES.

THURSDAY, MARCH 30.

ROYAL SOCIETY, at 4.30.—Skull of Ichthyosauras, Studied in Serial Sections: Prof. W. J. Sollas.—The Relation of Excised Muscle to Acids, Salts and Bases: Dorothy J. Lloyd.—The Endemic Flora of Ceylon, with Reference to Geographical Distribution and Evolution in General. A Correction: J. C. Willis.

CHILD STUDY SOCIETY, at 6.—The Child Delinquent: C. M. Chapman.

FRIDAY, MARCH 31.

ROYAL INSTITUTION, at 5.30.—The Spectra of Hydrogen and Helium: Prof. A. Fowler.

SATURDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

MONDAY, APRIL 3.

SOCIETY OF CHEMICAL INDUSTRY, at 8.

ROYAL GEOGRAPHICAL SOCIETY at 8.30.—A Year's Travel in New Caledonia: C. H. Compton.

ROYAL SOCIETY OF ARTS, at 4.30.—Surveying: Past and Present: E. A. Reeves.

SOCIETY OF ENGINEERS, at 5.30.—Modern Coal and Coke Handling Machinery, as used in the Manufacture of Gas: J. E. Lister.

VICTORIA INSTITUTE, at 4.30.—The Influence of German Philosophy in bringing about the Great War: Prof D. S. Margoliouth.

TUESDAY, APRIL 4.

ROYAL INSTITUTION, at 3.—Modern Horticulture—Growing Time and Seed Time (Internal Rhythm): Prof. F. Keeble.

ZOOLOGICAL SOCIETY, at 5.30.—Living Cæcilians from South America: Prof. J. P. Hill.—(1) Specimens of the Perciform Fish, *Tilapia nilotica*, with Increased Number of Anal Spines; (2) The Lizards allied to *Lacerta muralis*: G. A. Boulenger.—Some Fresh-water Entomostraca from Ceylon: R. Gurney.—Notes on the Sitatunga or Marsh-Antelope of the Sesse Islands: Major R. Meinertzhagen.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The Rangoon River-Training Works: Sir G. C. Buchanan.—The Present Conditions of Arterial Drainage in some English Rivers: R. F. Grantham.

RÖNTGEN SOCIETY, at 8.15.—A Chronograph Constructed to Work with the Electro-cope: P. J. Neate.—The Enclosed Tungsten Arc as a Source of Ultra Violet Light: B. H. Morphy and S. R. Mullard.—Experiments with a Coolidge Tube: E. Schall.—A New Modification of the Ionisation Method of Measuring X-Rays: H. E. Donnithorne.

WEDNESDAY, APRIL 5.

GEOLOGICAL SOCIETY, at 5.30.

ENTOMOLOGIAL SOCIETY, at 8.

ROYAL SOCIETY OF ARTS, at 4.30.—Painting by Dipping, Spraying, and other Mechanical Means: A. S. Jennings.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Alkalimetric Estimation of Certain Bivalent Metals in the Form of Tertiary Phosphates: Dr. W. R. Schoeller and A. R. Powell.—Note on a Specimen of Russian Oak: P. A. Ellis Richards.—The Estimation of Potassium in Presence of Other Substances: A. H. Bennett.

THURSDAY, APRIL 6.

ROYAL SOCIETY, at 4.30.

ROYAL SOCIETY OF ARTS, at 4.30.—The Work of the Imperial Institute for India: Prof. W. R. Dunstan.

LINNEAN SOCIETY, at 5.—On Five New Species of Edwardsia, Quatr.: Prof. G. C. Bourne.—A New Species of Enteropneusta from the Abrolhos Islands: Prof. W. J. Dakin.—The Southern Elements of the British Flora: Dr. O. Stapf.

FARADAY SOCIETY, at 8.—The Making of a Big Gun: Dr. W. Rosenhain.

FRIDAY, APRIL 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—Notes on the Corallian of the Oxford District: M. Odling.—The Glacial Geology of the Hudson Bay Basin: J. B. Tyrrell.

SATURDAY, APRIL 8.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

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