THURSDAY, JULY 2, 1914.

ORIGIN OF IGNEOUS ROCKS.

Igneous Rocks and their Origin. By Prof. R. A. Daly. Pp. xxii+563. (London: Hill Publishing Co., Ltd.; New York: McGraw-Hill Book Co., Inc., 1914.) Price 17*s.* net.

PROF. DALY is a man of ideas. A few facts observed in the field suggest to him a hypothesis which he then proceeds to test by searching for other facts which must exist if the hypothesis be of any value for scientific purposes. He is perhaps most widely known as the author who, more than any other, has developed the theory of "magmatic stoping." Large masses of plutonic rock—such, for example, as the granites of Devon and Cornwall—can be proved by field evidence to fill spaces that must formerly have been occupied by other rocks. In the case referred to the displaced rocks consisted largely of folded sediments. What has become of them? According to the theory in question, the roof of the magmatic chamber has been shattered, and the detached fragments have in general sunk in the rising plutonic magma. This theory is explained and illustrated in the present volume, and much use is made of one of its probable consequences—namely, the development of secondary magmas by "syntexis"; or, in other words, by the solution in the rising magma of the masses detached from the walls and roof of the magma chamber. This action is believed to account directly or indirectly for many varieties of igneous rock.

But the theory of magmatic stoping is only a subsidiary feature of the work. Its main object is to explain the known facts of igneous geology by a few general assumptions as to the composition, structure, and physical condition of the planet, and whatever view is taken as to the validity of the assumptions, there can be no doubt that in working out their consequences the author has produced a most interesting work, full of information on the present-day aspects of igneous geology, and eminently calculated to stimulate thought.

The book is divided into three parts. The first deals with the composition and mode of occurrence of igneous rocks, the relative abundance of the different types at the surface of the earth, and the phenomena of active volcanoes. Rosenbusch's classification is adopted with slight modifications. The classification based on the "norm" is discarded as being useless for the object which the author has in view. The second part deals with abyssal injection, magmatic stoping, assimilation, and differentiation, the mechanism of volcanic vents, and concludes with a statement of what the author terms an *eclectic* theory of igneous rocks. By the term *eclectic* he means to imply that in framing the theory he has selected and appropriated whatever seemed to him best in the earlier theories relating to the same subject. The third part is devoted to applying the general theory to igneous rocks, which, for this purpose, are divided into seven great groups or clans: the gabbro-clan, the granite-clan, the diorite-clan, the granodiorite-clan, the syenite-clan, the alkaline-clans, and the peridotite-clan (including magmatic ores).

The eclectic theory may be briefly summarised as follows:—The earth, regarded as a planet, is roughly stratified according to density, but the three outer shells are alone involved in the production of the igneous phenomena with which geologists have to deal. The outer shell is composed of sediments, with an admixture of volcanic material, and is discontinuous. The second shell, represented by the Canadian and Fennoscandian "shields," approximates to granite in composition. It is probably continuous under continental areas, but may not be present under all the oceanic areas. These two shells collectively form the "crust" of the earth. Beneath them is a third shell or substratum of basaltic composition which alone, "since an early pre-Cambrian period (typified in the Keewatin) has been not enough for spontaneous eruption." It may be discontinuous, but, if so, parts of it underlie both oceanic and continental areas. Abyssal injection implies the rise of the material of the substratum in magmatic wedges which are superheated at the higher levels and therefore capable of dissolving the rocks of the crust to a variable but large extent. Both the primary basaltic magma and each of its solutions with crust-rocks are subject in certain conditions to magmatic differentiation, this giving rise to various magmas by the freezing of which the different types of igneous rock have been produced. A few illustrations of the way in which the author applies the theory will now be given.

The composition of the primary basaltic magma is regarded as that of a basalt containing only a moderate amount of olivine. From such a magma basalts and gabbros rich and poor in olivine may be derived by gravitative differentiation to which the author attaches great importance. Peridotites and anorthosites may be regarded as the extreme phases of the differentiation of the primary magma. Quartz-basalts and related rocks which are now known to be widely distributed in continental areas, though apparently absent from oceanic areas, probably owe their origin to the

slight acidification of the primary magma through the solution of siliceous crust-rocks.

In discussing the origin of the rocks forming the granitic clan, the author describes at considerable length cases in which granites are found in association with thick intrusive sheets or sills of basalt or gabbro. Thus the Purcell sills of British Columbia, which vary in thickness from 100 ft. or less to about 1500 ft., are intrusive in thick felspathic and micaceous quartzites of Cambrian or earlier date. In several instances the top of a sheet consists "of a true biotite-granite (rarely hornblendic) passing downward into hornblendic gabbro." Inclusions of quartzite surrounded by syntectic material occur in the gabbro, and the author maintains that the granite of these sills is the gravitative differentiate of a quartzite-gabbro syntectic. The post-Cambrian batholithic granites are supposed to have been formed in a somewhat similar way. They are regarded as differentiates of crust-material dissolved in large abyssal wedges injected from the basaltic substratum. The author, however, hesitates to extend his theory to all the large pre-Cambrian batholiths, and suggests that some of these may be re-fused portions of a primitive crust of granitic composition, the necessary heat having been supplied by radio-activity. Although he refers more than once to radio-activity, this is the only case in which he appears to regard it with any degree of favour as a source of the thermal energy manifested in igneous action.

The origin of each of the other clans is discussed at length, and the chapter dealing with alkaline rocks which are regarded as differentiates of syntectics of primary basalt and carbonates is of special interest. The concluding chapter deals with the application of the general theory to the igneous phenomena of the North American Cordillera.

The book represents an interesting attempt to solve a problem of great complexity with the aid of our present knowledge, which is probably quite insufficient for the purpose.

INTRODUCTIONS TO NATURAL SCIENCE.

(1) *The Realm of Nature. An Outline of Physiography.* By Dr. H. R. Mill. Second Edition, largely re-written. Pp. xii+404. (London: John Murray, 1913.) Price 5*s*.

(2) *Introduction to Biology. An Elementary Textbook and Laboratory Guide.* By Prof. M. A. Bigelow and Anna N. Bigelow. Pp. ix+424. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s*.

(3) *Botany.* By Prof. E. Brucker. Pp. xv+185. (London: Constable and Co., Ltd., 1913.) Price 2*s*. net.

(4) *A First Book of Nature Study.* By E. Stenhouse. Pp. 148. (London: Macmillan and Co., Ltd., 1913.) Price 1*s*. 6*d*.

(5) *Weeds. Simple Lessons for Children.* By R. L. Praeger. With illustrations by S. Rosamond Praeger and R. J. Welch. Pp. x+108. (Cambridge University Press, 1913.) Price 1*s*. 6*d*. net.

(6) *Notes on the Natural History of Common British Animals and some of their Foreign Relations. Vertebrates.* By Kate M. Hall. Pp. xii+289. (London: Adlard and Son, 1913.) Price 3*s*. 6*d*. net.

(1) SINCE 1891 Dr. Mill's "Realm of Nature" has been well known as one of the very best introductions to the study of the physical aspects of the world we live in. Along with a few other books, such as Huxley's "Physiography," it has occupied the first rank among text-books, and that place this new edition will retain. The reasons for this are to be found in the author's quite remarkable clearness of head and style (which everyone who has heard him lecture has admired and envied), in his competence to deal with the many sides of the synoptic science of physiography, and also, we think, in the success with which he has made his facts illustrate principles. The book deals with the earth, the atmosphere, climate, weather, the ocean, the action of water on the land, the record of the rocks, the continents, the distribution of organisms, and man in nature. It has been thoroughly revised and brought up to date, but we are relieved to find that it remains in essence as we have known it for nearly a quarter of a century—with the same grip and terseness, the same absence of loose ends and dark corners—along certain lines one of the most educative books we have read. Though in a new dress it is an old friend, and we may be allowed with heartiness to wish it and its author well.

(2) The introduction to biology proposed by Prof. Maurice A. Bigelow and Anna N. Bigelow is one which the authors have tested and found serviceable. It is an introduction to biological facts and ideas, and it is distinctive in selecting those facts and ideas which have a direct bearing on daily life. Thus we find much attention paid to the structure and functions of the human body, the biology of personal hygiene, organisms that affect human health, the economic relations of organisms, the reproduction of organisms, and so on. To our thinking, this is a partial introduction

to biology, but the authors know this as well as we do; they have chosen their path and their book has a strong character of its own, which is more than can be said of many. We have previously referred to the "Teachers' Manual" by the same authors, and we see that there is another companion volume entitled "Applied Biology."

(3) We referred some time ago to Prof. E. Brucker's "Zoology" in the "Threshold of Science" series, and now we have his "Botany." Its conspicuous features are the simplicity of the style, the experimental introduction to the life of the plant, and the way in which the reader is led on from one cohort of natural orders to another. Referring plants to their natural orders is an educative discipline of sorts, but it seems to us to occupy far too large a part of this introductory book. There are many English introductions to the study of botany, and we do not see any reason why this translation should have been added to the list. A new introduction, to justify itself, should be in some way fresh and distinctive. The simplicity that we have alluded to does not always come off, as we may show by a couple of sentences:—"Once they have developed, even very dissimilar living things appear the more alike the younger the states at which they are compared," and "Algæ, mushrooms, bacteria and lichens form the four classes of the *type of algae.*" We protest against two of the lesson titles—"Beginnings of Philosophy" and "Philosophical Considerations Again." Needless to say, there is no philosophy in the lessons, nor should there be. The book is well illustrated.

(4) If a book of nature-study is to be used by junior pupils, which seems to us, in most cases, undesirable, Mr. Stenhouse's can be recommended as one of the best of its kind. It is simply and clearly written, and it is not much too informative. It prompts inquiry, not only in its questions and practical work, but also in its style; and this is a great virtue. The subjects dealt with are common British mammals, plants as food-makers, flowers and fruits and common trees, pond-life, burrowing animals, flying animals, the work of a river, and common stones and fossils. Mr. Stenhouse shows his good sense in keeping, on the whole, to common things and to phenomena which can be readily verified.

(5) Those who are never tired of criticising the modern efforts to lead school children into an intelligent and appreciative acquaintance with the world round about them should take account of a book like Mr. R. Lloyd Praeger's "Weeds," which appears to us very educative—in the truest sense—for the teacher. And happily it does not stand alone. Those teachers who wish to make themselves at home with some good subjects for nature study would do well to take a leaf from Mr. Lloyd Praeger's book. The root-idea is here, and the stem and its leaves and flowers are here too; for the author has shown that in the study of "weeds," which are always with us, you can get the brain-stretching discipline of precision, the mind-awakening appreciation of fitnesses, the naturalist's vision of inter-relations in the web of life, and more besides. The book is uncommonly well done, but it is for teachers—especially for teachers with a way with them. For children it is much too difficult; it is not in the right key. It might become a holy terror.

(6) Miss Kate M. Hall has written a useful and often skilful introduction to mammals, especially British mammals; but she should not have allowed her "good publisher" or herself to entitle the book externally—"Common British Animals." Mammals, to which the book is quite legitimately restricted, form a very small proportion of common British animals; so the title and title-page are quite misleading. Miss Hall knows how to teach, and we find on many a page an educative lesson; but too often this gift has been smothered in very interesting information. We think that a series of somewhat simpler studies on British mammals would have made a more effective book. But we recognise that part of the idea was to compare British with foreign forms.

CHEMISTRY OF PLANTS.

(1) *Untersuchungen über Chlorophyll. Methoden und Ergebnisse.* By Richard Willstätter and Arthur Stoll. Pp. viii+424+xi plates. (Berlin: Julius Springer, 1913.) Price 18 marks.

(2) *Biochemie der Pflanzen.* By Prof. Friedrich Czapek. Zweite umgearbeitete Auflage. Erster Band. Pp. xix+828. (Jena: Gustav Fischer, 1913.) Price 24 marks.

(1) THE paper cover in which the former of the above books is issued contains advertisements of the monographs by Emil Fischer on the amino-acids and proteins, on the purine substances, and on the carbohydrates, which are issued by the same publisher. The book of Willstätter and Stoll under review is a worthy successor of these classical works, and will be extremely welcome to all who have followed the publications during the last eight years of the researches of Willstätter and his pupils in Liebig's *Annalen*; they will be especially grateful for the full experimental details given in the description of the various preparations.

The monograph is not merely a reprint of the numerous papers from Liebig's *Annalen*, but starts, in the first chapter, with a useful summary of all the results obtained up to the date of issue, and the relationship of the various substances isolated during the course of the researches is clearly indicated in tabular form. The book concludes with a description of some researches, most of which receive their first publication in this volume, on the pigments of the blood and their derivatives, and throw further light on the chemical relationship between the green pigment of plants and the red pigment of the blood, amplifying in a striking manner the earlier investigations of Hoppe-Seyler, Schunck, Nencki, and others.

It is difficult to select from such a mass of new material points for special mention in a short review. As an example, however, of the immense amount of patience and skill required in the preparation of chemically-pure preparations, the separation of chlorophyll into its components *a* and *b*, described on p. 163 *et seq.* may be cited; to obtain only a preliminary separation of the two substances contained in 8 grams of a mixture, no fewer than fourteen extractions of the solution in light petroleum with methyl alcohol were required, and 2 litres of the alcohol were employed for each extraction. Experimental details of this character are of interest, in that they illustrate the great technical difficulties of modern biochemical research, and the necessity of a somewhat costly equipment for laboratories devoted to this object; it is doubtful, indeed, whether the talent of a Willstätter would have availed in accomplishing what is described in this monograph, had there not been, in the first place, ample funds for the supply of the necessary material and apparatus, and in the second place, the cooperation of several accomplished students. The book contains many other examples of brilliant experimental technique, and for this reason alone it is well worthy of perusal by all chemists whose work entails large-scale laboratory operations.

Of the results of scientific interest, attention may, in the first place, be directed to the confirmation of the statement of Stokes, published in 1864, based on spectroscopic examination, that the chlorophyll of land-plants contains no fewer than four pigments. To this investigator and to Kraus and Sorby are due the principles of the method which, in the hands of Willstätter and his pupils, has finally led to the isolation of all the four pigments in a chemically-pure form.

Of great interest also, is the discovery of the fact that magnesium is an essential part of the chlorophyll molecule, just as iron forms an integral part of the molecule of the blood-pigment. No less interesting is the discovery of the alcohol, phytol, and of the enzyme phytase, an example of a new species of ferment capable of acting in alcoholic solutions. Mention must also be made of the mysterious change, designated by Willstätter "allomerisation," which takes place, apparently under the influence of some catalyst in alcoholic solution the exact nature of which has not yet been explained.

Although the results so far obtained do not warrant the assignment of a definite formula to the two chlorophylls, the general character of these pigments and of hæmin appears to be fairly well established. The recent valuable work of Piloty, Hans Fischer, and others on the synthesis of various pyrrole derivatives has also materially aided in the elucidation of the complex formulæ of these pigments. It is to be hoped that the publication of the researches on chlorophyll in their present form will afford a stimulus to research on plant physiology. The vexed question as to the mechanism of the sugar synthesis in the presence of chlorophyll still remains unsolved, and the fact that it is now possible to obtain the separate pigments of the leaf free from all contaminations should materially assist in the solution of this problem. Certain interesting suggestions as to the relationship of the pigments to one another, and as to their biological functions, are made in this monograph, which opens great vistas of future research.

(2) It is now nine years since the first edition of Prof. Czapek's two bulky volumes on the general chemistry of plants was issued, and it may be regarded as a favourable sign that a complete new edition of a work of this magnitude should be called for so soon. The first 240 pages of the present issue deal chiefly with general biological problems, including those relating to the physical structure of the cell, a subject which has received much attention from plant physiologists in recent times as a result largely of Prof. Czapek's own researches. The remainder of the volume is devoted to the special biochemistry of the sugars, fats, and lipoids, which are treated both from the more purely chemical and the physiological point of view. Books of reference of this description are indispensable nowadays to workers on biological chemistry, when the results of recent investigations are dispersed amongst so many journals. We owe, therefore, a great debt of gratitude to Prof. Czapek for his labours in collecting together a heterogeneous mass of material and issuing it in a form in which it can be readily reviewed. S. B. S.

OUR BOOKSHELF.

A Junior Geography of the World. By B. C. Wallis. Pp. x+310+maps. (London: Macmillan and Co., Ltd., 1913.) Price 2*s.* 6*d.*

THIS book possesses many merits; its language is always clear, its accuracy, so far as can be judged, unimpeachable. It is arranged on the plan of a long introductory section dealing with the principles of geography, followed by a treatment of the continents in detail, in which the order followed is the unusual (and not obviously advantageous) one of Australia, Africa, the Americas, Asia, Europe. A final separate section deals with the British Isles. The volume is entitled a junior geography, but, to juniors, parts of it (such as that on map-making, or some of the sections which deal with the quantitative analysis of products) may be found difficult; while, excellent as the geographical principle of regional comparison is, it is open to question whether it should be followed from the very beginning. In this department, the text possibly tends to be overweighted with examples. Each section contains a number of questions, in many cases based upon examination questions selected with great care from a wide range of papers.

The illustrations, whether maps, diagrams, or pictures, are clear and good, but we cannot conceive that the extremely small type employed is justifiable on any standard. The index is remarkable. It is stated to be "intentionally short"; in point of fact, it contains about sixty references under eight headings, and the student is charged to make a full index for himself on the lines indicated. Is modern educational practice to demand of the student that he should index all his text-books?

Hereditary Genius: An Inquiry into its Laws and Consequences. By F. Galton. New edition. Pp. xxix+379. (London: Macmillan and Co., Ltd., 1914.) Price 5*s.* net.

"HEREDITARY GENIUS" was first published in 1869 and comes second in the series of works in which Galton's investigations on inheritance were given to the public, being preceded in 1865 by the papers in "Hereditary Talent and Character" which appeared in *Macmillan's Magazine*. A second edition appeared in 1892 from which the present issue has been reprinted. That after forty-five years there should still be a demand for this book is no source of wonder. It is the work of a master and for that reason one shrinks from praising it. But coming back to it after an interval one is struck again by its freshness, its readableness, and the wealth of apt comparison with which it is illustrated. Of the social significance of the subject it is also needless to speak. As Galton shows it bears on most things of interest to the human race from the doctrine of original sin to the vigorous growth of new colonies, and it led him in the last chapter to express views on individuality and the place of the individual in the living universe, which seem to be echoed in much modern sociological teaching on the subject.

The publishers have earned our gratitude in again making this book available, but it is to be regretted that economy in the matter of margin has given the printed pages a rather unattractive appearance.

The Engineering Index Annual for 1913. Pp. 508. (New York: The Engineering Magazine Co., 1914.) Price 2.00 dollars.

THIS volume of the Engineering Index is the twelfth since the work first appeared and is the eighth since the appearance of annual issues. It comprises the monthly instalments published in 1913 in the *Engineering Magazine* and covers the field of serial literature in engineering up to October, 1913. The purpose of the volume is to aid the searcher for information on any specific subject connected with engineering to obtain quickly the names and dates of issue of periodicals, etc., containing articles dealing with the subject. The matter is classified under the main headings of civil engineering, electrical engineering, industrial economy, marine and naval engineering, mechanical engineering, mining and metallurgy, railway engineering, and street and electric railways. These again are subdivided into sections, thus facilitating the process of obtaining all published information on any given subject. Each reference gives, in addition to the name and date of the periodical, a brief summary of the contents of the article or paper, sufficient in most cases to enable the searcher to decide whether it is worth while to pursue his inquiries further. Owing to the great mass of engineering matter published annually throughout the world, the need for such a volume is evident, and the present work can be recommended as a successful attempt to give a concise and complete index of last year's publications.

Routledge's New Dictionary of the English Language. Edited by C. Weatherby. Pp. viii+1039. (London: George Routledge and Sons, Ltd., 1914.) Price 3*s.* 6*d.*

THIS attractively produced dictionary claims to include all the principal new scientific, technical, industrial, sporting, colloquial, slang, and other words, both English and American, as well as pronunciations and etymologies. Prolonged use alone enables one to pronounce judgment on a dictionary; but it may be said that this has answered successfully numerous test appeals made to it.

Nature in Books. A Literary Introduction to Natural Science. By J. L. Robertson. Pp. 156. (Oxford: The University Press, 1914.) Price 2*s.*

THE primary object of this little book is to kindle in young readers an interest in, and love for, Nature and her works. The author's idea is to lead pupils from the descriptions of Nature by our great writers to the world of wonder itself. We echo his hope that the book will take many of its readers to "the open," and that there they may become open-eyed and intelligent first-hand observers.

LETTERS TO THE EDITOR.

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

The Principle of Relativity

In reading through Mr. Cunningham's article on "The Principle of Relativity," I have been struck by several points which seem to require some elucidation.

Whether these difficulties are inherent in the "principle of relativity" as it is generally understood, or whether it is merely owing to the fact that for some time I have been accustomed to look at the matter from a different point of view, which I believe solves these difficulties, and that, on this account, I am rather obtuse towards other views, I cannot say.

Some of these points may be best indicated by Mr. Cunningham's own words, as follows:—

(1) "Now the very first thing that appears, if we accept the hypothesis of relativity, is that it is impossible for us to determine uniquely whether two events are or are not simultaneous."

(2) "We find that the conception of 'simultaneity' does not become definite until we have assigned a definite velocity to a certain point."

Query—What is a "definite velocity"? Is it to be defined in terms of length and time in the usual way, and, if so, how are length and time to be measured? For, as Mr. Cunningham remarks:—

(3) "The next thing we may notice is that the notion of the 'length of a body' becomes indefinite along with the term 'simultaneous.'"

(4) "If now we start from the fundamental law that there is a definite physically-determined velocity, that of light. . . ."

Query—What does Mr. Cunningham mean by a "definite physically-determined velocity" in view of statements (1), (2), and (3)?

Things apparently indefinite:—(1) "Simultaneity"; (2) mode of measuring length; (3) mode of measuring time intervals; (4) meaning of velocity.

Query—What are Mr. Cunningham's fundamental concepts?

A. A. Robb.

Cambridge, June 20.

It should be fairly clear that the articles referred to by Mr. Robb were written with the intention of showing the need for a revision of the common ideas about space and time, which discussions on the principle of relativity have shown to be deeply ingrained. Mr. Robb would be the first to admit that such a revision is a necessity. The passages quoted above—(1), (2), (3)— were written to emphasise it.

To Mr. Robb's first query it must be replied that in the conceptual scheme of relations which we have evolved out of the data of perception, velocity is defined in terms of length and time in the usual way; but unfortunately experiment has not enabled us to think out a unique way of "measuring" space and time.

To the second query it need only be said that it is universal to think of light as being propagated in time, that this propagation is determined by physical considerations, and that it is at any rate a possible hypothesis that in the conceptual representation of the phenomena this propagation takes place always at a definite rate.

To the third query the reply is that the fundamental "concepts" in the representation of physical phenomena are space and time.

But the articles did not profess to describe in detail a logical scheme of the universe of motion. Mr. Robb's forthcoming work in which this is attempted is anticipated with much interest.

E. C.

Distribution of Rainfall on Sunday, June 14.

I am endeavouring to trace out the distribution of the rainfall on Sunday, June 14, in a similar manner to that in which I investigated a thunderstorm some three years ago. May I ask anyone who is interested, and has not already communicated with me, to send as full details as possible either to me or to the British Rainfall Organisation, 62 Camden Square, N.W., unless they would report in due course to the Meteorological Office or to the Royal Meteorological Society?

Especially should I like information on the following points:—When the rain began; when it fell or did not fall; whether there was hail; if so, when and for how long; whether there was wind, and from what directions. It would add to the value of the facts if the precise point of observation were stated.

Information is desired as to the weather outside the storm area, as well as to the conditions where rain fell.

Any observations, however slight, even if they refer only to one particular time, will be welcome and useful.

J. Fairgrieve.

London Day Training College (University of London), Southampton Row, London, W.C., June 26.

The Photo-electric Effect of Carbon as Influenced by its Absorbed Gases.

The existing contradictory results on the photo-electric effect of carbon can be explained by means of the quantity and quality of the gases absorbed by the carbon. The influences of ammonia, hydrogen, air, and carbon dioxide were investigated. The most consistent results were obtained from carbonised bamboo and hydrogen. Saturation curves showed ammonia to be the most active, and carbon dioxide the least. Distribution of velocity curves were obtained for bamboo and hydrogen. The maximum initial velocity was found to be independent of the quantity of hydrogen absorbed, while the maximum current was proportional to the quantity of gas absorbed.

O. Stuhlmann.
R. Piersol.

University of Pennsylvania, June 17.

MAYA ART.[1]

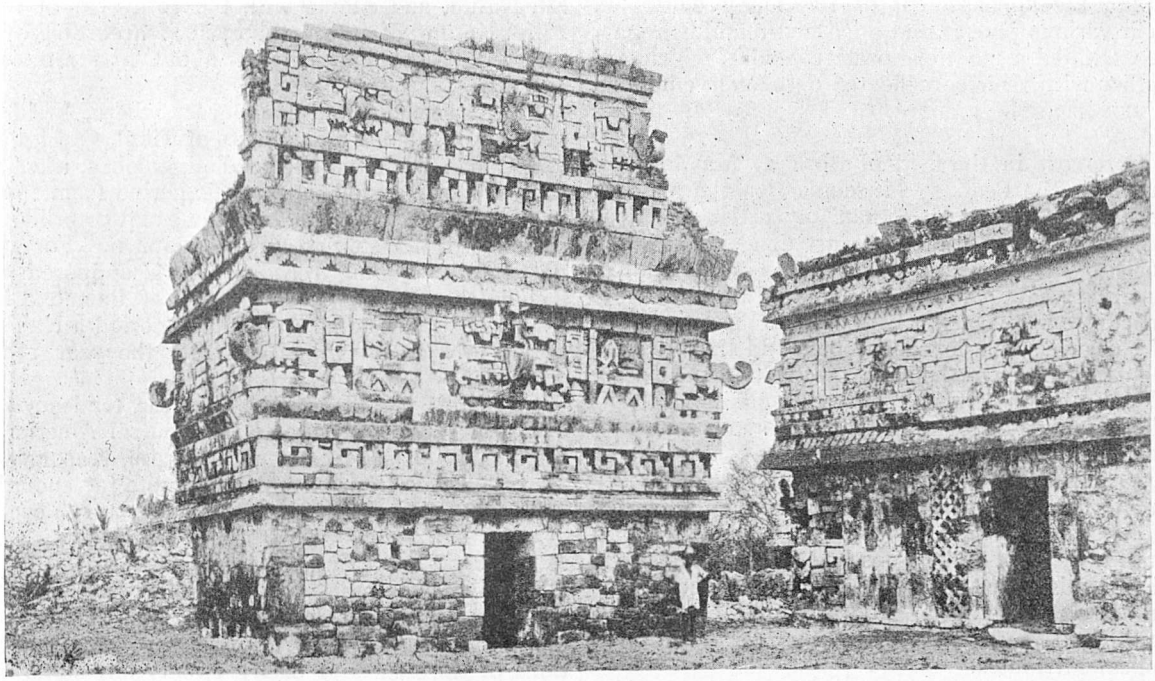
Excepting the splendid labours of A. P. Maudslay, embodied in four volumes of beautiful illustrations, with a descriptive text, the study of old Maya civilisation is almost entirely German-American, and it became a science through Foerstemann, who, with marvellous intuition, was the first to read some of the glyphs.

It is a study quite self-contained, fascinating, but leading apparently nowhere. When the Spaniards conquered Middle America, the Maya glory was already a thing of the past, whilst the Mexican civilisation was at its height. This also has vanished without in the slightest degree

[1] Memoirs of the Peabody Museum of American Archæology and Ethnology, Harvard University. Vol. vi. A Study of Maya Art: Its Subject Matter and Historical Development. By H. J. Spinden. Pp. xxiii+285+29 plates+map. (Cambridge, Mass; Peabody Museum, 1913.)

having influenced the present civilisation, which is entirely Spanish, certainly Latin. The natives neither know nor care anything about the monuments of their ancestors, more often than not they do not even consider them as ancestral, but merely as relics of the olden times. Christianity —and they are nearly all nominal Christians— has smothered, or ruthlessly destroyed, the old life and its traditions. Idolatry being forbidden by law, it is practised more or less secretly, and many old heathen rites have been cleverly woven into the orthodox practices of the Church, especially with the celebrations of the numerous feast days.

The ancient eastern civilisations from Egypt to India and China are more or less akin, have influenced each other, and their effect lasts into our own present-day life. Almost any Mesopotamian



The "Church" at Chichen Itza in Yucatan.

find is sure to throw some light upon the history of the European-Asiatic communities. Nothing of the kind applies to America. If it had been found uninhabited by the Europeans, that would in the long run have had no effect upon the culture and thoughts of the rest of the world. As it happened that there were natives, they have been used as beasts of labour. They were sweated, but not more than the Aztecs had sweated and raided the other tribes.

Dr. Spinden is a pupil of the active and flourishing School of American Archæology, under the guidance of Dr. Tozzer, at Harvard University. His most noteworthy contribution in the present volume is the exposition of the archæological sequence of the Maya monuments.

Who are the Mayas? Maya-speaking people inhabit the Mexican States of Tabasco, Chiapas, and Yucatan, south of the Isthmus of Tehuantepec, besides Guatemala and Honduras. To the north and west this larger Maya area adjoins those of the Zapotecan (Mitla) and Nahoan or Mexican civilisations.

It seems most probable that the mysterious Toltecs were those Mayas in a wider sense, who, in prehistoric times, had extended on to the plateau of Mexico, raising there the great pyramids of Teotihuacan, Cholula, etc. Then the Nahoa, coming originally from the north and west, drove out the Toltecs, and themselves gradually became civilised, building upon the inheritance, the longer they remained in contact with the Toltec-Maya crafts, arts, and science, which continued to flourish in the far south-east. Even so late as shortly before the Spanish conquest the Aztecs or Mexicans proper were sending military colonies down to Nicaragua. Spinden accepting this view, considers the pre-Aztec monuments on the plateau as contemporary with what he designates as the brilliant period of building in Mayaland; the fine Aztec and Zapotec buildings arose later.

The ethnology is very doubtful; anything before 1325, the generally accepted date of the foundation of the city of Mexico, is fictitious. The Codices, illuminated manuscripts, are picture-writings, a compound of idiograph-pictures, and phonetic writing, just on the verge of the invention of an alphabet. It is a highly developed art of pun-drawings, or rebus. Whilst the Nahoa codices—they were nearly all almanacs, or memoranda of accounts—are easy to read, so far as names of places and numbers are concerned, those of the Maya had far advanced, the pictures having

been condensed into much conventionalised signs, and nothing but cyphers and sums have been made out with some certainty. The rest is guesswork, run wild.

The Nahoa, Zapotecs, and Tarascans had risen to kingships, but the Maya were split into many small tribes, independent, and each under its own hereditary chief, a condition of things which makes it difficult to account for the splendour and size of the temples and other public buildings, unless, as Spinden suggests, the old Maya, like the Greeks, were religiously and artistically a nation, but politically a number of small sovereign States. Little is known about their religious ideas. They worshipped many deities—above all, one represented by the plumed serpent, with endless symbolic variations. The ceremonials centred in processions, incense-burning, and human sacrifices, the victims being supplied by raids. The ritual, the appeasement of the many deities in their various phases and imagined manifestations, necessitated a most elaborate calendar, which, together with their complicated chronology, implied a considerable amount of astronomical knowledge.

Foremost in the field of work at Mayan antiquities is the Peabody Museum. "Maya art was on a much higher scale than any art in America, except, possibly, the textile art of Peru." "The ancient masterpieces of Yucatan and Central America show a fine technique and an admirable artistic sense, largely given over to the expression of barbarous religious concepts, and they furnish many analogies to the early products of the classic Mediterranean lands. Indeed, upon such technical grounds as fore-shortening, composition, and design, Maya art was in advance of the art of Assyria and Egypt, and only below that of Greece in the list of great national achievements." But whilst the Greeks apotheosised the human form, the Maya gods and heroes had fundamentally the characteristics of reptiles, birds, and beasts, more or less humanised grotesque figures, often smothered, overpowered by the detail of symbolical attributes.

Painting in colours upon paper and excellent plaster, carving in wood and stone, modelling in clay and stucco, low and high relief, and full round, were much practised, and these people would have accomplished more if they had risen to iron and bronze chisels, instead of implements of stone and obsidian, and if the country had supplied them with marble instead of a coarse and uneven limestone.

Our author has arranged the numerous principal monuments of Copan in Honduras upon a primarily stylistic principle. They fall into four chronologically successive stages, but it is to be remembered that a new type of stela, for instance, was well begun before the old type was abandoned, so that there is a considerable overlap; provided always that their Maya dates have been correctly interpreted, which is by no means always the case.

First: the stelæ show glyphs of archaic form, and in low, flat relief. Altars are drum-shaped, plain, or with rudely carved ornamental symbols.

Second: the stelæ are sculptured, with gradually higher relief. The face of the figure is that of an animal. The head-dress of the figure consists of the face of an animal. The heels stand together, with toes turned outward, forming an angle of 180°.

Third: the stelæ are sculptured. Grotesque faces with turban-dress.

Fourth: stelæ sculptured, practically in full round, with considerable modelling of face and limbs, which assume a less awkward position. Elaborate head-dress with feather-drapery. The altars represent two-headed dragons or serpents, a turtle, or a couple of grotesque jaguars.

The whole development at Copan comprised only 276 years, beginning with the 11th tun of the 4th Katun, and ending with the 10th year of the 18th Katun of the 9th cycle; according to Spinden's assumption from about 250 A.D. to 525 A.D.

For Guatemala and Honduras, where, besides others, the famous monuments of Tikal, Quirigua, and Copan are situated, he distinguishes, after a proto-historic period, an archaic period from 160–755 A.D., upon which follows the great or brilliant period which lasted to about 600 A.D. For no particularly binding reasons this is supposed to include the wonderful monuments of Palenque in Tabasco. After some transitional period a Nahoa period in Mexico is fixed at from the year 1195 onwards.

From this it will be seen that the tendency to assign a sensational age to the Central American monuments has given way to more reasonable views, although our author goes quite far enough back when he puts the beginning of the 9th cycle at 160 A.D., whilst others are satisfied with a date several hundred years later.

It may not be amiss to make a few explanatory remarks about this Maya chronology. They had a ceremonial almanac of 260 days; twenty sections of thirteen days each; twenty day-signs of animals and other natural objects, combined in a certain order with the numerals 1–13, so that every one of these 260 days had an absolutely fixed name, number, and position. They reckoned by scores, whilst the number 13, as Foerstemann discovered, is based upon the fact that eight years of 365 days are exactly five years of the planet Venus, which they worshipped. This curious almanac is, in fact, based upon a combination of terrestrial and Venus years.

They had further a civil year of 360 days, called a *tun*; twenty tuns are a *katun*, and twenty katun a cycle or big period. Now, if every score of years is designated by a name-day of the ceremonial almanac, 260 katuns can be fixed without repetition, *i.e.* 5200 years of 360 days. If this unwieldy number is subdivided by a score of scores, 400, there result thirteen cycles. Foerstemann has further discovered that the zero

of the whole reckoning system refers to a day which in this almost perpetual calendar is a 4 Ahau katun, which begins with the eighth day of the score called Kumku. This has therefore been called the normal or zero date, from which all the monumental dates reckon in days, scores of days, years, scores of years, and cycles. Astronomers do not seem to have taken up the question whether this zero-date, which lies somewhere near 3000 B.C., may possibly refer to some remarkable planetary configuration. It may, however, be altogether fictitious. Very little is known about their cosmogony, and it is not known why they should have considered themselves in the ninth cycle of their world's history when they constructed the Quirigua and Copan monuments. This mode of reckoning was still used at the Spanish conquest, but as they had not invented a leap-year correction they occasionally shifted their new year's day to make the religious feasts tally with the actual seasons. But since it is not known when such shifts were made, and since the various nations did not interpolate alike, none of the numerous dates can be determined.

Most of this American archæology is still in the descriptive stage. For instance, the less there is known about the reason why the chief deity, or hero, Kukulcan or Quetzacoatl, the Great Plumed Serpent, is thus represented, the more minutely he is described and figured wherever a fragment of him is found. We can see that it is a snake. But the answer to the pertinent question: Why a serpent? That there is no particular reason except that "the body of a snake combines readily in art with certain characteristic parts of other animals," that it lends itself especially well to design and ornamentation, is rather disappointing. H. G.

BIRDS AND WEATHER.[1]

THE difficult question of the influence of meteorological conditions on the phenomena of bird migration has fortunately been very thoroughly studied as regards the British area, but we are none the less glad to welcome the recent labours of Dr. Defant on this subject. Dr. Defant as a meteorologist has submitted to a critical examination the data collected some years ago regarding the spring arrival in Austria of some thirty species of birds. He has selected four species for special treatment, and the data cover a period of seven seasons (1897–1903). The published weather reports have supplied all the necessary meteorological data for the corresponding periods.

At the outset of his paper Dr. Defant points out that, while all meteorological factors must be taken into account, the relation of all other conditions to that of atmospheric pressure renders possible a concentrated attention on the latter. A comparison of the ornithological data with the temperature records gave a purely negative result, no direct relation being discoverable. Dr. Defant also rightly insists on the importance of considering the weather of the whole of southern Europe, the conditions prevailing in the actual area of arrival being obviously less important than those in the regions immediately to the south through which the migrants must pass.

The spring immigration of the starling and the lark are treated together, these species showing a detailed similarity in this aspect of their seasonal movements. Tables are given showing that there is an annual variation both in the earliest date of arrival and in the duration of the influx. The period of heavy immigration usually lasts about eight days and the average date of maximum arrival for the seven years was February 23, while the average dates for particular years varied from February 12 to March 3.

With the partial exception of one year out of the seven it was found that the periods of maximum immigration coincided with periods of low atmospheric pressure in the west and north-west of Europe and higher pressure in the south, south-east, or east. These conditions give southerly or south-easterly winds in Austria and the countries immediately to the south, and usually rising temperatures. The immigration was all the greater when these favourable conditions had been immediately preceded by a prevalence of high pressure in the north and north-west (or north-east) and low pressure in the east or south-east; such conditions usually entail low temperatures and northerly or north-westerly winds.

Dr. Defant then considers the average daily pressure for the three regions into which he divides southern Europe. These are A = western Asia Minor, the Balkan Peninsula, the Adriatic Sea, and southern Italy; B = the remaining greater part of Italy, the western Mediterranean and northern Africa; and C = Spain and Portugal. The last-named region is soon shown to be irrelevant, and Dr. Defant's second conclusion results from a comparison between A and B. He finds that strong immigration in Austria occurred when the pressure in these regions was relatively higher than on the days immediately before and after and when the pressure in A was higher than in B. The east to west pressure gradient thus formed when coupled with the effect of the earth's rotation produces the south-easterly winds characteristic of the type of weather already described as favourable to migration.

The cuckoo and the house martin are then treated in like manner (not jointly as in the previous case, but simultaneously to economise space in tables and graphs). The same two conclusions are arrived at for these immigrations occurring much later in the season than that of the starling and the lark. A second type of weather was also found favourable in the case of the cuckoo, namely, extended high pressure over the whole of central and southern Europe, usually with weak easterly or north-easterly winds. In seasons

[1] "Der Einfluss des Wetters auf die Ankunftszeiten der Zugvögel im Frühling." By Dr. A. Defant, Vienna. Reprinted from *Schwalbe*, new series, vol. iii., 1913, pp. 135–56, and charts.

in which the strongest immigration occurred under such conditions the period of the chief movement was protracted to about nineteen (instead of about nine) days.

Dr. Defant has clearly proved that a certain type of weather is peculiarly favourable for the spring immigration of Austrian birds. He is to be congratulated on his clear and well reasoned treatment of very unwieldy data and on having made a valuable contribution to a difficult subject.

His further speculations are, however, open to serious criticism. He believes that the important factor in this type of weather is the wind and that birds prefer to fly with it behind them. His reasons as to *why* birds should do so seem to us to be wholly beside the point, and as the much more comprehensive results already obtained in this country are entirely opposed to Dr. Defant's theory, we cannot accept it, however temptingly obvious it may seem, on such very slender grounds.

The alternative theory is that "the winds and the performance, or non-performance, of the migratory movements are the effects of a common cause—namely, the particular type of weather prevailing at the time, which may be favourable or unfavourable for the flight of birds. . . ." (Eagle Clarke, "Studies in Bird Migration," 1912, p. 173).

In the British area there are certain types of weather favourable respectively for migration between the British Isles and northern Europe, between the British Isles and Iceland, and between the British Isles and south-western Europe. The winds accompanying these types of weather *may or may not* be in the same direction as the movements concerned. Furthermore, the same types of weather favour these movements both in autumn and in spring, the direction of flight being reversed, while the prevailing winds remain the same.

In Dr. Defant's simpler case it so happens that the favourable type of weather he has discovered produces a wind in the same direction as that of immigration from the Balkan Peninsula (his region "A") to Austria; but the immigration from the south-west ("B") probably forms a large part of the movements which were the subject of investigation. It is unfortunate that only the spring migrations have been dealt with. Should the same type of weather with its accompanying winds prove to be favourable to the autumn emigration (as in the case of the British movements), Dr. Defant's theory would be quite untenable.

In the meantime, Dr. Defant's selection of wind as the important factor is purely speculative, and his view entails an entirely different relation between birds and weather in Austria from that existing in the British Isles. While rejecting his theory of the importance of wind as unproven and improbable, we feel grateful for the new facts which he has added to our knowledge of bird migration by his most laborious and thorough research. A. LANDSBOROUGH THOMSON.

METROLOGICAL RESEARCHES.[1]

THE volumes referred to below contain particulars of recent metrological researches made at the international bureau of weights and measures. As the result of a long series of investigations on the length of invar wires used for geodetical measurements, it has been found that wires made of metal taken from the same tapping or ladle and treated in the same manner have practically the same coefficients of expansion; the differences from the mean lying within $\pm 0{\cdot}03 \times 10^{-6}$. If the same coefficient of expansion were adopted for all such wires it would need a difference of temperature of 30° C. to introduce an error of one part in a million. There is now no difficulty in procuring invar wires having a coefficient of expansion as small as $0{\cdot}1 \times 10^{-6}$.

At the fifth general conference on weights and measures held in Paris in October last, a resolution was passed to the effect that in view of the fact that the force of gravity is not precisely the same at sea-level for all places having the same latitude, it was undesirable that the value adopted for the normal force of gravity (viz., 980·665 cm. sec.$^{-2}$) should continue to be defined as that corresponding to a particular latitude (45°). In the reduction of observations the theoretical factor given by Clairaut's formula in the amended form now usually adopted should no longer be employed, but merely the numerical ratio of the normal force of gravity to that at the place of observation, the latter being determined directly if possible.

The normal scale of temperature hitherto adopted at the international bureau of weights and measures has been that of hydrogen at constant volume. The fifth general conference resolved that the absolute thermodynamic scale shall be substituted for the hydrogen scale as soon as the table of reduction from one scale to the other has been determined with sufficient certainty. It was also recommended that a number of thermometric fixed points be ascertained with as great accuracy as possible, in order to facilitate the calibration of thermometers. A meeting of the principals of the various national laboratories is to be arranged at Sèvres for the purpose of deciding what these fixed points shall be and how they are to be determined, as well as to promote their general recognition.

The question of the determination of the length of the metre in terms of wave-lengths of light was considered at the fourth general conference. It was decided that investigation on this subject had not then reached the stage for the conference to adopt any particular number of wave-lengths as representing the metre. Further researches made by physicists will be carefully studied at the international bureau with the view of obtaining in the course of time a fundamental

[1] Comité internationale des poids et mesures. Procès-verbaux des séances. Deuxième série, tome vii., session de 1913. Pp. v+140. (Paris: Gauthier-Villars, 1913.)

Travaux et Mémoires du bureau international des poids et mesures. Tome xv. (Paris: Gauthier-Villars, 1913.)

relation between the metre and a suitable wavelength of light.

All who have been brought into contact with Dr. René Benoît, for so many years director of the international bureau, will regret to hear that he will be retiring from that position at the end of the present year. Dr. Benoît has been identified with all the principal researches which have been undertaken at that institution during the last thirty-six years. In this country his services in connection with establishing the relations between the units of the British and the metric systems of weight and measure will be especially remembered.

A GREAT TELESCOPE FOR CANADA.

A NOTABLE addition is to be made to the equipment of the Dominion Astronomical Observatory at Ottawa, Canada. At present its chief instrument is a 15-in. refractor. This has been used mainly for radial velocity determinations, and for some time its limitations have been keenly felt. Using low dispersion, spectrograms of fifth magnitude stars could be obtained, but beyond this it was ineffective, and it was recognised that further progress demanded a more powerful instrument. Supported by various scientific societies and representative astronomers, the chief astronomer, Dr. W. F. King, appealed to the Dominion Government for improved equipment, and the request was successful.

Contracts have been made for the construction of a 72-in. reflector. The optical parts will be made by the John A. Brashear Co., of Pittsburgh, Pa., and the mounting by Warner and Swasey, of Cleveland, Ohio. The cost will be about 90,000 dollars (18,000*l.*).

The focal length of the great mirror will be 30 ft., with a hole ten inches in diameter at its centre to allow for a Cassegrain combination. For this purpose a convex hyperboloidal mirror, with an aperture of 19 in. and a focal length of 10 ft., will be placed 23 ft. above the main mirror. The resulting focal length will be 108 ft.

The mounting will resemble those of the Melbourne and Ann Arbor reflectors. The skeleton tube will be at one side of the long polar axis, nearly midway between its bearings, the balance being restored by the declination mechanism and counterweights on the other side of the axis. It is hoped to have the telescope completed within two years.

The instrument will be used primarily for spectrographic determination of radial velocities. For the brighter stars it will be used in the Cassegrain form just described, the spectrograph being attached in the axis of the tube, below the 10-in. opening in the mirror. For the fainter stars a low-dispersion spectrograph will be attached at the principal focus. Direct photography of nebulæ, clusters, and other small areas of the sky will also be attempted.

To be used effectively, such an instrument demands a suitable position, and for more than a year Mr. W. E. Harper, of the observatory staff, has been investigating the astronomical possibilities of various regions ranging from Ottawa to the Pacific coast. Of all those tested, Victoria, B.C., showed a decided superiority in good "seeing" and small nocturnal range of temperature, and accordingly that place was chosen. The precise site is on Saanich Hill (elevation 732 ft.), about seven miles north of the city, from which it is easily reached by electric railway and carriage road.

The great dome will be 66 ft. in diameter and 60 ft. high. A building to contain offices, library, and reading rooms will also be erected. The total cost of buildings and equipment will be about 200,000 dollars (40,000*l.*). All the plans and specifications have been made by Dr. J. S. Plaskett, after consultation with many experts, and he will be in charge of the station.

C. A. CHANT.

NOTES.

DR. F. W. DYSON, Astronomer Royal, has been elected a correspondant of the Paris Academy of Sciences, in the section of astronomy.

VICE-ADMIRAL SIR EDMOND J. W. SLADE, K.C.I.E., K.C.V.O., has consented to act as president of the Meteorological Conference to be held in Edinburgh next September.

THE Bill introduced in the House of Commons by Sir Frederick Banbury, to prohibit experiments on dogs, was withdrawn on Tuesday, June 30, after a number of amendments to the principal clause had been carried in the Standing Committee appointed to consider the Bill.

MR. W. O. REDMAN KING, lecturer in zoology at the University of Leeds, has been appointed Ray Lankester investigator at the Marine Biological Laboratory at Plymouth, in succession to Prof. E. L. Bouvier, of Paris. The investigator is required to undertake research work of his own choosing at the laboratory for a period of five months, the emolument being 70*l.*

SIR JAMES CAIRD, of Dundee, has given 24,000*l.*, free of any conditions, to Sir Ernest Shackleton's Imperial Trans-Antarctic expedition. This gift relieves Sir Ernest of anxiety as to the financial side of the expedition, which will now be able to start well equipped in about a month's time. Further subscriptions would, however, be not unwelcome, and would be used to obtain accessories for increased efficiency.

THE Geologists' Association has arranged a long excursion to the Rhenish Westphalian Upland, including the volcanic districts of the Eifel, Siebengebirge, etc., on September 4–19 next. The various daily excursions will be attended by Prof. G. Steinmann, Dr. Tilman, and others as directors. The official party will leave Charing Cross on September 4, at 9 p.m. The excursion secretary is Mr. E. Montag, 18 Woodchurch Road, Prenton, Birkenhead.

AT the annual meeting of the Royal Society of Arts, held on Wednesday, June 24, the Duke of Connaught

was re-elected president. A new by-law was adopted authorising members of the society to call themselves fellows. Since its foundation in 1754 the society has consisted of members only, but as most of the younger societies use the term fellow, many members of the society have expressed a wish that this title should also be used by members of the Royal Society of Arts.

THE Institute of Archæology in connection with the University of Liverpool, has arranged, in the rooms of the Society of Antiquaries, Burlington House, Piccadilly, on July 7–25, a special exhibition of antiquities, discovered at the excavations at Meroë, Sudan, during the past five seasons. The council of the University of Liverpool, we notice, has approved the acceptance by Prof. John Garstang, director of the excavations, of an invitation from the Sudan Government to be their honorary adviser to the Service of Antiquities of the Sudan.

THE statue of Captain Cook, the explorer, executed by Sir Thomas Brock, R.A., is to be unveiled on July 7 at noon. The statue has been placed on the Mall side of the Admiralty Arch, at the end of the Processional Road. It will be remembered that a statue of Captain Cook presented to the town of Whitby by the Hon. Gervase Beckett, M.P., was unveiled in that town on October 2, 1912. The erection of a fitting memorial to the great explorer in the capital of the Empire is largely due to the activity of the British Empire League.

IN a paper read before the Royal Geographical Society on June 22, Captain F. M. Bailey described his exploration of the Tsangpo, or Upper Brahmaputra river. The main results of the expedition were as follows:—The mapping of some 380 miles of the Tsangpo, which had previously been done by untrained or untrustworthy explorers; the mapping of the lower course of the Nagong Chu; the discovery of Gyala Peri, a snow-peak 24,460 ft. in height, and its glaciers. By observing the river where it breaks through the Himalayas some information regarding its enormous drop has been gained, and the falls reported to be 150 ft. in height have been proved to be merely an exaggerated rapid of 30 ft. The upper waters of the Subansivi have been discovered, and it is proved that this river rises north of the Himalayas, and breaks through the range. Many new snow-peaks, ranges, and rivers have been discovered, and a small collection of mammals, birds, and butterflies, among each of which were new species, was made.

INFORMATION has reached the Royal Geographical Society of the further work accomplished by Sir Aurel Stein in his new Central Asian expedition since he wrote at the end of last year. His objective was the region round Lop-nor, at the other extremity of the Tarim Basin, and various considerations obliged him to travel *viâ* Khotan. Pursuing a route hitherto largely unsurveyed, he moved to Maralbashi along the southernmost range of the Tien-shan, where he found some ruined Buddhist shrines, and thence towards the desert hills of the Mazar-tagh, the most forbidding ground he had hitherto encountered in the Taklamakan. Crossing the Tarim, he reached Niya, where he discovered an important sand-buried settlement with numerous documents inscribed on wood in the Indian language and script, furniture, household implements, etc. Meanwhile his Indian surveyor had resumed the triangulation along the Kun-lun range, thus connecting his observations with the Indian Trigonometrical Survey beyond the actual Lop-nor. Ample evidence of Chinese occupation, in the shape of a well-built fort and relics of the silk trade, which we know to have been a chief factor in opening the earliest route for Chinese direct intercourse with Central Asia and the distant West, was discovered. The ancient caravan route was marked by hundreds of early Chinese copper coins and unused arrow-heads dropped during the night marches. The difficulties were over when some scanty vegetation was reached, and the various parties reunited at Kumkuduk. A short halt at Tunhuang towards the end of March refreshed men and beasts, and after a renewed visit to the "Halls of the Thousand Buddhas," Sir Aurel Stein at the time of writing was starting to move into Kan-su for the work of the spring.

MANY readers of this journal will learn with deep regret of the death on June 13 of Mr. Thomas Thorp, whose name is widely known in connection with his transparent celluloid replicas of Rowland's and other diffraction gratings, whereby spectroscopes of high dispersion may be produced at a trifling cost. Born at Whitefield, near Manchester, and educated at the Manchester Grammar School, Mr. Thorp was apprenticed to a firm of architects and surveyors. Soon, however, he evinced a strong mechanical and scientific bent, and, happily combining a wonderful scientific ingenuity with a keen appreciation of the practical application of his inventions, he was able to follow his inclinations, to the great benefit of science and of industry. A much larger world owes to him the first "penny-in-the-slot" gas-meter. While every mechanical device was an object of fascination, optical instruments were most constantly in his thoughts. A keen amateur astronomer, he made himself several telescopes and took up the manufacture of small mirrors. His replica gratings were invented many years ago, but he constantly returned to the subject, producing silvered replicas, applying them to direct-vision spectroscopes, and especially applying the transparent replicas to colour-photography, for which last invention he was awarded the premium under the Wilde Endowment Fund by the Manchester Literary and Philosophical Society. Almost his latest invention was an ingenious method of varnishing telescope mirrors to prevent tarnish—a feat which he accomplished without sensibly impairing the definition. At the time of his death he was engaged on a machine by which he hoped to rule gratings superior to any yet produced. Mr. Thorp became a member of the Manchester Literary and Philosophical Society in 1896, and was one of the most valued members of its council from 1902 until his death. The Manchester Astronomical Society was similarly indebted to him. A man of sterling quality, beloved by all who knew him, some regret must be felt that an aversion to publication hindered the spread of his richly deserved reputation.

A VERY interesting exhibition of African big-game trophies, organised by *Country Life*, was opened on June 25 at the Royal Water Colour Society's Gallery, 5*a*, Pall Mall East, and will remain open until July 11. The total number of exhibits is 312, the greater portion of which are antelopes, the remainder comprising a couple of East African giraffe heads, some elephant tusks, a few rhinoceros heads, and heads of wart-hog, ibex, wild sheep, etc. The specimens are arranged, in the main, in zoological order, and are grouped, as a rule, in species, without recognition of races, and without scientific names, the same plan being followed in the catalogue. It is, however, difficult to understand why Diggle's hartebeest, which is but a local race of the tora, is widely separated from the typical race of that species, while the Sudani race of the bohor reedbuck, which is so remarkably different from the typical form of that species, is not distinguished from the latter. A similar remark is applicable to the separation of Buffon's kob from the white-eared kob, both these being merely races of a single variable species; it also applies, in a less degree to the sundering of the red lechwe from Mrs. Gray's black lechwe. As regards the trophies themselves, they include some of the finest representatives of their respective kinds, the gems of the whole series being perhaps three magnificent sable antelope skulls, each with horns of more than 60 in., and in one case reaching 62½ in. in length. Especially fine, too, are three heads of the giant eland of the Bahr-el-Ghazal, and a bongo head, in spite of its somewhat battered condition, is of special interest on account of its unusually dark colour, which is doubtless an indication of age. A western hartebeest head is noticeable for the great development of a light spectacle-mark, recalling that of Hunter's hartebeest. A number of other interesting specimens well deserve mention, but limitations of space prevent more than directing attention to the magnificent series of East African buffalo-heads. The exhibition reflects great credit on its organisers, although it might have contained a few more "records."

ON Friday last a demonstration of Williams's Firedamp Indicator was given at the Hotel Cecil. Instruments for detecting firedamp have been based on two broadly different principles. Some have depended upon the physical properties of the gas, in particular on its density, but these have suffered from want of sensitiveness and also from actual error unless the carbonic anhydride present is absorbed. An instrument of this class, in which the musical notes emitted by two pipes, one containing normal air and the other the air of the mine to be tested, but with the heavy and disturbing CO_2 removed, which gave rise to beats in the presence of a notable quantity of firedamp, has recently attracted some attention in Germany. The other class depends upon the heat of combustion of the gas present when helped by extraneous heating. This system is the more satisfactory, as there is so much more available and possible effect. A highly satisfactory instrument of this class was made about 1877, invented by E. H. Liveing, the well-known mining engineer; but though it would certainly show the presence of ¼ per cent. firedamp, while ½ per cent. was highly conspicuous, and it required nothing more than the turning of a handle to operate it, colliery engineers and proprietors at the time did not in general care to have it about the mine. The instrument invented by Mr. Williams belongs to this general class, but Prof. S. P. Thompson's report does not indicate that progress has been made in the direction either of simplicity or of delicacy. Shortly, it depends on the excess of temperature set up in one of two little balls of porous material containing platinum black, which are heated by an electrical current, and one of which is exposed to the air of the colliery. This one becomes the hotter of the two, and the excess of temperature is determined by electrical means. If, when the instrument is manufactured, it is found to work in an easy and satisfactory manner, it is to be hoped that the thirty-seven years which have elapsed since the construction of the Liveing instrument will have brought about some change in the attitude of those whom it is hoped to benefit.

THE question of the admissibility of evidence in criminal cases to prove the facts of detection of crime by bloodhounds has been at last raised in the Courts of Law. In a case before the High Court, Allahabad, reported in the *Pioneer Mail* of May 22, evidence was called to show that a cap and turban were found in the room of a murdered woman, and on these being shown to the dog, he guided the police to the house of the accused. The counsel for the defence objected to the admission of this evidence, on the ground of the impossibility of cross-examining the animal. This question was not actually decided; but the judge remarked: "I feel no hesitation in saying that the employment of trained intelligence of an animal of this description as an aid to detective work should, so far as possible, be confined to the detection of crime or the tracing down of an individual whose whereabouts are unknown, rather than for probative purposes. If the court is asked at the trial to draw inferences of vital importance from the conduct of an animal, it then becomes necessary that the court should have before it expert evidence of the very best description in order that it may feel justified in drawing them with certainty."

IN a paper recently read before the Royal Anthropological Institute, Profs. Seligmann and Parsons discussed a skeleton from one of the Cheddar caves discovered by the late Mr. R. C. Gough in 1877, and associated with bones of extinct animals, including bear, hyæna, bison, rhinoceros, and Irish elk. Stone implements found close to the skeleton are recognised by M. Breuil as belonging to the Magdalenian culture, the latest stage of the Palæolithic period. The prognathism of the skull is slight, and the Cheddar man did not possess the beetling brows of the Mousterian period. He seems to belong to the River-bed race, but this race is at present indistinguishable to the anatomist from the Neolithic people who, at a later period, buried their dead in the long barrows.

THE committee of the Castle Museum, Norwich, in their report for 1913, records a most successful year, the attendance and gate-money being remarkably

good, and the list of additions large. Among the latter are a number of specimens of Indian and African big game, inclusive of a proportion on loan. Nature-study exhibitions formed a feature of the year's work.

IN the report of the council of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, for 1904–10, published in vol. iv., part 1, of the new series of Transactions, attention is directed to the serious falling off in the number of members, which at that date was only 395. Had it not been for the Crawhall bequest of 6000*l.*, the position of the society would have been serious, and the maintenance, to say nothing of the improvement, of the museum jeopardised.

VARIOUS kinds of interesting "animals" and birds in the Zoological Gardens form the subject of an illustrated article in the July number of the *Children's Magazine*, issued by the publishers of the "Children's Encyclopædia." Most striking of all is a photograph of the long-beaked echidna of New Guinea, despite the circumstance that the creature is referred to merely as the "egg-laying echidna," without regard to the fact that it represents a genus apart from the ordinary echidna, and also that it is alluded to "as a link with the ancient reptiles before the mammals came."

ACCORDING to the Annual Report on Sea-Fisheries, issued, in two parts, on June 19, the value of the catch landed in England and Wales during 1913 was no less than 10,337,000*l.*, an increase of considerably more than a million over that of the previous year, which was the highest on record. Exclusive of "shell-fish," the weight of the food thus gathered amounted to something like 16,000,000 cwt., a very considerable proportion of the increase over 1912 being due to the prodigious take of herrings. A portion of this immense food-supply was diverted from the British Isles to go to foreign—mainly Dutch—ports, where a brisk and increasing trade in this commodity has sprung up of late years.

ALBEIT reported to be somewhat unwholesome, hilsa (*Clupea ilisha*) is by far the most succulent and tasty native fish served, during the rainy season, at Calcutta tables. With a view of increasing the supply, attempts at artificial propagation of the species were made in Bihar in the autumn of 1911 and 1912, when the fish are ascending the big rivers. These, however, according to a report by Mr. T. Southwell in a recent issue of the *Bihar Agricultural Journal*, proved unsuccessful, partly owing to the lack of ripe fish, and partly to the fact that the natural breeding places have not yet been discovered. Other attempts, on the lines of the shad-hatcheries in the United States, are to be attempted.

MR. J. H. ORTON, one of the naturalists of the Marine Biological Association's Laboratory at Plymouth, has for some time past been engaged in a comparative study of the ciliary mechanisms of various invertebrates and protochordates, and his latest contribution to the subject appears in a recent number of the Journal of the association (vol. x., No. 2). Mr. Orton shows that the "gill" in such widely separated animals as Crepidula, Lamellibranchiate Mollusca, Ascidians, and Amphioxus, is in the main an organ for collecting food and passing it to the alimentary canal. His views with regard to the mechanism of the process differ somewhat from those of certain earlier observers. Apparently the endostyle serves merely to secrete mucus and sweep it into the gill filaments, not as a food channel. One of his most interesting results is the discovery of an "endostyle" in the gasteropod Crepidula, which histologically closely resembles that of Amphioxus, and thus constitutes an extremely interesting case of convergent evolution.

IN NATURE of June 4 (p. 350), Lieut.-Col. Manners-Smith challenged some statements as to the destruction of bird-life in Nipal, made by Sir H. H. Johnston in an article on "The Plumage Bill," contributed to our issue of December 11, 1913. Sir Harry Johnston based his remarks partly upon reports by Mr. C. William Beebe, curator of birds, New York Zoological Society; and he has now sent us a letter from Mr. Beebe, from which we print the following extract:—"In that part of my pheasant monograph which deals with the pheasants and tragopans of Nipal, I have spoken of the havoc which the Nipalese shepherds are working, at least in the eastern part of the country. This I know from my own observations. There seems practically no way to put an end to the trapping of these men which goes on throughout the year. When I was in Calcutta, I was shown large boxes and bales of pheasant and other skins being exported for sale to milliners. The British officials told me that they were powerless to interfere, as the freight was sealed by the Rajah of Nipal's Government, and they, of course, had no authority to stop the exportation of goods from an independent country."

THE Hawaiian Volcano Observatory, which was built in 1812 on the edge of the crater of Kilauea, near the well-known Volcano House, is doing most useful work under the direction of Dr. T. A. Jaggar. Every week a bulletin appears giving an account of all changes taking place within the crater, and the varying activities of the several vents within it. The observatory was built, and is supported by, subscribers belonging to the Massachusetts Institute of Technology, and by other voluntary helpers in the Hawaiian Islands. The Whitney Laboratory of Seismology, which is established in the basement of the observatory, is furnished with the improved Omori seismometers and tromometers, their records being published in the same weekly bulletin. Scientific men desirous of carrying on vulcanological investigations are welcomed by the board of directors, and recently the facilities afforded at the observatory have permitted of very valuable observations being made on the gases emitted from the vents. The bulletin, of which, in its collected form, a second volume is being published, can be supplied to annual subscribers and to workers in vulcanology and seismology, as well as to scientific libraries in exchange for other publications.

IT may be interesting to note that while, generally speaking, the second half of April last was "very

dry" in this country, very heavy rains accompanied by much flooding occurred generally over the Argentine Republic. An article by Mr. R. C. Mossman in *Symons's Meteorological Magazine* for June states that between April 21 and 27 from 8 to 14 in. of rain fell during a cyclone in the northern parts of that country, the maximum daily falls being from 8½ to 9 in. Mr. Mossman states that although similar intensity has occurred locally in previous floods, it is not thought that such a widespread rainstorm has occurred before. Owing to difficulties of road transit it has been impossible in many instances to get the maize crop to the railway stations, with the result that an enormous deficit is already apparent in the receipts of the various railway companies.

IN the Journal of the Washington Academy of Sciences for June 4, Mr. F. E. Wright, of the Geophysical Laboratory, gives a *résumé* of the methods hitherto available for the determination of the index of refraction of a small drop of a liquid, and describes some interesting improvements he has introduced. One of these enables the index to be determined with an ordinary petrographic microscope to one unit in the third decimal place. It depends on the use of a stage refractometer made from a small sheet of optically dense lead glass, the upper surface polished, the lower parallel surface matt, and the edge bevelled to make an angle of 60° with the former surfaces. The sheet is cut in two by a plane perpendicular to the bevelled edge, one-half turned over, and the two bevelled edges brought together. Between them the drop is placed, and the boundary between the transmitted and totally reflected portions of the field, is read on the eyepiece scale, which is calibrated by the help of standard liquids. A simple device which enables the Abbe-Pulfrich refractometer to be used with light incident at the grazing angle, even with a small drop of liquid, is also described.

IN the *Atti dei Lincei* (vol. xxiii., p. 523) Prof. L. Marino and F. Gonnelli describe a modification of the ordinary Kjeldahl method for estimating nitrogen based on the pronounced catalytic activity of vanadium oxide. It is shown that, by carrying out the ordinary decomposition process with sulphuric acid in presence of potassium sulphate and a trace of vanadium pentoxide exact results are obtained in a large number of cases. The process suggested is recommended when the ordinary Gunning process is carried out with difficulty, or in cases where the use of mercury gives rise to mercury-ammoniacal compounds which resist decomposition. It is shown by special experiments that vanadium, even when present in quantity, does not retain even traces of ammonia.

THE *South African Journal of Science* (March, 1914) contains a paper by Dr. C. F. Juritz on the chemical composition of rain in the Union of South Africa. This forms part of a scheme for the world-wide and systematic examination of rain-water from the point of view of both composition and total rainfall, and more particularly as regards the nitrogen brought into the soil in the form of rain. The data are as yet somewhat incomplete, but it appears that in general more nitric nitrogen is brought down by the summer than by the winter rains, and the same is true of the nitrogen in the form of ammonia, although the rule is sometimes reversed. The total nitrogen per acre in the rainfall of South Africa ranged from 1·5 to 6·2 lb. per annum. The chlorine was abnormally high in some instances, amounting in the Durban districts to 60–70 lb. per acre.

IN the current number of the *Comptes rendus* of the Paris Academy of Sciences is a paper by Otto Scheuer on the reduction of carbon monoxide by hydrogen in the presence of radium emanation. Starting with 240·122 c.c. of a mixture of these two gases containing 43·71 per cent. of hydrogen, after nineteen days the volume was reduced to 217·332 c.c., representing a loss of 1·8 c.c. per Curie-hour. The analysis of the residual gas gave figures consistent with the assumption of the formation of methane, with possibly a little ethane. The gaseous mixture contained neither methyl alcohol nor formaldehyde, but from the appearance of a minute solid deposit in a second experiment the author concludes that formaldehyde may be the primary reduction product, this being finally reduced to methane. The reaction is accompanied by the formation of water.

Engineering for June 26 contains an illustrated article dealing with Mr. F. Baines's report on the condition of the roof timbers of Westminster Hall. Mr. Baines demonstrates the necessity of large and effective repair, and discusses the proper treatment that will give to the roof the necessary strength and support without injuring its historical character or archæological features. Tender regard for the ancient work overthrows all proposals for securing the roof by piecing up defective members, and a system of steel reinforcement has been approved as the most suitable course. Supposing the timber decay to continue, the loads would be borne by the steel reinforcement, and the possibility of complete collapse would be eliminated. An entire truss of steel will be added to the existing timber work, of sufficient strength to support the whole of the present roof, together with the weight of the steel-work itself, so as to bring the total weight of the strengthened roof to a safe and satisfactory bearing on the walls. Both walls and foundations are strong enough to bear the additional weight of the steel and to resist any possible outward thrust such a weighty reinforcement might produce. The work will take six years to execute.

A SECOND edition of Dr. A. Harden's monograph on "Alcoholic Fermentation" has been published by Messrs. Longmans, Green and Co. The first edition was reviewed in the issue of NATURE for June 29, 1911 (vol. lxxxvi., p. 579); and though no change has been made in the scope of the work, the rapid progress of the subject has rendered necessary many additions to text, and an increase in the bibliography.—The Society for Promoting Christian Knowledge has published a second edition of Canon McClure's "Modern Substitutes for Traditional Christianity." The first edition was reviewed in NATURE on March 26, 1914 (vol. xliii., p. 81), and it will be sufficient

to say of the present edition that it has been revised and has added to it a chapter on modernism, which is also issued separately, price 6*d*. net.

A SECOND edition of their List No. 52 has been issued by Messrs. A. Gallenkamp and Co., Ltd., of Sun Street, Finsbury Square, London, E.C. The catalogue deals in an exhaustive manner with charts, diagrams, lanterns, and lantern slides, botanical and hygenic models, and other requirements of lecturers and teachers. The list brings together in a convenient manner the publications, and so on, of a great variety of firms, and will save intending purchasers much time and trouble. Even a glance through these well-illustrated 200 pages is enough to show the wealth of pictorial illustration now at the disposal of lecturers.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JULY :—

July 2. 11h. om. Earth at greatest distance from the Sun.
8. 23h. 27m. Uranus in conjunction with the Moon (Uranus 1° 42′ N.).
9. 19h. 14. Jupiter in conjunction with the Moon (Jupiter 0° 32′ N.).
16. 6h. om. Mercury in inferior conjunction with the Sun.
20. 2h. 43m. Saturn in conjunction with the Moon (Saturn 5° 59′ S.).
21. 2h. om. Neptune in conjunction with the Sun.
,, 19h. 46m. Mercury in conjunction with the Moon (Mercury 8° 37′ S.).
22. 10h. 50m. Neptune in conjunction with the Moon (Neptune 3° 43′ S.).
25. 18h. 24m. Venus in conjunction with the Moon (Venus 1° 52′ N.).
26. 4h. 33m. Mars in conjunction with the Moon (Mars 2° 7′ N.).
,, 17h. om. Mercury stationary.

THE RADIATION OF THE SUN.—The Journal of the Franklin Institute for June (vol. clxxvii., No. 6, p. 641) publishes an article on the "Radiation of the Sun," being an address presented by Prof. C. G. Abbot at the meeting of the section of physics and chemistry. The article is popularly written, and displays the general nature of the problem of solar radiation, and the different researches which have and are being pursued to elucidate the knotty points. Interesting photographs, diagrams, and curves accompany the text, and the name of the distinguished author is a guarantee of the accuracy of the information given. Articles such as the above are most valuable to those whose work in astronomy lies along other lines, but who keenly desire to be posted on the progress of the researches of workers in other branches of the subject.

DISPLACEMENT OF THE LINES TOWARDS THE VIOLET IN THE SOLAR SPECTRUM.—Dr. T. Royds, acting director of the Kodaikanal Observatory, gives the results of his researches (Bulletin No. 38) in the form of a preliminary note on the displacement to the violet of some lines in the solar spectrum. While the majority of the metallic lines in the solar spectrum are shifted towards the red when compared with their positions in the electric arc, there are, however, many exceptions, and some of these are specially dealt with in this paper, the iron arc spectrum being compared with that of the sun's centre. A full list of the wave-lengths of the lines employed and their intensities in long or short arcs, with other data, accompany the discussion. Summarising briefly the results, it may be stated that the iron lines which are unsymmetrically widened to the red in the arc are displaced to the violet in the sun relative to a short iron arc, and those unsymmetrically widened to the violet are displaced to the red. Symmetrical lines give normal displacement to the red. The change of wave-length of certain classes of iron lines is caused in a way other than by pressure or motion in the line of sight. The unsymmetrical iron lines are displaced in the short arc compared with the long arc. Those widened towards the red are displaced to the red in the short arc, and those widened towards the violet to the violet, whilst symmetrical lines have mostly small displacements. Differences in the density of vapour is suggested as a possible cause of the displacement between the different kinds of arc; but the matter, as Dr. Royds remarks, requires further investigation. The longer the iron arc, the more nearly do the conditions approach those in the reversing layer of the sun. Lines of other elements than iron also have sun minus arc displacements, which cannot be explained as due to pressure or line of sight motion.

METEORS ON JUNE 25–26.—Mr. W. F. Denning writes us that, though meteoric phenomena are seldom displayed abundantly on a June night, he observed some strikingly brilliant and interesting meteors on Thursday, June 25. At 10.39 a 2nd magnitude was seen nearly stationary, and close to its radiant at 269°+46°. At 10.52 a fine meteor, exceeding 1st magnitude, crossed τ Herculis and θ Draconis in a rapid flight, and left a transient streak. Radiant at 260°−24°, and height of object forty-eight to forty-four miles; path, fourteen miles, and velocity twenty miles a second. At 11.28 a bright meteor equal to Venus fell about 6° to the right of α Andromedæ, and left a streak. Its radiant was at 342°+39°, and its height fifty-one to twenty-five miles, path forty-five miles, and velocity thirty miles a second. At 11.52 a meteor equal to Jupiter glided down the eastern sky about 2° to the left of α–β Pegasi, its flight being as nearly as possible parallel with those stars. Graceful, slow motion, there was no trace or streak, yellow nucleus. Radiant at 354°+77°, and height fifty-nine to twenty-three miles. Path, forty-six miles; velocity, eighteen miles a second. At 11.58 another meteor equal to Jupiter shot swiftly upwards in the eastern region of Cygnus, leaving a bright phosphorescent streak for several seconds. Its radiant was on the eastern horizon at 350°−8°, and its height sixty-seven miles; path, fifty-two miles, and velocity, about fifty-two miles a second. At 12.57 a 3rd magnitude meteor with a streak was directed from a radiant at 24°+42°, and at 12.58 a very slow 2nd magnitude was seen in Camelopardalus moving from the direction of Ursa Major. Others were observed, and the sky remained beautifully clear during the night. The heights, etc., of the several meteors given are computed from duplicate records obtained by those enthusiastic observers, Mr. and Mrs. Wilson, of Bexley Heath, Kent.

REPORT OF THE U.S. NAVAL OBSERVATORY FOR 1913.—The report of the superintendent of the U.S. Naval Observatory for the fiscal year 1913 forms Appendix 2 to the annual report of the chief of the Bureau of Navigation, 1913. Commencing with the interesting statement that "this observatory, being the first institution in the world to have its time signals regularly transmitted by radio-telegraphy," the superintendent proceeds to describe the part played by the delegates appointed to represent the United States at the Inter-

national Time Conference which was held in Paris in October, 1913. Reference is next made to the arrangements for the determination of the difference of longitude between the observatories of Paris and Washington using the Eiffel Tower and Arlington as the radio stations for the transmission of the signals. A suggestion is made that owing to the great range of the signals to be sent out from Arlington, advantage will be taken of these signals by other institutions to determine their own longitude. The replies to the issue of a circular letter giving information concerning the special signals have indicated that a number of institutions widely scattered in the United States will utilise the opportunity offered. The report then describes the work carried out during the past year in the different instrumental divisions. These relate to the 9-in. transit circle, 5-in. altazimuth instrument, 6-in. transit circle, 26-in. and 12-in. equatorials, photoheliograph, etc. The reduction work is next summarised, followed finally by that of the department of compasses, chronometers, and other nautical and surveying instruments.

TRADE AND TECHNICAL EDUCATION IN FRANCE AND GERMANY.[1]

THE interesting and important report recently presented to the Education Committee of the London County Council by one of its officers, specially deputed to make the inquiry, on recent developments in the provision of continued and specialised education in France and Germany, deserves the closest attention of all who are seriously concerned with the educational well-being of the children of the United Kingdom, and with the conditions necessary to the maintenance in the highest state of efficiency of our industries and commerce.

The report confines itself to the educational activities of four great cities, namely, Paris, Munich, Leipzig, and Berlin, dealing especially with measures having for their object the continued education of the child on leaving the elementary school, the thorough technical training of the apprentice, and the adequate preparation of the capable young workman or business man for positions of responsibility and leadership.

The question of the higher scientific and technical training is only incidentally treated, its ample provision, especially in the case of Germany, being fully recognised.

The report is, therefore, devoted in the main to the facilities offered in specialised and monotechnic schools, whether day or evening, dealing with specific trades and industries, of which the city of Paris affords abundant illustration in its apprenticeship schools and in its schools of applied design, the work of which was a most interesting feature of the educational section of the Paris Centennial Exhibition of 1900.

But the chief interest of the report is to be found in its description of the provision made, in the three important German cities named, for the continued effective education of German youth on leaving the elementary school and entering upon their respective occupations, "blind alley" or otherwise.

Much stress is laid upon the successful working of the Imperial Law of Industry, establishing compulsory continuation schools, applying especially to all boys on leaving school at fourteen years of age and requiring attendance from six to nine hours a week over a session of forty weeks during a period of three or four years—time for which must be provided by the employer within the usual hours of labour.

[1] Trade and Technical Education in France and Germany. Report by J. C. Smail, Organiser of Trade Schools for Boys, London County Council. (Westminster: P. S. King and Son.) Price 1s.

The result has been, notably in Berlin, Munich, and Leipzig, that provision has been made for almost every class of occupation, skilled and unskilled—the instruction dealing not only with vocational needs, but also preparing the boy for his future responsible domestic and public duties.

Evidence is forthcoming that after a period of doubt and difficulty employers are beginning to appreciate the value and advantage of this continued education and training, though it is somewhat disconcerting to learn that in 1912 in Berlin there were proceedings pending, either on account of school neglect or of offences against school laws under this Act numbering 6,448.

In England, not to speak of the girl population, only 13 per cent. of the boys between fourteen and seventeen years of age are continuing their education, and even this small percentage attends the continuation classes on the average only fifty-eight hours per annum, whilst in Munich virtually all boys engaged in occupation are in the continuation classes and receive 375 hours' instruction per annum for a period of four years. Much praise is given to the admirable facilities existing, especially in the cities of Munich and Leipzig, for the effective training of the commercial and industrial rank and file.

The leaders of German thought and business enterprise are persuaded that in the best interests of the nation all ranks of the industrial army must be thoroughly trained, not only vocationally, but as citizens. They do not fear that they will be less able to compete with their industrial rivals, but, on the contrary; and unless we are prepared to better their example we cannot hope to maintain the industrial and commercial pre-eminence we now enjoy.

We have still to abolish half-time for young children now at school, and to adapt our factory and workshop organisation to conditions which shall secure the educational well-being of the children employed therein.

J. H. REYNOLDS.

MARINE BIOLOGY IN THE TROPICS.[1]

THE Department of Marine Biology of the Carnegie Institution of Washington has issued in this fifth volume of contributions from its laboratory on the Tortugas, near Florida, a number of important papers. Three of these deal with the origin of Oolitic rocks, such as those of the Bahamas and of Florida, and inferentially with the origin of oolitic structure in other deposits. The first paper is the last work of a brilliant English investigator, Mr. G. H. Drew, whose recent death has deprived marine biology of one of the most original and fertile workers, and to whose memory the director of the department, Mr. A. G. Mayer, contributes a sympathetic and appreciative notice. Drew's memoir deals with the action of denitrifying bacteria in the tropical seas, and also with the precipitation of calcium carbonate by marine bacteria. Though necessarily incomplete, the results are a fine contribution to the difficult subject of marine bacteriology. They show that the reason why marine plankton is less abundant in the tropics than in temperate seas lies in the rapid and complete action of the denitrifying organisms in the warmer parts of the ocean; and Drew was able also to point to the extraordinary interest and importance of *Bacterium calcis* in inducing such precipitation of the calcium carbonates as to give rise to nodules of chalk. He suggests that chalk and oolitic rocks have been formed in shallow seas and are being produced round the Bahamas by this peculiar bacterial action.

[1] Papers from the Tortugas Laboratory of the Carnegie Institution of Washington. Vol. v. Pp. 222+plates+maps. (1914.)

This mode of rock origin was suggested by Dr. Wayland Vaughan in 1912, and he contributes a further paper on the subject, and on the geology of the Bahamas in the present volume. It appears therefore as a companion paper to the work of Drew, and both should be read by those who wish to realise how bacteriology and marine research are throwing light on the problems of geology. Dr. Vaughan also contributes a memoir on the origin of the coral reefs on the Florida coast with especial reference to the origin of the atolls of that district. His main conclusion is that atolls are formed "not by solution of an interior mass of limestone, but by constructional geologic processes."

Careful systematic studies of the Polyzoa of the Tortugas Islands and of Jamaican Echinoids have been made, and the result should be of interest to systematists. Of more general importance is a study of mammalian spermatogenesis, curiously out of place in a publication of this kind, and therefore likely to be overlooked by workers on this subject. Prof. H. E. Jordan, who contributes this paper, comes to the conclusion that in several mammals examined the spermatozoa are not all alike, but, as in certain other groups of animals, fall into two classes. Amongst the mammals exhibiting this important peculiarity are white mice, sheep, horse, mule, bull, and dog. In man the evidence is at present contradictory and difficult properly to assess. The importance of this subject lies in its bearing on the theory of sex determination.

The last paper we have space to refer to concerns the habits and power of regeneration in sea-fans or Gergonians, a group of corals which have been little studied in a living state. The establishment of a marine laboratory in the tropics now permits these and many other neglected subjects to be more fully investigated, and under the directorship of Dr. A. G. Mayer there is every reason to believe that important biological advances will be made.

TERMITES AND THEIR HABITS.

TWO interesting papers on termites and their habits, by Mr. T. Petch (reprinted from the *Annals* of the Royal Botanic Gardens, Peradeniya, November, 1913), have reached us. The author has already made a special study of the fungi which grow in termite nests, and not only serve as food for the insects, but are also frequently cultivated by the latter, and undergo remarkable changes in form and mode of growth as the result. The first paper deals with a supposed association of white ants with a mushroom-like fungus, and though the facts are not yet definitely established, it would seem probable that after a period of cultivation in the termite nest this fungus loses its vigour, and in order to remedy this defect the termites carry spherical masses of the fungus up to the surface and plant them out in places where they will develop spores, which the termites convey back to the nest as "seed" for a new fungus crop.

The second paper is an extended study of the habits of the Ceylon black termite (*Eutermes monoceros*), which usually builds its nest in hollow trees. The nest contains a single comb, and consists of thin, tortuous plates, irregularly united to form a sponge-like mass with wide passages separated by thin walls; its substance is composed of excrement, fragments of the epidermis of various plants, fungus threads, and spores, and crystals, and the same mixture is found in the stomachs of the workers and soldiers. After describing the process of nest-building, the remarkable organised foraging processions, etc., the author states that lichens form the staple food of the black termite, and that they prefer lichens with loose texture and powdery surface (crustaceous lichens); they prefer algæ, but as the supply of these is small in comparison with the extensive growths of lichens on tropical trees, they evidently eat the lichens for the sake of the contained algæ, and not the fungal constituent, since they rarely touch fungi even when no other food is available.

THE AUSTRALASIAN ANTARCTIC EXPEDITION, 1911–14.[1]

THE object of the expedition was to investigate the Antarctic regions to the southward of Australia, a locality where the hypothetical Antarctic Continent was supposed to extend far to the north, but concerning which only the most meagre information was at hand. Most of the expeditions of late years have had as their objective the South Pole. Consequently, in order to secure the most promising route, their geographical fields have much overlapped, and the area of the unknown has not diminished commensurably with the magnitude of those undertakings.

There is still a vast unknown at the southern extremity of the globe, and, now that the Pole is reached, it is hoped, in the interests of science, that no further consideration will arise to cause future expeditions to follow upon each other's tracks, until at least a superficial knowledge of the whole has been attained.

It was our intention to land several self-contained wintering parties at widely separated points between longitude 90° E. and 150° E., each to make continuous scientific records at the base-station, and to investigate the surrounding region by sledge journeys. On the southward voyage, a party was also to be left at Macquarie Island, a little-known possession of the Commonwealth. Wireless telegraphy was to be used for the first time in Polar exploration, our Macquarie Island station transmitting Antarctic news to Hobart.

The vessel selected and fitted for the work was the *Aurora*, with a carrying capacity of about 600 tons. The ship sailed from Hobart on December 2, 1911.

Macquarie Island, a sub-Antarctic possession of Tasmania, situated in the same latitude as South Georgia, was sighted on December 11. There exists there but one main island around the shores of which are many rocky reefs and islets. Rocks also appear for many miles to the north and south rising from a submarine ridge, which is the submerged continuation of the main island itself. The habitable island has a length of more than 20 miles and greatest breadth of $3\frac{1}{2}$ miles. The chief vegetation is tussock grass and Kerguelen cabbage, but it abounds in a truly wonderful population of birds and animals.

At one time the island was a favourite haunt of the valuable fur seal, but for fifty years or more only odd specimens have been seen. The ruthless slaughter of the early sealers is responsible for this almost complete extermination. Sea elephants, however, are numerous, the bulls being met with up to 20 ft. in length and weighing probably some 2 tons.

Very little accurate information was known concerning the island, and the only available map preceding Blake's survey was a sketch made by a sealer. Rumours of the existence of wingless parrots and other continental forms of life indicated that perhaps Macquarie Island was the last remaining summit of a vast sunken southern land. Other evidence also suggested that probably at one time such a land existed uniting Australia with the Antarctic Continent. There was, indeed, an interesting field for scientific work.

Steaming south from Macquarie Island, the first ice

[1] From a paper read before the Royal Geographical Society on June 9 by Sir Douglas Mawson.

was met in lat. 64° S., and in lat. 65° 40′ S., the pack became impenetrable.

Progress to the south was made when the conditions permitted. During the afternoon of January 6 an ice cliff loomed up ahead, extending to the horizon in both directions. This proved to be an immense barrier tongue—afterwards named the Mertz glacier—pushing 60 miles out to sea from a great ice-capped land. This land, along which we steamed during the next two days, had never before been seen. Its continuity with Adelie Land was subsequently proved, and it was then decided to include our new discoveries under the same title.

The land rose up everywhere from the sea to form a plateau. Only rarely did portions of the rocky platform break through the ice-sheet. Numerous rocky islets fringing the coastline were a notable feature, and these formed admirable breeding grounds for marine birds.

At a point some miles from the nearest portion of D'Urville's Adelie Land a suitable spot was discovered for a wintering station. This was a rocky outcrop, a little more than a mile in extent, henceforth known as Cape Denison. In this locality rocks projected from under the ice-sheet within a sweeping indentation of the coastline, which we named Commonwealth Bay.

Although summer was at its height, the weather proved little better than a succession of gales directed off the land, veering between south and south-east. This state of things greatly hindered landing operations. We were fortunate in finding an excellent boat harbour at Cape Denison, between which and the ship the invaluable motor launch continually plied whenever the weather was propitious. By January 19 the whole of the stores and gear of the main base were transferred to the shore.

The *Aurora* steamed west for a day along the coast seen by D'Urville and Wilkes in 1840, until the limit of open water was reached. This stretch of navigable water we named the D'Urville Sea. Later we discovered that its freedom from ice is due to the persistent gales setting off the land in that locality.

The coast of Adelie Land could be traced in a westerly direction, but, on account of heavy pack, the vessel could not follow along the coast, the only course being to skirt the heavy ice to the north and west. At this point Capt. Davis expected to sight the high land reported by the United States Squadron (1840) as lying to the west and south-west, but no land was seen.

In long. 132° 30′ E., they were able to stand south again and shortly afterwards passed over the charted position of D'Urville's Côte Clarie. Quoting from Capt. Davis's report: "The water here was clear of pack ice, but studded with bergs of immense size. The great barrier which had been followed for 60 miles by the French ships in 1840 had vanished—nothing remained to mark its former position except a collection of huge bergs.

"At 10 a.m., having passed to the south of the charted position of Côte Clarie, we altered course to S. 10° E. true. Good observations placed us at noon in 65° 2′ S. and 132° 26′ E. with a sounding of 160 fathoms on sand and small stones. We sailed over the charted position of land east of Wilkes' Cape Carr, the weather was clear and there was no trace of land to be seen in this locality."

A few hours afterwards, still steaming south, new land was sighted to the south—icy slopes rising from the sea similar to those of Adelie Land, but of greater elevation.

To this discovery we gave the name of Wilkes Land, to commemorate the name of a navigator whose daring was never in question, though his judgment as to the actuality of *terra firma* was untrustworthy.

It was not until noon on January 31 that the atmosphere was sufficiently clear to see any distance. The ship was then pushing south amongst heavy pack ice in the vicinity of Sabrina Land. A portion of Balleny's Sabrina Land was sailed over, and there was no indication of land in the vicinity. Finally a point was reached 7 miles from a portion of Wilkes's Totten's Land, reported to be high land. A sounding gave 340 fathoms. The weather was clear and high land would have been visible at a great distance. It was therefore apparent that Totten's Land either does not exist at all or is situated some distance from its charted location. The pack was too heavy for the ship to penetrate further to the south, so a course was set to the west. Heavy pack barred the way to the south.

Some days after, the vicinity of Knox Land, of Wilkes' charts, was reached. With the exception of Adelie Land, which the French sighted some days previous to the Americans, the account by Wilkes concerning Knox Land is more convincing than any of his other statements relating to new land.

If not already disembarked, we had counted on settling our Western Base in this place. It was, therefore, very disappointing when heavy pack ice barred the way, at a point still north of Wilkes's furthest south in that locality. Repulsed from his attack upon the pack ice in that vicinity, Captain Davis decided to go still further west. The course made carried the ship to the north-west. Early on the morning of February 8, in foggy weather, a wall of ice about 80 ft. high appeared across the bows extending in a north-westerly direction. Following this along, the weather cleared, and it was recognised to be the face of an extensive flat-topped mass of floating ice. Rounding a cape to the west, and passing through loose ice, open water was reached to the south. Fifty miles in that direction the sea was found to shallow rapidly and a maze of large grounded bergs was entered. The bottom was found to be very regular, ranging between 110 and 120 fathoms.

The last of the obstructing ice was negotiated on February 13, and the ship steamed into a broad sheet of water still stretching to the south. This open sea inside the pack-ice belt we ascertained, later, to be a permanent feature of that vicinity, and to it I gave the name of the Davis Sea, after the intrepid captain of the *Aurora*.

One hundred miles further to the south, in lat. 66° S. and long. 94° 23′ E., the icy slopes of new land were seen extending east and west as far as the eye could reach. The sphere of operations of the German Expedition of 1902 was now near at hand, for their vessel, the *Gauss*, had wintered frozen in the pack about 125 miles to the west. The land to the south, which the Germans visited by sledge journey over the pack ice, was eventually proved by one of our own sledging parties to be continuous with the new land now sighted by the *Aurora*. The "high land" in the direction of Wilkes's Termination Land, seen by the Germans during a balloon ascent, we found to be a high ice-sheathed island about nine miles in diameter. To this we gave the name of Drygalski Island. The position marked for Termination Land on Wilkes's charts we found to be occupied by pack-ice and a barrier-ice formation (marginal shelf ice).

The formation in question, trending about 180 miles to the north from the newly discovered land just referred to, was found to be very similar in character to the well-known Ross Barrier over which lay part of Scott's and Amundsen's journeys to the south pole. This we named the Shackleton Ice Shelf. Its height is remarkably uniform, ranging between 60 and 100

or more feet. Making allowance for the average specific gravity, this indicates an average total thickness of perhaps 600 ft. In area it occupies many thousands of square miles.

This wonderful block of ice originates fundamentally from the glacier-flow over the great plateau-land to the south. Every year an additional layer of consolidated snow is added to its surface by the frequent blizzards. These annual additions are clearly marked on the dazzling white face near the brink of the ice-cliff. However, there is a limit to this increasing thickness, for the whole mass is ever moving slowly to the north, driven by the irresistible pressure of the land-ice behind. Its northern face is crumbling away before the action of the sea, breaking down into bergs and brash-ice.

Its present limits are, no doubt, in a state of temporary equilibrium, in which the crumbling keeps pace with the yearly advance. During the third voyage of the *Aurora*, we had the unique experience of witnessing this crumbling actively at work. This happened as we were steaming along within 300 yards of the cliff face. Suddenly a mass weighing perhaps a million tons broke away, first sinking down into the sea. Then followed an interval of a few minutes, during which it majestically rose and sank alternately accompanied by a rapid splitting up. At the end of five minutes only small bergs and brash-ice remained.

A position for the landing of the western party was chosen on the Shackleton ice shelf. The spot selected was about seventeen miles from the land itself—the nearest approach possible by the ship.

At the main base station in Adelie Land, the hut was quickly erected and self-recording instruments housed and set running without delay. The average wind velocity in Adelie Land proved to be far beyond anything previously known. The charts of the self-recording instruments show the average for the whole year to be fifty miles an hour. Average hourly velocities of one hundred miles and more were common, and twenty-four hourly averages of more than ninety miles were recorded. Frequently the air travelled forward in a series of cyclonic gusts, near the foci of which momentary velocities were reached very much higher than the averages mentioned. Thus, pebbles were lifted and structures not buried in the *névé* thrown down.

Fortunately, the hut was soon drifted over to such an extent that only a portion of the roof remained above ground. Entrance to the interior was effected in fine weather by a trap-door in the roof; at other times through tunnels in the *névé*.

For months the drifting snow never ceased, and intervals of many days together passed when it was impossible to see one's hand held at arm's length. The drift-snow became charged with electricity, and in the darkness of the winter night all pointed objects and often one's clothes, nose, and finger-tips glowed with the pale blue light of St. Elmo's fire. Add to this, the force exerted upon the body, the indescribable roar of the hurricane, the sting of the fury-driven ice particles, and the piercing cold, and some idea is got of the conditions under which the routine of outdoor observations was maintained. Such weather lasted almost nine months of the year. Even in the height of summer, blizzard followed blizzard in rapid succession.

It was not until November 7 that there was sufficient moderation in the weather for a final start. Five diverging parties worked simultaneously, so that a maximum of new ground was covered during the comparatively short sledging season.

The Near-East Journey.—Stillwell, assisted by Close and Laseron, mapped in the coastline to the east as far as the Mertz Glacier. Stillwell's map illustrates the immense number of rocky islets that fringe the mainland in that vicinity. There silver petrels, Antarctic petrels, Wilson petrels, snow petrels, cape pigeons, etc., were found nesting in large colonies.

The Eastern Journey.—Further east Madigan, assisted by McLean and Correll, continued the work, reaching 67° 14′ S. lat., and 150° 21′ E. long. Eastward of the Mertz Glacier they found the sea frozen, and travelled over it for the remainder of the journey, crossing the fifteen miles wide tongue of the Ninnis Glacier and visiting several headlands by the way. In the vicinity of the Horn Bluff there is a sweep of coastline bounded by rocky cliffs, 1000 ft. high. There they discovered coal and carbonaceous shales outcropping at an elevation of several hundred feet, associated with Red Sandstone and capped by an immense thickness of columnar dolerite. Madigan made frequent determinations of magnetic dip and azimuth. Nearer to winter quarters only gneiss and schists are exposed. The new land east of the Mertz Glacier we have received his Majesty's gracious permission to name King George V. Land.

The Far-East Journey.—It was across King George V. Land that Ninnis, Mertz, and I made the sledging journey that ended so unfortunately in the deaths of my two companions. It was our intention to cross rapidly the coastal highlands to the south of the tracks of Madigan's party, and to pick up the coast beyond where they could expect to reach. On December 14, when we had travelled outwards 311 miles, and were crossing the coastal highlands in 68° 54′ S. lat., 151° 33′ E. long., Ninnis, with his dog team and sledge, broke through the roof of a *névé*-covered crevasse and fell into an unfathomable depth below. About midnight on January 7–8 Mertz passed away, after having been in a delirious and unconscious state for some hours.

My own condition was such as to hold out little hope, but I determined to push on to the last, anticipating that at least a record might be left near Aurora Peak, a place likely to be visited by search parties. On January 11, after spending three days, during which particularly bad weather prevailed, in arranging everything to facilitate forward progress, I resumed the march alone. After three weeks' creeping forward wherein most providential escapes from crevasses were experienced, I had the good fortune to stumble upon a cache of provisions. Stimulated by good food, the march was resumed. Eventually the 5½ mile cave was reached. Then a strong blizzard, reaching a velocity of eighty miles an hour caused further delay. The wind fell off on February 8. Descending the ice slopes to the hut, the *Aurora* was visible on the horizon, outward bound.

The Southern Journey.—Of summer sledging parties from the main base, one was led by Bage to the south, inland over the plateau, and another led by Bickerton over the highlands to the west. Bage's companions were Webb and Hurley. Murphy, Hunter, and Laseron formed a supporting party accompanying them for sixty-seven miles. After leaving the coast no sign of rock was seen, their track lying over a desolate wind-swept plateau. The wind seldom ceased, and drifting snow was the rule. This constant flow of air has cut in the plateau surface deep sastrugi, of such dimensions as are not met with elsewhere. Over those obstacles they dragged their sledges into the face of the wind for 300 miles out from the hut, to a point within a few miles of the magnetic pole. There an elevation of 6500 ft. was reached. On one occasion they made a march of forty miles. The magnetic data from that journey are particularly valuable, for Webb took full sets of observations for dip and azimuth at regular intervals.

The Western Journey.—Hodgeman and Whetter

with Bickerton, formed the western party. The western journey was conducted for the most part at an elevation of about 4000 ft., and proved very dreary. Wind and drift were the rule, notwithstanding the fact that it was then the height of summer. The average wind velocity for the period of the whole journey, as calculated from the daily records, was thirty-four miles an hour.

The party passed over the highlands of the Adelie Land seen by D'Urville, coming close to the coast in lat. 66° 35′ S. long., 137° 58′ E., where they saw frozen sea to the west. One of the points of special interest connected with this journey was the finding of a piece of rock[2] a pound or two in weight, lying on the surface of the inland ice sheet far from any nunataks.

Seven of us remained in Adelie Land for a second year. Wireless communication was established with Macquarie Island about the middle of February, 1913, and we were able to apprise the world of the happenings before even the *Aurora* herself had reached Hobart. The wireless proved a success and a boon throughout the year, though temporary stoppages, however, occurred, owing to unusual difficulties arising chiefly from the constant hurricane. For example, it was found difficult to keep the aerial up; difficult to hear the messages on account of the muffled roar of the wind; and often impossible to work on account of the heavy electrical discharge from the atmosphere.

On December 2, the *Aurora* arrived, picking up Ainsworth, Blake, Sandell, and Hamilton *en route*, to relieve us in Adelie Land. With them they brought three new men down to carry on the meteorological and wireless station on account of the Commonwealth Government, by whom the station is to be maintained in the future.

The result of the labours of Ainsworth and his party is that complete scientific information regarding Macquarie Island is now available. Besides the routine work, many new problems have arisen enriching biological, meteorological, and geological literature.

Commonwealth Bay was reached on December 13. Visits were paid to outlying islets, and a considerable programme of oceanographical work and dredging on the continental shelf carried out. Steaming westwards, a new addition was made to the western extremity of Adelie Land. Oceanography and an examination of the Shackleton ice shelf occupied us until February 7, when the pack was finally left behind. On the return journey a line of soundings was secured, completing a section of the ocean floor between Western Australia and Queen Mary Land. Adelaide was reached on February 26, 1914.

SUMMARY OF SCIENTIFIC OPERATIONS.

1. TERRESTRIAL MAGNETISM.

A. *Field Work.*

(*a*) Dip determinations at Macquarie Island, on the eastern and southern journeys from the main base, and on a short journey from the western Antarctic base.

(*b*) Declination by theodolite observations was determined at Macquarie Island and at intervals on all sledging journeys in the Antarctic.

(*c*) Rough observations made daily on the ship.

B. *Station Work.*

(*a*) Regular magnetograph records were kept at the main base for a period of eighteen months. A system of term days for quick runs was also followed; Melbourne, Christchurch, and other stations cooperating. In connection with the magnetograph work, Webb conducted regular absolute observations throughout the year. His work was admirably done in the face of remarkable difficulties in the matter of weather.

(*b*) At the western base Kennedy kept term days through the winter, using a magnetometer and dip circle.

[2] This rock is quite unusual in appearance and may prove on examination to be a stony meteorite.

BIOLOGY.

1. *Station Collections.*

(*a*) At Macquarie Island, Hamilton worked for two years amongst a rich fauna. The forms discovered are not merely those of oceanic types; amongst other things a new native finch has been discovered.

(*b*) At the main base, Hunter, assisted by Laseron, secured a large collection, notwithstanding the obvious disadvantage of bad weather. Dredgings down to 50 fathoms were made during the winter. The eggs of practically all the flying birds known on Antarctic shores were obtained, including those of the silver-grey petrel and of the Antarctic petrel not before known; also a bird and its eggs of an unrecorded species.

(*c*) At the western base, the eggs of the Antarctic and other petrels were obtained, and a large rookery of Emperor penguins located. Harrison did a little marine work from floe, working with inadequate gear in 250 fathoms of water. In this way he succeeded in trapping some interesting fish.

2. *Ship Collections.*

(*a*) A collection made by Mr. Waite on the first sub-Antarctic cruise.

(*b*) A collection made by Prof. Flynn on the second sub-Antarctic cruise.

(*c*) A collection made by Hunter, assisted by Hamilton, in Antarctic waters during the summer of 1913–14. This comprises a number of deep-sea dredgings working down to 1800 fathoms, also regular tow-nettings, frequently serial, to depths of 200 fathoms. Six specimens of the rare Ross seal were secured.

GEOLOGY.

(*a*) A geological examination of Macquarie Island by Blake. The older rocks were found to be all igneous. The island has been overridden comparatively recently by an ice-cap travelling from the west.

(*b*) Geological collections at the main base. In Adelie Land the rock outcrops are metamorphic sediments and gneisses. In King George V. Land there is a formation similar to the Beacon sandstones and dolerites of the Ross Sea. Carbonaceous shales and coaly strata are associated with it.

(*c*) Stillwell collected a fine range of minerals and rocks from the terminal moraine at winter quarters. Amongst them is abundance of red sandstone, suggesting that the Beacon sandstone formation extends also throughout Adelie Land, but is hidden by the ice-cap.

(*d*) Collections by Watson and Hoadley at the western base. Again gneiss and schists are the dominant features

(*e*) A collection of erratics brought up by the dredge in Antarctic waters.

GLACIOLOGY.

(*a*) Observations on the pack-ice.
(*b*) Observations on sledging journeys of the inland-ice.
(*c*) Observations on the coastal glaciers, tongues, and shelf-ice.

METEOROLOGY.

(*a*) Two years' observations at Macquarie Island by Ainsworth.
(*b*) Two years' observations at Adelie Land by Madigan.
(*c*) A year's observations at Queen Mary Land by Moyes.
(*d*) Ship's observations on each of the voyages.
(*e*) Observations on sledging journeys.

BACTERIOLOGY.

In Adelie Land Dr. McLean carried out many months of steady work.

TIDES.

Self-recording instruments were run at Macquarie Island by Ainsworth, and at Adelie Land by Bage.

WIRELESS AND AURORAL OBSERVATIONS.

Very close watch was kept upon auroral phenomena with interesting results, especially in their relation to the permeability of the æther to wireless waves.

GEOGRAPHY.

(1) The successful navigation by the ship of the Antarctic pack-ice in a fresh sphere of action, where the conditions were practically unknown. This resulted in the discovery of new lands and islands.

(2) Journeys have been made over the sea-ice and the continental plateau in regions never before sledged over. At the main base journeys aggregating 2400 miles were made, and at the western base journeys of 800 miles. These figures do not include depôt journeys, supporting parties, or relay work. The land has been followed through 33° of longitude, 27° of which were covered by sledging parties.

(3) The fixing of a fundamental meridian in Adelie Land, using wireless telegraphy.

(4) By soundings the continental slopes, and in most cases the shelf itself, have been indicated through 55° of longitude.

(5) The mapping of Macquarie Island.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LIVERPOOL.—Mr. T. B. Abell has been appointed to the Alexander Elder chair of naval architecture, rendered vacant by the resignation of his brother, Prof. W. S. Abell.

LONDON.—The University College Committee will shortly proceed to appoint a lecturer and demonstrator in anatomy at a salary of 350*l*. Applications must reach the secretary of University College on or before July 11.

MANCHESTER.—Dr. Niels Bohr, of the University of Copenhagen, has been appointed reader in mathematical physics. For some time Dr. Bohr was engaged in research in the physical department of the University of Manchester, and has made a close study of mathematical physics. He has contributed a series of important original papers on the constitution of atoms, molecules, and the origin of spectra. This work has attracted much attention, and has formed the starting point of numerous research now in progress.

SHEFFIELD.—The council of the University has appointed Mr. H. J. W. Hetherington to the post of lecturer in philosophy, in succession to Mr. T. Loveday, resigned.

ON their way home from Australia, the following men of science who are attending the British Association meeting, will, the *Pioneer Mail* states, lecture on the subjects named for the University of Calcutta:—Prof. H. H. Turner, on pure mathematics; Prof. Ernest W. Brown, on applied mathematics; Prof. H. E. Armstrong, on chemistry; Prof. W. M. Hicks, on physics; and Prof. W. Bateson, on biology.

WE have received the Livingstone College Year Book for 1914. This college, which has now reached its twentieth session, is doing good work in giving a training in the elements of medicine and first aid to missionaries. The principal, Dr. Harford, has resigned, after twenty-one years' service, and Dr. Loftus Wigram has been appointed to succeed him. An appeal has been issued for 10,000*l*. in order to clear off the debt and to effect improvements to the college property.

WE learn from *Science* that the Sheffield Scientific School, Yale University, has received a provisional gift from one of its graduates of 20,000*l*. This gift is contingent upon an additional 20,000*l*. being secured. From the same source we learn that the Gustavus Adolphus College, St. Peter, Minnesota, has completed an endowment fund of 50,000*l*. The two largest contributors were Mr. J. J. Hill, of St. Paul, and Mr. C. A. Smith, of Minneapolis, each of whom gave 10,000*l*.

IN reply to questions asked by Sir Philip Magnus in the House of Commons on June 29, Mr. Pease said that the Government certainly contemplates the reconstitution of the University of London, but not a new London University, distinct and separate from the present University. Mr. Pease does not suppose the Departmental Committee appointed to frame a Bill to give effect to the recommendations of the Royal Commission on University Education in London will be able to submit its report before the close of the session.

ON the occasion of the tercentenary of the founding of Groningen University, the following honorary degrees have been conferred:—*Doctor of Medicine,* Sir Edward Schäfer (Edinburgh) and Prof. J. N. Langley (Cambridge); *Doctor of Letters,* Prof. W. M. Lindsay (St. Andrews) and Principal Peterson (McGill University, Montreal); *Doctor of Dutch Letters,* Prof. A. S. Napier (Oxford); *Doctor of Geology and Mineralogy,* Dr. A. L. Day (Washington); *Doctor of Botany and Zoology,* Prof. S. J. Hickson (Manchester); and *Doctor of Political Science,* Lord Reay and Mr. Carnegie.

IT is announced in the issue of *Science* for June 12 that Mr. Andrew Carnegie has added, presumably from the income of the Carnegie Corporation, 400,000*l*. to the endowment of the Carnegie Institute of Pittsburgh, to be equally divided between the institute and the school of technology. Mr. Carnegie's gifts to these institutions now amount to 4,800,000*l*. From the same source we learn that by the will of the late Judge J. F. Dillon, Iowa State University receives 2000*l*. and Iowa College and Cornell College 200*l*. each. An additional gift of 5000*l*. has been received by Oberlin College for carrying out the general building plans and the improvement of the grounds. The old students of the University of Illinois are planning to erect a 30,000*l*. building as a memorial to Dr. J. M. Gregory, first president of the University.

THE Board of Agriculture and Fisheries proposes to award the following scholarships, tenable for three years from October 1 next. Three agricultural science scholarships of the value of 150*l*. per annum, open to students who have graduated with honours in science at a British University; two veterinary research scholarships of the value of 150*l*. per annum, open to students who have obtained the diploma of the Royal College of Veterinary Surgeons; three veterinary scholarships of the value of 100*l*. per annum, open to students who have graduated with honours in science at a British university, and tenable for three years at a veterinary college in the United Kingdom. Applications for any of the foregoing scholarships must be made not later than July 17, on a form to be obtained on application from the secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

THE Education Committee of the London County Council has recently had under consideration the recommendations of the Royal Commission on University Education in London. Two questions in particular have received careful attention: the constitution of the governing body of the University and its relation to the teaching institutions, and in particular to the Imperial College of Science and Technology; and the provision to be made for the education and examination of persons who are unable to devote their whole time to study. The committee approves generally the proposals of the Commission with reference to the government of the University of London, and is of opinion that no scheme for the reorganisation of the University will be satisfactory which does not provide that the Senate shall have full and effective control over the work of the University in the constituent colleges. The committee considers it essential that the Imperial College of Science and Technology shall become a constituent college of the University. It is also of opinion that the University of London should continue to confer degrees in honours as well as ordinary degrees on all British subjects in all faculties other than the faculty of medicine on the results of examination only, without regard to the course of training the candidate has pursued, or in the case of the higher degrees, on the submission of original work.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, June 9.—Prof. E. A. Minchin, vice-president, in the chair.—P. D. **Montague**: Report on the fauna of the Monte Bello Islands. The islands are barren limestone with a limited vegetation and some mangroves. The collections prove conclusively the entire dependence of the islands for their fauna on the neighbouring continent. Partial depopulations of the islands owing to drought are suggested, succeeded by repopulations by means of wind-borne forms from the south.—Dr. W. A. **Cunnington**: Parasitic Eucopepoda collected by the third Tanganyika Expedition in 1904–5. The collection consisted of a very small number of specimens, these forms being evidently much rarer than the Argulidæ, which are also external parasitic Copepods infesting fish.—Dr. F. E. **Beddard**: A new species of avian Cestodes and a further discussion of the paruterine organ in Otiditænia.—R. I. **Pocock**: The facial vibrissæ of mammalia. In all the principal orders of the class, with one or two exceptions, the following groups of vibrissæ are present in some genera:—Mystaciale on the upper lip, submental on the chin and lower lip, superciliary over the eyes, gonal on the cheeks, and interramal on the throat behind the symphysis of the jaw. Within the limits of the orders these tufts are present in the primitive genera, but more or fewer of them may be lost in the more specialised types. This fact, coupled with their prevalence in widely different types, points to the arrangement of the vibrissæ above indicated being exceedingly primitive.—R. I. **Pocock**: The feet and other external features of the Canidæ and Ursidæ. The paper dealt with the rhinaria, the facial vibrissæ, and the pads and interdigital integument of the feet in many of the genera of Canidæ and all the admitted genera of Ursidæ.—Dr. G. A. **Boulenger**: A second collection of batrachians and reptiles made by Dr. H. G. F. Spurrell in the Choco, Colombia.—D. M. S. **Watson**: *Procolophon trigoniceps*, a cotylosaurian reptile from South Africa.—A. W. **Waters**: Marine fauna of British East Africa and Zanzibar, from collections made by Cyril Crossland in the years 1901–2: Bryozoa—Cyclostomata, Ctenostomata, and Endoprocta. Out of the twenty-four species from these three groups, four are new; and, as the species mentioned are all from 10 fathoms or under, it will not occasion surprise that the number of Cyclostomata is but small.

Physical Society, June 12.—Prof. T. Mather, vice-president, in the chair.—Prof. C. H. **Lees**: Note on the connection between the method of least squares and the Fourier method of calculating the coefficients of a trigonometrical series to represent a given function or series of observations. In view of the number of alternative methods which have been suggested for calculating the coefficients of the terms of a Fourier series to represent a number of observations of a variable quantity, the author points out that the Fourier method gives the most probable values of the coefficients, since it makes the sum of the squares of the errors at the points of observation a minimum.—F. E. **Smith**: A magnetograph for measuring variations in the horizontal intensity of the earth's magnetic field. In the case of unifilar instruments for recording variations in H, if θ is the angle which the magnetic system makes with the magnetic meridian, M the moment of the magnet, and H the horizontal intensity of the earth's field, equilibrium results when when $MH \sin\theta = T\phi$, where ϕ is the torsion on the fibre and T is a constant. In the instrument described ϕ may be made great or small, but high sensitiveness is secured by making ϕ great.—G. **Shrimpton**: The atomic weight of copper by electrolysis. Four copper cells separating two silver cells were run in series. The areas of the four copper kathodes increased from 10 to 50 s.cs. By plotting the weights of the copper deposits against the corresponding areas of the kathodes, and extrapolating to zero area, the weight of the deposit is corrected for under experimental conditions. The atomic weight of copper

$$= \frac{\text{corrected weight of Cu}}{\text{mean weight of Ag}} \times 107{\cdot}88 \times 2.$$

The mean atomic weight for ten determinations + 63·563, with a mean error of ±0·003.—W. H. **Apthorpe**: Note on an improvement in the Einthoven string galvanometer.

Mineralogical Society, June 16.—Dr. A. E. H. Tutton, president, in the chair.—Dr. J. **Drugman**: Childrenite from Crinnis mine, Cornwall, and eosphorite from Poland, Maine. Analyses of childrenite from Crinnis mine showed it to contain even less manganese than the specimens from George and Charlotte mine. Eosphorite from Poland is richer in manganese than that from Branchville, the only occurrence previously known. It is well crystallised, unlike the Crinnis mine childrenite.—R. H. **Solly**: Sartorite. From a goniometrical examination of two hundred crystals it is concluded that Dr. Trechmann's crystals, Nos 1

and 2, belong to a new species closely allied to sartorite and smithite. Many new forms for sartorite were found.—Dr. G. T. **Prior**: Re-determination of nickel in the Baroti and Wittekrantz meteorites. Precipitation with ammonia was found not to separate iron from nickel completely, however often the operation was repeated. Re-determination showed that the proportion of iron to nickel in the case of both the meteorites in question was nearer 6 : 1 than 10 : 1, as previously stated.—Dr. L. L. **Fermor**: Ice crystals from Switzerland. Last winter the surface of the snow in shady situations near Zweisimmen and Lenk was often characterised by a dense growth of hollow prisms formed of a thin shell of ice coiled spirally parallel to the face of a hexagonal prism.—Dr. L. L. **Fermor**: Hematite from the Kallidongri manganese mine, India. The crystals, which had the habit of corundum, and were marked with three sets of striations due to twin lamellation parallel to 100, showed the forms 111 and $61\bar{4}$ well developed, together with 100, $22\bar{1}$, 28.28.13 (a new rhombohedron), $51\bar{3}$, $71\bar{5}$, and $10\bar{1}$, less prominent.—H. B. **Cronshaw**: A variety of epidote from the Sudan. A mineral discovered by Mr. G. W. Grabham in a pegmatite vein closely resembles allanite in appearance, but is free from rare earths and agrees in composition with epidote; in its pleochroism and negative sign it also resembles the latter, but has an abnormally low optic-axial angle of about 54°. In thin section it presents a well-marked zonal structure.

Royal Meteorological Society, June 17.—Mr. C. J. P. Cave, president, in the chair.—B. C. **Wallis**: The rainfall of the southern Pennines. This inquiry had been undertaken with the view of attempting to find a scientific justification of the claim made for the wetness and humidity of Lancashire suitable to the manufacture of cotton. In summarising the distribution of the rainfall of the Pennine district, the author said it may be asserted that the west is wetter than the east on the whole and as a rule, although the difference between the two areas is least marked during the dry season from March to May. In June and July, however, the lowland of the Trent and Ouse valleys receives a relative excess of rainfall which is compensated by the relative dryness in December and January. The uplands are absolutely wetter than the neighbouring lowlands, and the western slopes are wetter than the eastern slopes, but the difference in rainfall between upland and lowland is least marked during the warm weather and most marked during the cold weather. Throughout the whole district, on the average, the rainfall decreases in intensity from January until April, increases from April to August, shows a drop in relative quantity for September, rises to a maximum in October, and then declines until December. The local relief of the Pennine uplift gives to the cotton towns their characteristic climate, and is the dominant factor which has made Lancashire supreme in the cotton industry.—H. J. **Bartlett**: The relation between wind direction and rainfall. This was a discussion of wind and rain records at the four observatories Valencia, Aberdeen, Falmouth, and Kew for the ten-year period 1901–10. It was shown that a large proportion of the total rainfall falls with winds in the south-east and south-west quadrants, except in the case of Aberdeen, where the amount in the north-west quadrant is relatively high. The greatest amounts at Kew and Falmouth are, with a south-west wind, respectively 22 and 28 per cent. At Aberdeen the south-east wind brings the highest amount, 20 per cent., while Valencia receives 30 per cent. with south, 20 per cent. with south-east, and 15 per cent. with the south-west wind during the year. At each observatory there are two months during the year when the proportion of rain occurring normally in one or more quadrants diminishes considerably. For Valencia, Falmouth, and Kew this feature is strongly marked in June and September, while for Aberdeen, where it is less obvious, the months are May and November.—E. H. **Chapman**: Barometer changes and rainfall: a statistical study.

PARIS.

Academy of Sciences, June 22.—M. P. Appell in the chair.—G. **Humbert**: Some remarkable numerical functions.—J. **Boussinesq**: The mean velocity, or the flow and the maximum or axial velocity, in a prismatic tube, of regular section with any number (m) of sides.—H. **Deslandres** and V. **Burson**: The exact study of band spectra, the so-called Swan spectrum, in the magnetic field. The division and polarisation of the lines of the spectrum. The study of the Swan band spectrum has given results in general agreement with the work previously published on other band spectra. Comparing with line spectra the deviation of the Zeeman components is much smaller and the circular vibrations do not show the negative effect exclusively, but, nearly as often, the positive effect. These facts can be explained by assuming the presence of both positive as well as negative particles, of a mass much larger than the electron. A very powerful magnetic field is necessary in these researches.—Charles **Depéret**: The reconstitution of a skeleton of *Felsinotherium serresi*, from the Montpellier sands. A photograph is shown of the skeleton which has been reconstructed from the remains of several individuals. It is slightly longer than the present dugong.—P. **Chofardet**: Observations and remarks on the Kritzinger comet, 1914*a*, made at the Observatory of Besançon. Positions given for May 22, June 17 and 20. The peculiarities in the variations in magnitude of this comet are discussed.—Ch. H. **Müntz**: A property of Bernoulli's polynomials.—C. **Popovici**: A functional equation.—J. E. **Littlewood**: The distribution of the prime numbers.—Ludwig **Schlesinger**: Integro-differential equations.—K. **Bartel**: A geometrical method of formation of some ruled surfaces of higher order.—G. **Koenigs**: A new formula expressing the power indicated by a four-cycle motor as a function of the experimental elements. A recalculation of some results by M. Lumet.—Jacques **Duclaux**: The mechanism of light radiation and the entropy quantum.—F. **Bourcier**: The propagation of Hertzian waves along a wire wound as a helix.—A. **Defretin**: The Foucault currents in a soft iron core and the influence of hysteresis. The effective value of the mean induction for a given ring and magnetising current varies inversely as the square root of the frequency, if this is moderately large.—Otto **Scheuer**: A reduction of carbon monoxide by hydrogen caused by the radium emanation (see page 463).—Z. **Klemensiewicz**: The electrochemical properties of radium-B and thorium-B. The method is based on the determination of the distribution ratio of a radio-active body between an amalgam of the metal supposed to be isotopic with it and an aqueous solution of one of these salts. It was found that the normal electrolytic potentials $E_N = 0{\cdot}029 \log P$ of radium-B and of thorium-B are equal to that of lead within $2{\cdot}10^{-5}$ volt. This confirms the view that the radio-active metal and its isotope are chemically inseparable.—Victor **Henri**: Study of the dispersion of the ultra-violet rays by organic bodies. For the numerous organic substances studied it was found that for a wave-length up to about $\lambda = 2600$, the radio-active power of CH_2 is as additive as in the visible spectrum; for shorter waves the additivity subsists only as a first approximation.—Paul **Pascal**: The diamagnetic properties of the

elements follow a periodic law.—H. **Pélabon**: The thermo-electric power of the selenides of tin. The curve representing the thermo-electric power of the tin-selenium alloys as a function of the composition shows a marked angular point corresponding with the compound SnSe, but there is no discontinuity at the composition $SnSe_2$.—R. **Cornubert**: The allyl*cyclo*hexanones and the methylallyl*cyclo*hexanones. A tabulated statement of the physical properties of nineteen substituted *cyclo*hexanones.—E. **Léger**: A new method of transformation of barbaloin into β-barbaloin. The conversion is readily effected by heating with acetic anhydride in the presence of sodium acetate.—E. **Gourdon**: The mineralogical constitution of the Southern Shetlands (Antarctic).—M. **Chouchak**: The influence of a continuous electric current on the absorption of nutritive substances by plants. Under the action of an electric current the velocity of absorption of nutritive materials by plants depends on the concentration of the nutritive materials and on the electric state of the roots of the plants. The facility with which the last factor can be altered has an important practical application on plant growth.—E. **Bataillon**: A reagent of activation and fecondation on the eggs of Batrachians cleaned with cyanide.—J. M. **Lahy**: The comparative effects on the blood pressure of physical fatigue produced by a long walk and psychical fatigue resulting from work requiring close attention. With soldiers performing long marches there is no notable increase in the blood pressure, but with work requiring concentrated mental attention there is an increase.—Mlle. G. **Koenigs**: Researches on the excitability of the motor pigment fibres.—J. E. **Abelous** and C. **Soula**: The modifications of the urine in anaphylaxy.—Pierre **Robin**: Circumduction cannot exist in temporo-maxillo-dental articulation.—Y. **Manouélian**: Cytological researches in human tetanus. A histological study of the modifications caused by tetanotoxin in the peripheral motor neurones.—J. **Tissot**: The function of the dissociation of soaps in the mechanism of the inactivation of serums by the addition of salts, dilute acids, carbonic acid, and globulin.—Edm. **Sergent** and H. **Foley**: The latent periods of the spirilla in the patient attacked by recurring fever. M. **Lécaillon**: The existence of phenomena of rudimentary natural parthenogenesis in the common toad, *Bufo vulgaris*.—L. **Bordas**: Propulsive vibration. Gliding and beating flight in birds.—Maurice **Piettre**: Crystallised tyrosine in microbial fermentations. The presence of tyrosine in the muscles or in other organs not normally containing products of digestion is an indication of putrefaction of the meat.—J. **Blayac**: The sands of the Landes in their relations with the Adour terraces. Contribution to the study of their origin and age.—Michel **Longchambon**: The distinction of the two secondary series of strata superposed in the neighbourhood of Vicdessos, Ariège.—E. **Maury**: The tectonic signification of the folds between Nice and Mentone.—Jean **Groth**: The tectonic of the Sierra Morena.

NEW SOUTH WALES.

Linnean Society, March 25.—Mr. W. S. Dun, president, in the chair.—R. J. **Tillyard**: The study of zoogeographical regions by means of specific contours, with an application to the Odonata of Australia.—H. J. **Carter**: Revision of the subfamily Tenebrioninæ (family Tenebrionidæ). Australian species: with descriptions of new species of Tenebrioninæ and Cyphaleinæ.

April 29.—Mr. C. Hedley, vice-president, in the chair.—L. **Kesteven**: The venom of the fish, *Notesthes robusta*. Tenison-Woods ("Fish and Fisheries of New South Wales," 1882, p. 48) has given a fairly accurate account of the symptoms following upon wounds inflicted by the spines about the head of this fish. The opportunity of treating professionally a number of cases of persons suffering from such wounds, has enabled the author to confirm and amplify Tenison-Woods's statements that the symptoms are not compatible with non-toxic wounds, but are undoubtedly venomous (contrary to the contention of Ogilby).—G. I. **Playfair**: Contribution to a knowledge of the biology of the Richmond River.—A. G. **Hamilton**: The xerophilous characters of *Hakea dactyloides*, Cav. (N.O. Proteaceæ).

CALCUTTA.

Asiatic Society of Bengal, June 3.—Dr. N. **Annandale** and S. W. **Kemp**: Fauna of the Chilka Lake in Orissa and Ganjam. The Chilka Lake is a shallow lagoon on the east coast of India, some thirty miles long and ten miles broad. It is connected with the sea by a narrow mouth which opens into a channel separated from the main body of the lake by a series of peninsulas and islands running parallel to the coast. The salinity of the water differs greatly at different seasons, but that of the outer channel is always much higher than that of the rest of the lake. The fauna consists of a mixture of marine and fresh-water types with a certain element that appears to be peculiar to brackish water.—Dr. E. P. **Harrison**: The "Gore effect" in iron. An anomaly in the expansion coefficient of iron at a dull red heat was discovered by Gore in 1869. The phenomenon is attributed to an obscure structural change in the metal and is probably closely associated with changes in magnetic quality and in electric resistance which are known to occur at high temperatures. A similar peculiarity affects the expansion coefficient of nickel.

BOOKS RECEIVED.

Ancient India. By Prof. E. J. Rapson. Pp. viii+199. (Cambridge University Press.) 3*s*. net.

Die Insekten Mitteleuropas insbesondere Deutschlands. Edited by Prof. C. Schröder. Band iii. Hymenopteren (Dritter Teil). Die Gallwespen (Cynipidæ). By Prof. J. J. Kieffer. Die Blatt- und Holzwespen (Tenthredinoidea). By Dr. E. Enslin. Pp. viii+213+8 plates. (Stuttgart: Franckh.) 7.20 marks.

Argyllshire and Buteshire. By P. Macnair. Pp. x+161. (Cambridge University Press.) 1*s*. 6*d*. net.

A Practical Handbook of the Tropical Diseases of Asia and Africa. By Dr. H. C. Lambart. Pp. xv+324+plates. (London: C. Griffin and Co., Ltd.) 8*s*. 6*d*. net.

The Examination and Thermal Value of Fuel: Gaseous, Liquid, and Solid. By J. H. Coste and E. R. Andrews. Pp. xvi+278. (London: C. Griffin and Co., Ltd.) 6*s*. net.

The Metallurgy of the Non-Ferrous Metals. By Prof. W. Gowland. Pp. xxvii+496. (London: C. Griffin and Co., Ltd.) 18*s*. net.

Tierbau und Tierleben in ihrem Zusammenhang betrachtet. By Profs. R. Hesse and F. Doflein. Band ii. Das Tier als Glied des Naturganzen. By F. Doflein. Pp. xv+960+plates. (Leipzig and Berlin: B. G. Teubner.) 20 marks.

A Reconstruction of the Nuclear Masses in the Lower Portion of the Human Brain-stem. By L. H. Weed. Pp. 76+vi plates. (Washington, D.C.: Carnegie Institution.)

The Climatic Factor, as Illustrated in Arid America. By Prof. E. Huntington and others. Pp. vii+341. (Washington, D.C.: Carnegie Institution.)

Size Inheritance in Rabbits. By E. C. MacDowell, with a Prefatory Note and Appendix by W. E. Castle. Pp. 55. (Washington, D.C.: Carnegie Institution.)

The Daily March of Transpiration in a Desert Perennial. By E. B. Shreve. Pp. 64. (Washington, D.C.: Carnegie Institution.)

Guide to the Materials in London Archives for the History of the United States since 1783. By C. O. Paullin and Prof. F. L. Paxson. Pp. xi+642. (Washington, D.C.: Carnegie Institution.)

Tasmania. Department of Mines. Geological Survey. Bulletin No. 14. The Middlesex and Mount Claude Mining Field. By W. H. Twelvetrees. Pp. iv+131 and maps and sections. (Hobart: J. Vail.)

Lehrbuch der Physikalischen Chemie. By Dr. K. Jellinek. Vier Bände. Erster Band. Die Lehre von den aggregatzuständen. (I. Teil.) Pp. xxxvi+732. (Stuttgart: F. Enke.) 24 marks.

Bacon's Excelsior School Map of the United States. (London: G. W. Bacon and Co., Ltd.) 15*s*.

Geological Excursions round London. By G. MacDonald Davies. Pp. v+156. (London: T. Murby and Co.) 3*s*. 6*d*. net.

The Great Society: a Psychological analysis. By G. Wallas. Pp. xii+406. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Catalogue of Scientific Papers. Fourth Series (1884–1900). Compiled by the Royal Society of London. Vol. xiii., A–B. Pp. xcviii+951. (Cambridge University Press.) 2*l*. 10*s*. net.

Allgemeine Geologie, iii. By Prof. F. Frech. Dritte Auflage. Pp. iv+124. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Impurities of Agricultural Seed. By S. T. Parkinson and G. Smith. Pp. 105+xxxviii plates. (Ashford, Kent, and London: Headley Bros.) 3*s*. net.

The British Isles. By Dr. F. Mort. Pp. xi+231. (Cambridge University Press.) 3*s*.

The Ileo-Cæcal Valve. By Dr. A. H. Rutherford. Pp. vii+62+plates. (London: H. K. Lewis.) 6*s*. net.

Careers for our Sons. Edited by the Rev. G. H. Williams. New edition. Pp. xii+564. (London: A. and C. Black.) 5*s*. net.

Board of Agriculture and Fisheries. Annual Report of the Education Branch on the Distribution of Grants for Agricultural Education and Research in the Year 1913–14. Pp. viii+149. (London: H.M.S.O.; Wyman and Sons, Ltd.) 8½*d*.

Memoirs of the Geological Survey. England and Wales. Explanation of Sheet 112 and the Southern Part of Sheet 100. The Geology of the Northern Part of the Derbyshire Coalfield and Bordering Tracts. By Dr. W. Gibson and C. B. Weed. Pp. viii+186. (London: H.M.S.O.; T. Fisher Unwin.) 3*s*.

The Rubber Industry in Brazil and the Orient. By C. E. Akers. Pp. xv+320. (London: Methuen and Co., Ltd.) 6*s*. net.

Arithmetic. By H. Freeman. Pp. viii+231+xxxi. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*.

Statics. Part i. By R. C. Fawdry. Pp. vii+165. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*.

Modernism and Traditional Christianity. By Rev. Canon E. McClure. Pp. 147–226. (London: S.P.C.K.) 6*d*. net.

A Treatise on Differential Equations. By Prof. A. R. Forsyth. Fourth edition. Pp. xviii+584. (London: Macmillan and Co., Ltd.) 14*s*. net.

Dialogues concerning Two New Sciences. By Galileo Galilei. Translated by H. Crew and A. de Salvio. Pp. xxi+300. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Song and Wings: a Posy of Bird Poems for Young and Old. By I. J. Postgate. Pp. xi+50. (London: A. Moring, Ltd.) 2*s*. 6*d*. net.

Smithsonian Institution. U.S. National Museum. Report on the Progress and Condition of the U.S. National Museum for the Year Ending June 30, 1913. Pp. 201. (Washington: Government Printing Office.)

Clay and Pottery Industries, being Vol. i. of the Collected Papers from the County Pottery Laboratory, Staffordshire. Edited by Dr. J. W. Mellor. Pp. xviii+411+plates iv. (London: C. Griffin and Co., Ltd.) 15*s*. net.

DIARY OF SOCIETIES.

THURSDAY, JULY 2.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Lithological Map of the British Isles: Alan G. Ogilvie.

FRIDAY, JULY 3.

GEOLOGISTS' ASSOCIATION, at 8.—A Geologist's Visit to Canada: Dr. J. W. Evans.

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