THURSDAY, MAY 2, 1918.

OUR HERITAGE OF SCIENCE.

(1) *Britain's Heritage of Science.* By A. Schuster and A. E. Shipley. Pp. xv+334. (London: Constable and Co., Ltd., 1918.) Price 8*s.* 6*d.* net.

(2) *A Short History of Science.* By Prof. W. T. Sedgwick and Prof. H. W. Tyler. Pp. xiv+474. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 12*s.* 6*d.* net.

(1) THE main purpose of the first of these two historical books is to give a plain account of Britain's great heritage of science: "an heritage that—handed down through several centuries of distinguished achievements—will, if the signs speak true, be passed on to the coming age with untarnished brilliancy." It is a legacy to be proud of and to use. Prof. Schuster starts off with a fine chapter on the ten landmarks of physical science associated with the names of Roger Bacon, Gilbert, Napier, Newton, Dalton, Young, Faraday, Joule, William Thomson, and Clerk Maxwell. Then follows a sketch of physical science in the universities during the seventeenth and eighteenth centuries, and the achievements of men like Halley and Hooke, Bradley and Black. The non-academic succession is illustrated by the work of Boyle, Cavendish, Priestley, Herschel, and Watt. Through Rumford and Davy and George Green the author passes to the golden age of mathematics and physics at Cambridge associated with the names of Stokes and Adams, Sylvester and Cayley. His survey broadens out to include the work of Thomson and Tait, Rankine and Fitzgerald, and other illustrious physicists of the nineteenth century. Thus the author deals with such investigators as Graham, Joule, Balfour Stewart, Reynolds, Sorby, Crookes, Rayleigh, George Darwin, Ramsay, Rutherford, Airy, John Herschel, Adams, and Gill, and the distinguished roll fitly ends with Henry Moseley, whose career of singular promise was cut short in 1915 by a Turkish bullet. The next chapters illustrate the function of scientific institutions, such as the Royal Society, and "the effects of pure scientific research on that complex organisation of the community which usually goes by the name of civilisation."

Prof. Schuster's historical sketch is illuminating and inspiring—a fine example of wise selection of materials. In illustration of his judicial spirit we may refer to what is said about the estimation of the relative merits of co-operative discoverers. A generalisation gradually matures; many investigators may contribute to it; "when the time is ripe, some one with a better appreciation of the significance of the facts or a deeper insight into their mutual connection touches the matter with a master hand, and presents it in a form that carries conviction." Sometimes there is a long balancing of arguments for and against a new idea; he who adds the last grain that tips the balance is technically the discoverer. "There will always be a conflict between those who attach importance to the intrinsic merit of an investigation and those who look only on the actual influence it has had on scientific thought."

Dr. Shipley begins with the biological science of the Middle Ages; he sketches the development of botany in Britain from Turner to Ray, from Grew to Hales, from Knight to Brown, from Lindley to Hooker; he outlines the history of British zoology from Pennant and the Hunters to Owen and Huxley, from Erasmus Darwin to Charles Darwin, from Robert Chambers to Alfred Russel Wallace, and on to Balfour and Weldon, and to a master of the craft still with us, Sir E. Ray Lankester. A vivid sketch is given of the progress of physiology from Harvey and Hales to Michael Foster and Burdon Sanderson, and on to Wooldridge and Roy. The growth of geology sketched in the final chapter affords a crowning instance of the glory of the British heritage of science.

Dr. Shipley's story leaves one a little breathless, but this is because of the magnitude of his subject and the compulsory compression. His style is as vivid and delightful as ever; but we cannot approve of a construction like "the latter of whose work . . ." Some omissions strike us as curious; thus mention is made of four marine laboratories, but that at Millport, with the second largest record of researches, is left out; we find no mention of John Goodsir, whose work had far-reaching importance; and we are a little startled by finding no reference to the author of "The Principles of Biology." But we must not pursue the quest for omissions. Dr. Shipley makes some wise remarks on the limitations of science: "No body of scientific doctrine succeeds in describing in terms of laws of succession more than some limited set of stages of a natural process; the whole process—if, indeed, it can be regarded as a whole—must for ever be beyond the reach of scientific grasp. The earliest stage to which science has succeeded in tracing back any part of a sequence of phenomena itself constitutes a new problem for science, and that without end. There is always an earlier stage, and to an earliest we can never attain. The questions of origins concern the theologian, the metaphysician, perhaps the poet."

The authors have no thesis to establish, but their valuable book will leave in the minds of those who read it a strong impression of the large number of contributions of the first rank in importance that Britain has made to science, which is by its very nature cosmopolitan; and of the extent to which, in spite of our calamitous neglect, we are nationally indebted to science for advancement in mind, body, and estate. But we have not had more than the first-fruits.

(2) The aim of the second book is "to furnish a broad, general perspective of the evolution of science, to broaden and deepen the range of the students' interests, and to encourage the practice of discriminating scientific

reading." The authors believe that students will understand modern science better if they know more of its development, and we share this belief. Prof. Sedgwick is mainly responsible for the treatment of the "natural sciences"; Prof. Tyler for the mathematical. "The mathematical group, from their relatively greater age and higher development, afford the best examples of maturity; the natural sciences illustrate more clearly recent progress."

A considerable proportion of the volume—perhaps too much—is devoted to early history. In a very interesting way we are told of the gropings of the incipient scientific spirit in early civilisations, of early mathematics in Babylonia and Egypt, of beginnings in Greece and among the Ionian philosophers, of science in the Golden Age of Greece, of Alexandrian science, of science in the Roman world, and of Hindu and Arabian science. We are gradually led to the beginnings of modern natural science, which may be typified by the fundamental work of Galileo. The progress of the seventeenth century is illustrated by the work of men like Harvey, Boyle, Hales, and Huygens; the beginnings of modern mathematical science are found in Descartes, Newton, and Leibniz. The next chapter deals with the eighteenth century, and we read of Black, Cavendish, Priestley, Lavoisier, Scheele, and others in chemistry; the pioneers in the study of heat, light, sound, and electricity; the classifications of Linnæus, the descriptions of Buffon, the comparative anatomy of Hunter, the physiology of Haller, and so on. The story of the nineteenth century, all too short, is mainly concerned with the conception of energy, the rise of modern chemistry, and the development of genetic inquiries along many lines—geological, astronomical, biological, and anthropological.

There are some very interesting appendices, *e.g.* the oath of Hippocrates, the sixth part of the "Opus Majus" of Roger Bacon, the dedication Copernicus wrote to his "Revolutions of the Heavenly Bodies," Harvey's dedication of his work on the circulation, Galileo Galilei's condemnation and recantation, Newton's preface to the "Principia," and excerpts from Jenner and Lyell. There is a brief discussion of the origin of some inventions of the last two centuries. In a useful chronological list great names and dates in science are placed opposite great names and dates in general history and literature. And the volume ends with a selected list of reference books bearing on the history of science.

We appreciate the authors' scholarly and careful work, which will be of great value to serious students. The task attempted was perhaps too ambitious; for twenty authors, rather than two, would be required to show the true inwardness of the progress of scientific inquiry in its various departments. Sometimes the reader does not get enough material to enable him to understand the drift of the history; sometimes he will be apt to lose the wood in the trees. The success of the authors is most marked in the chapters dealing with early days, and in those sections where they have concentrated attention on the development of particular conceptions, such as energy or organic evolution. We like the frequent citation of typical passages from authorities, and we admire the solid competence of the whole work. There are some interesting illustrations, *e.g.* of Tycho Brahe's quadrant, Huygens's clock, and Newton's theory of the rainbow.

REFRIGERATION AND RELATED SUBJECTS.

La Statique des Fluides, la Liquéfaction des Gaz, et l'Industrie du Froid. By E.-H. Amagat and L. Décombe. Première Partie: *Statique des Fluides Purs.* By E.-H. Amagat and L. Décombe. Deuxième Partie: *La Problème de la Liquéfaction des Gaz, l'Industrie du Froid.* By L. Décombe. Pp. vi+265. (Paris and Liège: C. Béranger, 1917.) Price 18 francs.

THE first part of this book deals with the properties of liquids and gases, giving a very clear summary of some of the more important experimental work carried out in this branch of physico-chemical research. Amagat's work and conclusions are recorded in considerable detail, as well as much of the work of other physicists. The researches carried out by the great French physicist are of such importance that readers will be glad to have this connected account of them.

The compressibility of gases at different temperatures receives full consideration, and is illustrated by reproductions of the dpv/dp isothermals for ethylene, methane, carbon dioxide, air, and hydrogen. The curves for the last-mentioned gas are taken from the work of Onnes and Braak (1907) from $-180°$ C. to $-217°$ C., demonstrating that hydrogen at sufficiently low temperatures exhibits a minimum value for pv on the isothermals, as do other gases at higher temperatures. Van der Waal's equation, constituting an important advance with regard to our knowledge of the compressibility of gases, is given a prominent position in the book. The equations of Clausius, Sarrau, Amagat, and Onnes are briefly dealt with.

The application of the reduced equation of state (corresponding states) by Amagat to the determination of critical constants, by ascertaining the conditions of coincidence of the dpv/dp isothermals of different substances, is described in detail, and illustrated by superposition of the curves for carbon dioxide and ethylene, and carbon dioxide and ether. Leduc's work on molecular volumes in corresponding conditions receives attention, as well as the application of the method to the accurate determination of molecular and atomic weights. An interesting comparison of the results obtained for the atomic weights of a number of elements determined in this way with those obtained from density determinations shows that a high degree of accuracy obtains in most cases.

The study of refrigeration, dealt with in the second part of the book, opens with a brief account of the history of the liquefaction of gases. A chapter is devoted to the consideration of the

essential parts of the Claude and Linde air liquefiers and the principles underlying their working. The Hampson liquefier is not described. The fractionation of liquid air is illustrated by diagrammatic representations of Linde's and Claude's fractionating plants, and the merits of the two systems are compared.

The theory of refrigeration is dealt with from the thermodynamic point of view, and a consideration of the expansion of gases against external pressure and without external pressure leads up to the behaviour of the working substance in a refrigerating machine. A comparison of ideal indicator diagrams of the cycle with those obtained in practice is utilised to bring out the points needing careful attention in work of this nature. The construction of the essential parts of refrigerating machines is described in some detail, and profusely illustrated with excellent reproductions. The book concludes with a chapter on the applications of refrigeration to ice-production, cold storage, and the preservation of foodstuffs, and a description is given of the construction of railway wagons and steamships designed for the transport of perishable foodstuffs.

On the whole, the subject-matter of the book is well thought out and presented to the reader in logical sequence and in a very lucid and readable form. The illustrations are numerous, well reproduced and explained, and deserve a special word of commendation. The bibliography in the second part of the book is fairly comprehensive, but the value of the first part might, perhaps, be enhanced by a little further attention to this point.

The utility of the book would be increased by the addition of an index.

A. G. G. LEONARD.

THE NERVOUS IMPULSE.

The Conduction of the Nervous Impulse. By Dr. Keith Lucas. Revised by E. D. Adrian. Pp. xi + 102. (Monographs of Physiology.) (London: Longmans, Green, and Co., 1917.) Price 5*s.* net.

IN the spring of 1914 Keith Lucas by good fortune was called upon to deliver the Page May memorial lectures at University College, London. He intended to rewrite the lectures for the present monograph, and by July, 1914, had completed eleven of the thirteen chapters. At the outbreak of war he offered his services to the country, and was posted to the Royal Aircraft Factory at Farnborough, where, until he was killed in an aeroplane accident on October 5, 1916, he was fully occupied with problems of flying. The two missing chapters have been written by Mr. Adrian, pupil and fellow-worker, for the most part from the lecture notes.

Nearly one hundred years of intensive investigation has been devoted to the nervous impulse. The volume of the work and the number of workers of outstanding ability who have engaged in attempts to discover the nature of a wave probably of no great intrinsic complexity may appear strange to a physicist. The reason is one of scale: the single conducting unit, the nerve-fibre, being only some 18 to 20 μ in diameter, is too delicate for separate treatment. It is necessary, therefore, to work with the nerve, which is a bundle of many hundreds of fibres. For this reason so simple a matter as the relation between the intensity of the stimulus and the amplitude of the wave is incapable of direct measurement, for it is impossible to determine directly whether an increase in the integral response of the nerve is due to an increase of the response of individual fibres or to an increase in the number of fibres called into action.

Owing to this ineradicable difficulty, the whole structure of our knowledge of the nervous impulse is based upon an assumption, namely, that the molecular wave suffers a decrement in traversing a region the conductivity of which has been impaired by some narcotic such as the vapour of alcohol, and that the capacity of the wave for traversing a narcotised region is a measure of its amplitude. The effect of this fundamental insecurity is, to quote Lucas's words, that "the argument of the experiments becomes somewhat complex. . . . The experiments are often easily made, even with a considerable degree of accuracy; it is in their interpretation that the real difficulty begins. And this difficulty arises again and again from the same cause, that nerves and muscles are not units, but each composed of many fibres."

What is the nature of the wave? It is accompanied by a change of electric potential, but as the rate of travel is only of the order of 40 ft. per sec., it cannot be a simple electrical wave. It is true that on Kelvin's cable theory and by making many assumptions it can be shown that a wave of simple displacement of electricity would travel in a structure like the nerve-fibre at a speed of this order. But by delicate micro-chemical technique it has been found possible to detect an increased output of carbon dioxide during the passage of the wave, and a rise of temperature has been measured of the order of 7×10^{-6} of a degree Centigrade, not to be accounted for save as heat liberated during the passage of the wave, which would therefore appear to be one of exothermic chemical change.

These and other cognate problems are discussed in the clear logical way so characteristic of Lucas's mind, and from these relatively simple issues the author proceeds to consider how far the phenomena of the isolated nerve may be used to interpret the much more complex phenomena of the central nervous system.

I commend the book to physicists—to the physiologist it is a matter of professional interest, but to the physicist it should come as a romance.

Of the gifted author himself there is no space to speak. His skill, his courage, his clear vision are fittingly dwelt upon in a prefatory note by Prof. Starling which could not be bettered.

W. B. HARDY.

OUR BOOKSHELF.

A Course in Food Analysis. By Dr. A. L. Winton. Pp. ix+252. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 7*s.* net.

THIS is a useful introductory work for students who have had preliminary instruction in general chemistry and are commencing to learn the principles of food analysis. The author has arranged his subject-matter in a manner suitable for class work during a course extending over forty laboratory periods of four hours each. In his experience multiple pieces of apparatus, such as Kjeldahl digestion and distilling stands, are most convenient when designed for twelve determinations—that is, for six students, each carrying out duplicate experiments; and the same number of students is also a convenient one to use on the same day such apparatus as the polariscope, refractometer, or Westphal balance. Hence in the text provision is made for students to work in groups of six, if so desired, and the methods can be suitably allotted to avoid duplication of expensive apparatus.

General information is given upon, and laboratory work mapped out for, the various classes of foodstuffs—dairy products, flesh foods, cereal foods, sugars, fats, vegetables, fruits, flavourings, and beverages. The general matter indicates the nature and composition of the foodstuff dealt with, and includes brief statements of the principles involved in the chief methods of analysis employed for examining it. In the laboratory work prescribed there are detailed instructions for carrying out the commoner estimations. These include experiments with the polarimeter, refractometer, tintometer, and colorimeter; nitrogen estimations; determinations of alcohol, saponification numbers, iodine values, and so forth. A useful chapter is one devoted to the microscopic examination of vegetable foods.

The book is written primarily for American students, but the English user will find no difficulty arising from that fact—except perhaps for an occasional phrase such as "Hamburg steak" or "salt-mouthed bottle." As an introduction to more comprehensive works the volume can be confidently recommended. C. S.

Instruments de Musique: Le Télharmonium. By Julien Rodet. Pp. 96. (Paris: Gauthier, Villars, et Cie, 1917.) Price 3.50 francs.

THIS little book is characteristic of the clear exposition of a well-informed French author when he has thoroughly mastered the subject. All the phenomena of sound are briefly dealt with in such a manner that he who runs may read. The chapters include the production and propagation of sound, a short discussion of the laws of vibration of cords, plates, and tubes, the intimate nature of musical sounds, and a study of musical scales. Then follows a summary description of the more common instruments of music; this chapter will be of great use to the amateur who desires to know the principles on which his favourite instrument is constructed. The last chapter is on a new instrument, the tel-harmonium, and is the novel part of the book; it is the description of an electric organ by which, and by electrical means alone, a synthesis is possible of any musical sound, however complex. The tones so produced are developed by telephone. Alternating currents produce electric generators of tone, and these are superposed on the diaphragm of a telephone. A keyboard controls the tones of seven generators, and by resistance arrangements the intensity of any generator may be modified. In this way it is said that the qualities of the chief instruments of the orchestra, such as the clarinet, the oboe, the cor anglais, the violoncello, and others, can be reproduced with such accuracy as to satisfy the musical sense of a musician who is unaware of the origin of the sounds. Evidently the manipulation of the instrument must be difficult. J. G. M.

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.*]

Pope Innocent VIII. and Witchcraft.

IN the issue of NATURE for April 11, p. 113, is an erratum which corrects a statement made in NATURE for April 4, p. 82, regarding Pope Innocent VII. and witchcraft. It is stated that Pope Innocent VIII. in 1484 "gave the sanction of the Church to the popular beliefs concerning witches." In the cause of historical truth it must be stated that Pope Innocent VIII., by his Bull "Summis desiderantes affectibus" (1484), must be considered to affirm the reality of the alleged phenomena of witchcraft. But the Bull pronounces no dogmatic decision, and the Pope does not wish anyone to believe more about the reality of witchcraft than is involved in the utterances of Holy Scripture. The immediate effects of the Bull have been greatly exaggerated. The expression, "gave the sanction of the Church," is, therefore, inexact, and, being inexact, is unscientific; it needs much qualification.

A. L. CORTIE.

Stonyhurst College, April 18.

[The reference in NATURE was from an article by Dr. E. Withington in "Studies in the History and Method of Science," reviewed in our issue of April 4. Dr. Withington sends the following remarks upon Father Cortie's letter.—ED. NATURE.]

THE Pope's Bull is printed as preface to all editions of the "Malleus maleficarum." It was taken as authoritative by Catholic inquisitors, and, presumably, by most of the faithful. This is what ordinary English people would understand by "the sanction of the Church"; those who in future denied "the reality of the alleged phenomena of witchcraft" would contradict an affirmation of its supreme Pontiff.

The writer did not intend to suggest that such beliefs are current among Catholics of the present day or form part of Catholic dogma. E. WITHINGTON.

THE CENTENARIES OF GERHARDT AND WURTZ.

IT is surely a coincidence not without its special significance that, at the very time when France, with the sympathy of the greater part of the civilised world, is nobly struggling to regain the provinces of which she was despoiled nearly half a century ago, it should be her pious duty and peculiar privilege to celebrate the centenaries of two of her many eminent sons, both illustrious in the annals of chemical science, both Alsatians, and Frenchmen to their very finger-tips. These events, occurring under present conditions, we may be sure, have not failed to impress the soul of France, or to stimulate and strengthen her resolution to gather again within her fold those compatriots of whom a brutal and arrogant despotism had ruthlessly robbed her. Subjects of which Gerhardt and Wurtz are types are, indeed, among the most precious of her assets. In thus commemorating the services of these distinguished Alsatians, the Chemical Society of France has also expressed the sentiments of admiration and esteem with which those services are regarded wherever science is appreciated.

Charles Frederic Gerhardt was born at Strasburg on August 21, 1816, and died in that city on August 19, 1856. The son of a white-lead manufacturer at Hangenbieten, near Strasburg, it was the intention of his father that Gerhardt should assist him in his business, and with the object of learning chemistry he was sent, on leaving the Protestant gymnasium of his native place, first to the Polytechnic at Carlsruhe, and then to Leipzig, where he worked in Erdmann's laboratory. Here, when barely nineteen years of age, he made his first contribution to the literature of science—a lengthy paper in the *Journal für Praktische Chemie* on "The Formulæ of the Natural Silicates." He now returned to Hangenbieten, but the craft of chemical manufacturing had no attractions for him. He eventually threw up his position and enlisted in a cavalry regiment, from which, thanks to the generosity of Liebig, to whom he became in turn pupil, friend, and rival, he was enabled to procure his discharge. After a short stay at Giessen he made a second attempt to comply with his father's wishes. It was no more successful than the first, and, after eighteen months of irksome drudgery, he finally abandoned the effort and betook himself to Paris. Although only twenty-two, the venture was not altogether hopeless, for he had already made a mark in French scientific circles by his translation of Liebig's "Introduction to the Study of Chemistry," published by Mathias in 1837. The handsome, well-grown youth, almost feminine in features, was well received by Dumas, whose early experiences were not wholly dissimilar, and under his encouragement Gerhardt attached himself to the *Répertoire de Chimie*, then directed by Gaultier de Claubry.

On its foundation, in 1840, by Dr. Quesneville, Gerhardt joined the staff of the *Revue Scientifique*, and became one of the most active of the contributors to that famous periodical. The times were favourable to the development of his genius, and no field for the display of his peculiar talents could be better than that journal. Revolutions were impending not only in the political world, but also in that of science. It was, perhaps, the most pre-eminently polemical period in the history of chemistry—a time of Homeric combats between the opposing schools of France and Germany. Gerhardt, from his antecedents and upbringing, was well fitted to be what he actually became—a free-lance, whose keen and incisive thrusts were directed, with equal impartiality, sometimes at one protagonist and sometimes at the other. No wonder that the articles over the signature "Z" were eagerly scanned by both sets of combatants.

Space will not permit of any detailed examination of Gerhardt's powers as a critic. One example, however, may be given, which, although of minor importance, is typical of his skill in sarcasm. As is well known to chemists interested in the history of their science, the followers of Liebig were at first disposed to scoff at the doctrine of substitution, and the editor of the *Annalen* had disfigured his pages by a letter, supposed to emanate from Paris, and signed S. C. H. Windler, in which the writer, in execrable French, attempted a *reductio ad absurdum* of Dumas's great discovery. It was a somewhat clumsy piece of buffoonery, flavoured with that spice of malice which so frequently characterises what Germans regard as humour. Gerhardt took a neat revenge by reprinting the letter in the *Revue Scientifique* with all the solecisms, faults of grammar, and mistakes of idiom scored through or italicised, as if correcting a schoolboy's composition. The letter, as we now know, was written by Wöhler; it was unworthy of that calm and unimpassioned philosopher, and was, we may be sure, in after years regretted by him.

Whilst in Paris Gerhardt worked with Cahours, and after 1841 many of his papers appeared in the *Revue*, more especially on didactic subjects connected with chemical philosophy.

In 1841 he was appointed to succeed Balard at Montpellier, where he remained seven years. He continued to write for the *Revue*, but the results of his experimental work were, as a rule, sent to the Academy, and appeared in the *Annales de Chimie*. Almost at the outset of his career as a professor he was brought into conflict with Laurent, but the two men soon healed their differences, and to the great benefit of science and their own fame became firm friends and active co-workers until separated by Laurent's death in 1853.

In 1848 Gerhardt returned to Paris, where he learnt to know Williamson, who was at that time studying mathematics under Comte. He had started the *Comptes rendus des Travaux de Chimie* in 1845 in association with Laurent, presumably to afford its editors a wider and more independent scope for the dissemination of their peculiar views than was possible to them in the

Revue Scientifique. The journal had a somewhat chequered career; each year saw a change of publisher, and it ceased to appear in the troubled times of 1851. He now started a school of practical chemistry at 29 Rue M. le Prince, where he had as pupils and collaborators, amongst others, Chancel, Chiozza, Pisani, and for a time August Kekulé. It was here, too, that he made his memorable researches on the organic anhydrides—the culminating point of his experimental work. Shortly before his death, in 1856, at the age of forty, he was transferred to Strasburg, but beyond a couple of short papers published posthumously, nothing further appeared from his pen.

It would be impossible to do adequate justice, in an article of this kind, to the extraordinary value of Gerhardt's labours during the twenty short years of his ceaseless activity. His mind was continually at work upon the basic principles of theoretical chemistry, and his pen was never idle in expounding them. His wealth of ideas, the fruitfulness of his conceptions, his grasp, the range of his knowledge, and his logic and insight are simply astonishing. Much of his doctrine is now so woven into the structure of the science that to recall it all would seem to the student of to-day to savour of the commonplace. But what a catalogue it makes !—the reform of the atomic weights, the unification of formulæ, the true conception of the molecule and the atom, constitutional formulæ, the principle of homology, the *rôle* of water in chemical change, the basicity of acids, and the nature and classification of salts. Such is the baldest summary of Gerhardt's influence on the philosophy of chemistry, as expounded in his critical papers and his various text-books, above all in his classical treatise on organic chemistry. His published papers number more than 100, almost exclusively on subjects of organic chemistry—essential oils, the alkaloids, amides, anilides, ureides, thiocyanates, mellonides, and lastly the acid anhydrides—coextensive, in fact, with the whole range of that section of the science. The admirable biography which we owe to M. Grimaux and the filial piety of M. Charles Gerhardt, jun., does full justice to these imperishable labours, and they are recalled in graceful and felicitous terms in the *Conférence* which M. Marc Tiffeneau delivered before the Chemical Society of France on the centenary of the birth of their illustrious author.

Charles Adolphe Wurtz was born at Strasburg on November 26, 1817. He was the son of a Lutheran pastor in a small village near that city, and it was the intention of his father, who had inscribed his name at the Protestant seminary of theology, that he should follow his own profession. The boy, however, had been irresistibly attracted towards chemistry, and his inclination was strengthened by his association with Caillot, then professor at Strasburg, to whom eventually be became lecture-assistant. The father had little sympathy with the son's aspirations. In his judgment chemical science offered little or no prospect of a living, and accordingly the young Wurtz, to meet in some degree his parent's objections, applied himself to medicine and took his degree in that subject in 1843. In the course of his studies he repaired to Giessen, then the Mecca of chemists, and worked under Liebig for about a year. This circumstance determined his career. In 1844 he left Alsace to join Dumas, to whom he had been recommended by Liebig, and in the well-known laboratory in the Rue Cuvier he worked in company with Cahours, Melsens, Stas, Piria, and others, who became more or less eminent in that stirring and fruitful epoch.

Dumas's influence at that period was all-powerful in France, and Wurtz's rise was rapid. He was "chef des travaux chimiques" at the Ecole Centrale in 1845, and in 1846 a member of the Faculty of Medicine. When Dumas became Minister of Agriculture and Commerce, after the Revolution of 1848, Wurtz succeeded him as professor of organic chemistry, becoming titular professor of mineral chemistry in 1853 in succession to Orfila and a line of such illustrious ancestors as Fourcroy and Vauquelin. Here he remained for twenty-one years, attracting to himself a body of active workers from all parts of Europe and America by his power as a teacher, and by the enthusiastic energy with which he directed his school of research. In 1872 he was made professor of organic chemistry at the Sorbonne, a position created for him. He retired in 1882 and died on May 12, 1884.

During the half-century of Wurtz's scientific activity France passed through many political crises, which, no doubt, at times were not without influence on his position and prospects, but, on the whole, his career was far more placid and prosperous than that of his brilliant compatriot. Although practically contemporaries, Gerhardt was at the height of his fame when Wurtz was but little known outside Paris. To-day, indeed, the men seem to belong to a different age. By far the greater volume of Wurtz's work was published when Gerhardt had ceased to write. His earliest efforts were on inorganic subjects. He studied the acids of phosphorus and determined their basicities, which he afterwards confirmed by preparing their compound ethers; he discovered phosphoryl chloride and copper hydride, the first member of this class of substances to be made known, and noted the significance of the mode of its decomposition by hydrochloric acid in reference to the atomic constitution of elements in the free state.

But under the influence of Dumas he soon turned into the rapidly developing field of organic chemistry. His work on copper hydride led him to speculate on the constitution of Frankland's compound radicals, and to indicate the necessary existence of mixed radicals, such as methyl-ethyl, ethyl-amyl, etc. He discovered liquid cyanogen chloride and synthesised urethane, and prepared the cyanic and cyanuric ethers and the first of the compound ammonias—a subject brilliantly exploited by Hofmann a few years later. He prepared the compound ureas, established the triatomic character of

glycerol, and predicted the existence of the diatomic alcohols, which he established by the discovery of glycol, glycollic acid, and a number of other derivatives. The theoretical deductions to which these researches gave rise led to a memorable controversy between the French and German schools, which greatly influenced the development of the conception of basicity, and the spread of Gerhardt's teaching of the true principles on which the formulation of organic compounds should be based.

In 1854 Wurtz isolated butyl alcohol (*iso*-propyl carbinol) from the fusel oil of potato-spirit, and ten years later he added another term to this series of homologues by the preparation of his methylene hydrate, an isomeride of amyl alcohol discovered by Cahours. The mode of its resolution by heat into water and amylene led Wurtz to the study of abnormal vapour densities, as manifested by the thermal decomposition of phosphorus pentachloride, the hydrate and alcoholate of chloral, ammonium sulphydrate and chloride, etc. —an inquiry which brought him into conflict with Berthelot and Sainte-Claire Deville. His study of the action of hydrochloric acid on aldehyde led to the discovery of aldol, its polymerides, and other derivatives, which occupied much of his attention for several years.

The foregoing is a very incomplete summary of Wurtz's contributions to experimental chemistry contained within some 150 memoirs. His relation to his epoch has already been set forth in the admirable obituary notice by Friedel—himself an Alsatian—which appears in the Bulletin of the Chemical Society of France—a society of which Wurtz was one of the original founders, and which he consistently supported so long as he lived. A charming sketch of his life, work, and personality by his pupil and life-long friend, Prof. Armand Gautier, appeared in the *Revue Scientifique* of December 22–29, 1917, written on the occasion of the celebration of his centenary. It affords a delightful picture of Wurtz as he appeared in his laboratory—the directing and dominant agency, *primus inter pares*, of a galaxy of collaborators such as Friedel, Caventou, Crafts, Louguinine, De Clermont, Salet, Naquet, Willm, Oppenheim, Lauth, Girard, Le Bel, Grimaux, Cleve, Chydenius, Tollens, Sell, Silva, Henninger, Maxwell Simpson, Hanriot, Franchimont, Œchsner de Coninck, Richet, and van't Hoff, with Gautier himself—all men who, stimulated by the example of their leader and influenced by his teaching, have contributed to fashion the edifice of modern chemistry.

Wurtz was a fine character—a man with a broad mind in a large and manly frame. He had all the qualities which attract men and fascinate youth—charm of manner, transparent integrity, generous impulses and a ready sympathy, an enthusiastic and loyal devotion to science, and a quick and whole-hearted appreciation of merit in those who sought to enlarge its boundaries. He was idolised by his students. As a lecturer he had much of the force and fire of his master, Dumas, the same gift of happy and graceful diction, the same clarity of thought, the same power of logical and lucid exposition. He had also, in no small measure, Dumas's facility of literary expression. No nobler tribute was ever penned than that paid by Wurtz, in the opening pages of his well-known *Dictionnaire*, to the genius and labours of Gerhardt and Laurent. M. Armand Gautier well applies to him the words which he himself used at the graveside of Dumas: "Votre grande figure n'est pas de celles qui puissent disparaître dans l'oubli. Votre souvenir se perpétuera, votre nom passera d'âge en âge. Vous vivrez par vos œuvres, par l'exemple que vous avez donné, par les productions immortelles et les qualités de votre esprit."

T. E. THORPE.

ICE AND FLOWER EXPLORATION IN HIGH ASIA.[1]

(1) THE indefatigable explorers of the glaciers of the Karakoram Himalayas, Dr. and Mrs. Workman, who have done more than any others to visit and map out the details of those vast ice-fields, give in the volume before us still another account of their travels and explorations in a new sector of these regions. As usual, in order to cover as much new ground as possible within the narrow summer limits in which travel was practicable, they formed separate and independent expeditions, although they combine their results in a single volume. At the present time, when so much is being written about the extension of women's sphere on account of the war, it is interesting to find abundant evidence here of the *pre-war* exploits of a woman-pioneer in these Indian Alps, in fields usually regarded as the especial preserve of men, and of men of unusual nerve because of the physical perils to be encountered and overcome.

Mrs. Workman independently instituted and led the pioneer expedition to the hitherto unvisited Rose Glacier of Sia Chen, which is the longest non-polar glacier in the world; Dr. Workman explored the Sher-pi-Gang and other glaciers and basins; and between them they achieved the feat during two summers of mapping out nearly two thousand square miles of ice-field details for the first time. Although the journeys were performed in 1911 and 1912, the exigencies of the war have prevented the publication before now; but as no one else has visited those regions since then, this delay in no way detracts from the interest and solid scientific value of the work accomplished and now given to the public.

A striking feature of the moraines in those remote regions was the great preponderance in them of sedimentary rocks at such an extreme altitude. The "black" moraines on the north, which must have been intensified in the snowy surroundings, were found to consist of hardened black shale and mixed with slabs of "a pure white

[1] (1) "Two Summers in the Ice-wilds of Eastern Karakoram: The Exploration of Nineteen Hundred Square Miles of Mountain and Glacier." By F. B. Workman and W. H. Workman. Pp. 296. (London: T. Fisher Unwin, Ltd., 1917.) Price 1*l.* 5*s.* net.

(2) "On the Eaves of the World." By Reginald Farrer. Vol. i., pp. xii+311; Vol. ii., pp. viii+328. (London: Edward Arnold 1917. Price, 2 vols. 30*s.* net.

marble"; and on the south the black slaty sedimentary rocks contained some veins of iron pyrites with quartz and other igneous rocks.

As in their previous joint books, the text is enriched by a profusion of excellent photographs, all taken by the writers themselves, and quite up to the high standard set in their earlier journals. Altogether, it is an attractive record of solid geographical achievement.

(2) This is one of the travel-books which owe their existence to the enterprise of horticulturists ransacking the world for new species of flowering plants for decorative garden purposes. The recesses of south-western China have already proved a happy hunting-ground for such botanical expeditions, especially in the more southern borders, but our author traversed the unfrequented northern portion in the hope of securing new specimens which would be more hardy and thus more suitable for the British climate than the softer productions of Yunnan and Szechuan, which have now been freely explored by Forrest and other collectors. The narrative, in detailing the author's experiences, reflects his abounding enthusiasm; and though he has his eyes mainly on the business of collecting, he also gives incidentally a good deal of description of the people and of the country through which he passes. As it makes no pretence of being a scientific book, and is thoroughly colloquial in style, relatively free from technicalities except the names of plants, and somewhat facetious, it is easy reading for the general reader. The author had some excitement at times in evading the roving bands of brigands on the Tibetan border called the White Wolves. He prefers his own system of phonetics for Chinese names: thus Archueh becomes "Arjeri," and the familiar Yamen appears as "Yamun."

With Mr. Purdom, formerly of Kew, and three Chinese lads, Mr. Farrer started from Peking in the spring of 1914 and spent that year on the hill ranges of South Kansu on the border of Tibet, and thereafter wintered in the north, moving farther north in 1915 into the alpine tracts above Sining. Those tracts had previously been in part traversed rapidly by the scientific expeditions of Prezewalsky and Potanin, but these brought back only dried specimens, and did not gather seeds or living plants, which defect our author has now remedied for cultural purposes in regard to several rare species. A list of the new species is given in the appendix, and includes amongst others several new poppies, primulas, and asters, a new gentian, and two new rhododendrons, besides the Isopyrum named after the author, which is here illustrated. Several others of the new species are also decidedly decorative, as seen in good photographic reproductions, whilst other photographs illustrate some of the country traversed and its semi-Tibetan people. L. A. WADDELL.

FIG. 1.—*Isopyrum Farreri*, sp.n. From "On the Eaves of the World."

THE SUN AND THE WEATHER.

PROF. C. G. ABBOT has contributed to the *Scientific Monthly* (November, 1917) a reasoned discussion, in the light of recent investigations, of the extent and probable sequence of the effect of solar variation on world weather.

More than one independent line of argument will be found to point to the conclusion that in a period of two thousand years there has been no appreciable change of climate. Therefore the balance of the heat exchanges between the earth's income from the solar radiation and its expenditure in terrestrial radiation into space may be regarded as only fluctuating between narrow limits. Eighty per cent. of the solar radiation fails to reach the earth's surface through its protecting envelopes, and 90 per cent. of the terrestrial radiation fails to escape. Such is the beneficent effect of our atmosphere, for want of which the temperature of the moon's surface, as proved by actual observation, falls during the short period of a lunar eclipse many times as far as does that of any part of the earth between day and night. In most places on the earth the surface air temperature rarely varies as much as 1 per cent. from day to day, but the variation between day and night is affected by the character of the surface, Timbuktu, in the Sahara desert, having twice the daily and four times the annual change of temperature at Port au Prince, Haiti, in approximately the same latitude.

Prof. Abbot considers that a slow increase of 1 per cent. in solar radiation should produce a change of 1 per cent. in terrestrial radiation, and on the assumption that this varies as the fourth power of the absolute temperature, he finds this to be equivalent to a change of 0·7° C. for each unit per cent. of change of the solar radiation. The annual change of mean temperature at Timbuktu on this account should be 24° C., but is actually only 13·6° C. From this Prof. Abbot concludes that the annual variation (due to the sun's changing altitude) is not slow enough to produce its full effect, and suggests that the variation in the period of the sun-spot cycle may be more effective.

Dr. G. T. Walker finds in general a lower temperature at sun-spot maximum, and this is confirmed numerically. Köppen, for instance, finds at sun-spot maximum an average decrease of 0·7° C. for the period 1815–73, and of 0·5° C. for the period 1873–1910, when the maxima were, on the average, less intense. This apparent paradox is tentatively attributed to increased cloudiness, possibly due to greater penetrative power of the solar ions. Prof. Abbot's short-period fluctuations in the solar radiation provide another line of approach to the elucidation of the problem, and Dr. Clayton, of Argentina, has applied the method of correlation, for about fifty well-distributed stations, between Mount Wilson solar constant values and local changes of temperature for the few following days, obtaining in some cases significant coefficients. Thus an increase of solar radiation was followed by an increase of temperature at Pilar, Argentina, with its maximum one or two days late, and by a decrease at San Diego, California, with its maximum three or four days late. In the temperate zones, roughly speaking, the correlation is negative, and elsewhere positive, but the tropical belt of positive correlation is narrower over the oceans. The amount of the change found by Dr. Clayton is several times larger than Prof. Abbot's reasoning led him to expect. He therefore concludes that the results require confirmation, but that they indicate secondary processes set going in the atmosphere by changes in solar radiation, and that the effect on winds, cloudiness, and precipitation may be revealed. He infers that as the changes in the sun are followed by changes of similar magnitude on the earth, with a lag depending on latitude, these changes could be predicted if we can secure daily observation of the solar emission. For this purpose new observing stations in cloudless regions are required, and considerations of expense will probably defer this until after the war. Prof. Abbot hints finally that a bequest of half a million dollars would enable the Smithsonian Institution to handle the problem adequately. W. W. B.

ANTI-VIVISECTIONISTS AND PROTECTIVE MEDICINE IN THE ARMY.

IT is wonderful to what follies anti-vivisection will betray those who believe in it. The American Red Cross has been involved in a lawsuit by some of the American anti-vivisectionists, who are endeavouring to prevent it from doing medical research on active service. This research would be, almost all of it, bacteriological; it would be inoculations of small rodents in the direct course of the work of the Red Cross for the Army; but the anti-vivisectionists seem to care more for the rodents than for the Army. Dr. W. W. Keen, of Philadelphia, one of the very foremost of American surgeons, whose name is well known among our own physicians and surgeons, has written an admirable article in *Science* of February 22 last on this attempt to interfere with the work of the Red Cross. He tells again some of the oft-told truths: the facts of the protective treatment against typhoid, of the protective treatment against tetanus, of the results of Lister's work, and so forth. He points out that the anti-vivisectionists in his country all these many years have done nothing, absolutely nothing, to lessen disease or to save life either in animals or in man; and he quotes the statement made by forty-one American medical officers on active service in France: "We feel that anyone endeavouring to stop the Red Cross from assisting in its humanitarian and humane desire to prevent American soldiers from being diseased, and protecting them by solving the peculiar new problems of disease with which the Army is confronted, is in reality giving aid and comfort to the enemy."

This article by Dr. Keen is well worth studying; but some anti-vivisectionists are blind and cruel; and it is not possible to reason with them, any more than Antonio could argue with Shylock. The fact is that the anti-vivisectionists, since the War, have been rather out of work; and, as Dr. Watts says, "Satan finds some mischief still for idle hands to do."

Over here they have done, since 1914, very

little. Some of them led a wild campaign against the protective treatment of our soldiers against typhoid fever; but nothing worthy of notice came of it. Attempts have also been made lately to use the memory of Miss Nightingale as a sort of stalking-horse for anti-vivisection, and to persuade this nation that Pasteur and Lister were of little worth. Over these and the like vagaries, anti-vivisection is spending its time and its money, hoping, after the war, to recover hold of public attention. Surely it will be disappointed of that hope. The war has burned deep into the hearts of all of us this lesson, that the magnificent work of our Army medical services is indeed founded and built on knowledge made possible by experimental bacteriology. Not all the anti-vivisection societies in the world will ever persuade us to forget that lesson of the war.

NOTES.

SOME little excitement was caused in agricultural circles by an article in the *Times* of April 20 describing how to grow wheat and grass on the same land. The method, if well founded, would revolutionise agriculture and overcome some great difficulties in food production. At present it is impossible to express any opinion, as no sufficient statement of detail has yet been made. It was stated in the article that the Government experts had been much impressed by the method, but inquiries at the Food Production Department put rather a different complexion on the case. According to the article, the method consists in delivering a mixture of wheat- or oat-seed and artificial fertilisers under the surface of grass land in July. By September or October the cereal is stated to have grown from 8 in. to 10 in. high. Livestock are then run on to the field to eat down the corn and grass; the effect of this is said to be a strengthening of root-growth. The protection from frost given to the roots of the cereal by the covering of turf is further said to cause an earlier start of normal spring growth, more heads to be thrown up, more rapid development of the plant, and earlier ripening of the grain. The harvesting is proposed to be done by means of an ordinary mowing machine fitted with an extra knife at the proper height above the grass to cut the heads of the grain. The lower knife is to cut the hay as usual, and the upper knife to act as a "header." Special arrangements are proposed for separately collecting the grain and the straw. It would be easy to enlarge on the advantages of the method if it materialised, but expectations should be repressed until a definite trial has been made and seen by competent observers. Agricultural experiments are just as full of pitfalls as any others, and agricultural literature contains many proposals for revolutionising crop production which, unfortunately, never matured. There is a great deal of evidence to show that growing grass has a pernicious effect on wheat sown in the ordinary way, as careless farmers have often learned to their cost. Mr. Pickering's experiments at the Woburn Fruit Farm further demonstrate the incompatibility of grass and crops. It will be well, therefore, to await definite and unexceptionable evidence before attaching importance to the new claims, which are the subject of a further article in the *Times* of May 1.

A BILL entitled "Coinage (Decimal System)" has been introduced in the House of Lords by Lord Southwark. The measure provides that for the existing coinage of silver, copper, and bronze there shall be substituted a decimal coinage based on the sovereign. All coins below a sovereign are to be multiples of the thousandth part of a sovereign, such part being also minted and called a "mil." The new coinage specified in the schedule to the Bill includes silver coins of the double florin (200 mils), florin, half-florin, and quarter-florin; coins of nickel, or other metal or alloy, of ten mils and five mils; and bronze coins of four, three, two, and one mil. There is a provision to the effect that in the case of any statutory undertaking authorised to levy or demand rates, tolls, charges, or payments the Board of Trade may, on application, fix the amount to be payable in mils in respect of any such authorised rates, etc. If the measure becomes law, the date on which it is to come into operation will be fixed by proclamation. It will be noticed that the proposed legislation closely follows the suggestions put forward by the Decimal Association, which were referred to in NATURE of October 18 last (p. 132). The proposed bronze coins represent very approximately our present penny, halfpenny, and farthing, while, in addition, there is a coin of three mils which is nearly three farthings. This large range of coins of low denominations would probably be found convenient in the equitable adjustment of prices of commodities. The adoption of a decimal coinage has for some years been advocated by bodies representing banking and other commercial interests; and the decimal subdivision of the currency would certainly facilitate accounting work.

ABOUT five-and-twenty cases of a disease believed to be botulism have recently occurred in London and Sheffield. After an incubation period of from twelve to twenty-four hours the disease sets in acutely with paralysis of the internal and external muscles of the eye, dilatation of the pupil, vomiting, arrest usually of the salivary secretion, difficulty of swallowing and loss of voice, and depression of the heart's action, which may cause a fatal issue. The condition is due to a poison found in food by the action of a bacillus, the *B. botulinus*, which chiefly occurs in tinned food, ham, and sausages; from the last-named the name is derived (Latin, *botulus*=a sausage). So far the *B. botulinus* has not been isolated in connection with the present series of cases, and until this is accomplished its exact nature must remain somewhat doubtful.

THE Faraday Society has arranged a general discussion on "The Co-ordination of Scientific Publication," to be held on Tuesday, May 7, at 5.30, in the rooms of the Chemical Society, Burlington House. The discussion, which will be of an informal character, will be opened by Sir Robert Hadfield, Bart., president of the society.

IN reply to a letter addressed to the Board of Trade on the subject of the Lighting, Heating, and Power Order, 1918, the registrar of the Institute of Chemistry has been informed that, "where consulting analytical research and technological chemists and teachers and professors of chemistry are able to show that by reason of their professional needs they have been unable to effect the economy prescribed by the Order, the Board will accept this as a sufficient explanation under paragraph 14 of the Order."

AT the meeting of the Zoological Society of London on April 23, the secretary, Dr. P. Chalmers Mitchell, directed attention to an advertisement that recently appeared in the London Press announcing fur sales by public auction about to be held in the United States. The sales in question are only examples of what take place annually in London and other important commercial centres. The numbers advertised are smaller

than usual, no doubt on account of the war, but they include very large quantities of animals the extinction of which cannot be far distant, unless measures are carried out to protect them. In the opinion of Dr. Chalmers Mitchell, which was confirmed by the meeting, there is urgent need for drastic measures to protect mammals. The protection of birds appeals to popular sentiment, and is zealously advocated by many influential organisations. The danger that threatens mammals is even greater, and, on account of their higher intelligence and more sensitive nervous organisation, the cruelty involved in the methods of hunting, trapping, and killing them is incomparably greater.

A FOOD economy (plants) exhibit has been installed in a new case in the Central Hall of the Natural History Museum. The several sections of the exhibit comprise cereals, bread, roots and tubers and other "vegetables," nuts, the pulses, fresh fruits, beverages, and sugar and its substitutes. The plants are those most generally used in the United Kingdom for foodstuffs, and these are shown by specimens, models, drawings, and diagrams. A feature of the exhibit is the series of coloured diagrams showing the values of some typical foods in energy and in building power; comparison of the food-values of different foods is easy, as all the diagrams are on the same scale and each colour has the same significance throughout. Two interesting items appear in the bread section: one is a model of a 2-lb. loaf, the thickness of the several daily rations being indicated by black lines; the other is an analysis of 4 oz. of bread with the actual constituents of a piece of bread of this weight. Food equivalents are exemplified in another part of the case by a series of samples of foods, all of them being equal in energy-value to the 4 oz. of bread.

IN the issue of *Le Génie Civil* for April 20 M. Nicolas Flamel, a French authority, continues the discussion of the German long-range gun. Interesting information is given regarding the type of gun, powder, shell, etc. It appears that the Germans have taken one of their 15-in. naval guns and, by means of the technical process known as relining, reduced the calibre to 8·2 in. The powder is probably an ordinary slow-burning powder, the weight of the charge being increased to give the desired muzzle velocity to the gun. The shell is in two parts, the special fine-pointed head and the body. The shell has special driving bands turned on projecting portions of the body, in addition to the usual copper bands. The burster is either T.N.T. or trinitroanisol (an explosive similar to T.N.T., but having a lower melting-point). The writer of the article does not incline to the theory of a special propellant shell, but thinks the gun has been produced in accordance with the usual practice, with necessary modifications in charge, shape of shell, and other minor details.

AN extraordinary general meeting of the Institute of Chemistry was held at King's College, London, on April 27, to consider matters submitted to the institute by the Executive Committee of the proposed British Association of Chemists, having in view the desirability of effecting the more complete organisation of properly trained and competent chemists. Several resolutions were passed, among them being:—(1) That it is desirable that the council should modify the existing requirements of the institute, in order to include as many chemists as possible in the membership (associateship and fellowship) of the institute, so far as such a course is within the provisions of the royal charter of the institute. (2) That, until December 31, 1921, it is desirable that any candidate who can produce evidence satisfactory to the council of having had a sufficient general and scientific education, and of having practised pure and applied chemistry for not less than seven years, and who holds a responsible position, should be accepted as eligible to apply for admission to the associateship of the institute, provided that he has complied with the provisions of the charter of the institute with regard to age, general education, and scientific training—in chemistry, physics, mathematics, and an optional subject—and that he has passed approved examinations in those subjects. It is the intention of the council to maintain the requirements for fellowship at a decidedly high level. Every associate will be required to produce evidence that since his admission and for a period of three years therefrom he has been continuously engaged in the study and practice of chemistry in a manner satisfactory to the council; and that he has carried out original research of sufficient merit in the opinion of the council, or that he has devised processes or inventions of sufficient merit in the opinion of the council, or, in special circumstances, that he is possessed of knowledge and ability equivalent, in the opinion of the council, to having fulfilled certain specified conditions, otherwise an examination will be imposed. Steps will be taken towards closer co-operation between the work of the institute and that of the universities and colleges; the question of extending the publications of the institute will be reviewed; further endeavours will be made to bring before the public the importance of chemistry to the country, and generally to forward the interests of chemists in every way possible.

MR. SAMUEL HENRY MILLER was a native of Fenland, and lived during the greater part of his life at Wisbech and Lowestoft. Elected a fellow of the Meteorological Society so long ago as 1870, he contributed several papers to its publications, dealing chiefly with observational meteorology, in which he was keenly interested. From 1861–76 he maintained a fully equipped meteorological station at Wisbech, and from 1879–1900 at Lowestoft. An important work by him, written in conjunction with S. B. J. Skertchly and others, is "The Fenland: Past and Present" (1878), in which the principal characteristics of this famous and interesting district are efficiently described. Other works written at that time are "A Guide to the Fenlands" and "The Camp of Refuge." A record of the gales experienced round the British coasts was contributed to *The Shipwrecked Mariner* in 1887. Mr. Miller was a gold medallist and foreign member of the Society of Arts and Sciences, Utrecht, and a fellow of the Royal Astronomical Society for nearly forty years. He left Lowestoft in 1900, and spent the remainder of his life in quiet retirement at Deal, where he was buried on April 20 at the advanced age of ninety-four years.

DR. J. MICHELL CLARKE, whose death occurred at Looe, in Cornwall, on April 21, was Pro-Vice-Chancellor and professor of medicine in the University of Bristol. He was a son of the late Mr. W. Michell Clarke, of Clifton, and was educated at Dr. C. T. Hudson's school at Clifton, Clifton College, Caius College, Cambridge, Bristol Medical School, and St. Thomas's Hospital. He took the M.B. degree at Cambridge in 1885, M.D. in 1892, and became F.R.C.P. (Lond.) in 1896. At Cambridge he favoured anatomy, in which subject he held a junior demonstratorship, but experience of clinical work soon convinced him that his true vocation lay on the medical side. In London he became house physician at St. Thomas's, and on returning to Clifton settled down as a

physician. Dr. Clarke acted as lecturer on practical physiology, and later on as professor of pathology, in the Bristol Medical School; in 1907 he became senior physician to the Bristol General Hospital. He held a position of considerable influence, and was one of those chiefly concerned in the establishment of Winsley Sanatorium. Much of Dr. Clarke's scientific work was concerned with the welfare of his patients, and the list of his formal published writings is less extensive than might have been expected, though this is compensated for by the contributions, often of immediate utility, which he made to the medical journals. Amongst his writings may be mentioned "Hysteria and Neurasthenia," "Family Periodic Paralysis," "Spinal Cord Degenerations in Anæmia," and contributions to Quain's "Dictionary" and Allbutt's "System of Medicine." In 1915 he held the Bradshaw lectureship, and last year he was elected a member of the council of the Royal College of Physicians.

DR. A. H. CARTER, whose death occurred at his residence at Abingdon on April 1, was well known in Birmingham as a distinguished physician and an enthusiastic advocate of public and social work affecting the community of that great industrial centre. He was born at Pewsey, Wiltshire, and educated at Epsom College and University College, London, where his career as a student was marked by many distinctions, including gold medals in comparative anatomy, forensic medicine, and clinical medicine, also with silver medals in physiology and practical physiology. Dr. Carter took the degree of M.B. at the University of London, gaining first-class honours in physiology. In 1871 he was appointed house surgeon to the General Hospital, Wolverhampton, and two years later became pathologist at the General Hospital, Birmingham, afterwards as house physician, taking his M.D. degree in 1872. In 1876 he became a member of the Royal College of Physicians, and was elected a fellow of the college in 1881. Afterwards he was appointed physician to the Queen's Hospital, Birmingham, and became professor of medicine at Mason College, and later held the same office at the newly constituted University. Thus he was closely connected with the cause of medical education in Birmingham, and actively promoted the growth of the medical school in its affiliation to the University from Mason College. Dr. Carter's writings were mainly of a professional kind. In 1895 he published a text-book on the practice of medicine, which has reached the eighth edition. As president of the Birmingham branch of the British Medical Association in 1895 he gave an interesting address on "Rationalism in the Study and Practice of Medicine."

WE have received the seventy-eighth annual report (for 1917) of the Crichton Royal Institution, Dumfries. The physician-superintendent, Dr. Easterbrook, contributes a general account of the activities of this mental hospital. The causes of illness among the admissions for the year showed a decline due to alcoholism, but an increase due to venereal diseases. Results of ten years' treatment are discussed: the recovery rate is 35 per cent. among the certificated, and 46 per cent. among the voluntary, patients. Various experiments on potato-growing, cattle-breeding, and cattle-feeding have been carried out at the farm. The pathological research laboratory has been closed owing to the absence of the pathologist, Dr. Cruickshank, on war work. Notes on meteorological observations and data are included.

STUDENTS of animal behaviour will find some interesting facts on the "drumming" of the ruffed grouse (*Bonasa umbellatus*) in *Forest and Stream* for April, illustrated by a series of remarkable photographs, probably the first of the kind which have ever been taken. The author, Mr. F. K. Vreeland, had the good fortune to watch at close range one of these birds while "displaying," and he is convinced that the strange drumming sound then made is produced by the use of the wings alone. This may indeed be the case, but we suspect that later investigations will show that these sounds are at least partly vocal. The dissection of the syrinx would afford valuable evidence on this point. The author is apparently so much of an "outdoor naturalist" that he has never read any of the voluminous literature on this theme of courtship displays. But in some respects this adds rather than detracts from the value of his observations, since his records are made without bias.

THE deplorable results which are likely to accrue from hasty war-time legislation in regard to the Wild Birds' Protection Acts and game laws, in response to popular demand, are briefly commented upon in the *Scottish Naturalist* for April by Mr. Hugh S. Gladstone. The vindictiveness displayed towards the pheasant, he points out, is by no means justified. On overstocked estates these birds are certainly harmful to the farmer, but where the head of game is proportionate to the size of the estate they perform most useful work in clearing the ground of wireworm. It is certainly remarkable that, while we are severely penalising all kinds of "game," the French Government is making inquiries as to how best to restock the devastated area of the war-zone with partridges and hares. "It is to be hoped," Mr. Gladstone remarks, "that at no distant date there may be set up in this country an ornithological bureau similar to that already in existence in the United States."

IT is seldom realised that almost one-third of the continental part of Canada, or nearly a million square miles, must be regarded as unexplored. This is the estimate of Mr. C. Camsell, who has published in the *Geographical Review* for March (vol. v., No. 3) a map showing the location of the unexplored areas. In the same issue Mr. Camsell has a paper on some of the geographical problems awaiting solution in northern Canada. Recent discoveries have added more than 2000 square miles to the area of the Great Slave Lake, but few of its shores are yet surveyed. The Caribou Plateau, north of the Peace River, is a great unknown area, although it lies within easy access of settled regions. An even larger unexplored area lies north of Lake Athabaska, around the headwaters of the Thelon and Taltson rivers. On all sides of Hudson Bay there are huge areas which no white traveller is recorded to have crossed.

La Nature for April 6 describes a new form of voltaic cell, with electrodes of zinc and carbon in a solution of sal-ammoniac, which is due to M. Féry, and has been in use for some time on two of the French railways. The negative electrode is a plate of zinc which rests on the bottom of the glass containing-jar, the copper wire connected to it being insulated up to a point well above the level of the solution in the jar. The positive electrode is a carbon tube of diameter about half that of the jar, pierced with holes, which rests on the zinc plate, being insulated from it by an ebonite cross. The evaporation of the sal-ammoniac solution is retarded by the wooden cover. During the action of the cell the lower part of the solution becomes acid owing to the descent of the dense zinc chloride, while the upper part becomes alkaline owing to the ammonia produced. The depolarisation of the cell is effected by the air alone.

The electromotive force of the cell is 1·18 volts, and a cell giving 90 ampere-hours weighs only 2·1 kilograms.

THE work begun by Pollok and Leonard in 1905, on the spectrographic determination of metallic elements when present in solution in small quantities, has lately been extended to lithium, rubidium, cæsium, and gold by Messrs. A. G. G. Leonard and P. Whelan. The results are stated in a paper which appears in the Scientific Proceedings of the Royal Dublin Society, vol. xv. (N.S.), No. 25. In each case solutions of various strengths down to 0·001 per cent. were examined, and the tables show the relative persistency of the various lines as the concentration was diminished, thus providing a basis for quantitative analysis. Lithium and cæsium could be detected in 0·001 per cent. solutions, but rubidium and gold showed no lines in solutions of strength less than 0·1 per cent. Some of the photographs are reproduced, but, in the absence of a scale, comparison with the tables is somewhat difficult. A line at 2478 in the spectra of metallic lithium and rubidium, which the authors were unable to identify, was probably due to an impurity of carbon.

WE have examined a new astronomical model designed for use in schools and colleges by Dr. William Wilson. Those who saw the model at the Royal Astronomical Society last year must have been struck by its educational value, and will welcome the announcement that copies of it are to be placed on the market after the war, the matter of price being left for determination later. The model represents, with correct relative angular velocities and axial poses, the rotational and revolutionary movements of sun, earth, and moon, and the changes in the moon's orbit plane. Clockwork and cog-wheels are not employed, the movements being effected by taut endless strings passing over pulleys; each string has a tension regulator, easily adjusted to give the necessary tension. By slackening some of the tensions the corresponding movements are put out of action, so that the student can study simple cases, such as a planet revolving without rotation or a moon moving in the same plane as its primary. Fine adjustments are obtainable by slight alteration of the distance between the two half-discs into which the pulleys are divided; thus the severe test of the Saros eclipse cycle of 18 years 11 days was shown to be satisfied within a very small quantity; so the machine is not a mere toy, but is capable of giving graphical solutions of problems. The phases of the moon are shown by covering half of the white lunar globe by a black cap, which always keeps on the side opposite to the sun. Cones of different lengths can also be put on the moon to represent its shadow, and the production of total or annular solar eclipses. As Prof. Eddington has pointed out, the chief difficulty experienced by astronomical students is generally that of picturing relations that cannot be represented on a plane surface, but involve three dimensions. For such the model should prove very helpful. Full particulars of the model are given in an illustrated pamphlet to be obtained (post free 6*d*.) from Dr. Wilson, 43 Fellows Road, London, N.W.3.

WE have received a copy of a recent publication of the United States Bureau of Standards (Circular 67), entitled "Combined Table of Sizes in the Principal Wire Gages." This table includes the numbers and sizes in the following systems of wire gauges: American B. and S. (Brown and Sharpe), Steel (Stl.W.G.—known under the various names "Washburn and Moen," "Roebling," "American Steel and Wire Co."), Birmingham (Stubs'), British legal standard, and Metric. It gives the diameters of all the gauge numbers in these five systems in mils, inches, and millimetres, also the cross-sections in square mils, circular mils, square inches, and square millimetres. The table will probably be found useful by manufacturers who wish to determine the nearest equivalent in American or British sizes of wires, specified in millimetres or square millimetres, or *vice versa*. It should be noticed that the Stubs' Birmingham gauge is not the same as the series of sizes legalised in the United Kingdom in 1914 under the denomination "Birmingham gauge (B.G.)." The latter system is practically identical with the series of numbers and sizes issued by the South Staffordshire Ironmasters' Association in 1884, and is chiefly used for sheet and hoop iron and steel; but it is quite different from the legal American system ("Standard Gage for Sheet and Plate Iron and Steel," Bureau Circular No. 18). It is an excellent idea to issue in a handy form lists of the principal wire-gauge systems of America and the United Kingdom, and this table is likely to have a wide sphere of utility. A copy may be obtained on application to the Bureau of Standards, Washington, D.C., U.S.A.

THE tendency to utilise drop stampings has become very marked in recent years, and the advantages of these substitutes for forgings and castings have led to considerable developments in connection with munitions. Of the two chief methods of lifting the stamp steam is the older, but friction lifting is becoming more popular. Until recently the heaviest weight of tup and die dealt with by friction was about five tons, of which the tup weighed four tons. Messrs. B. and S. Massey, of Manchester, have now built two stamps capable of dealing with weights up to 9·5 tons, and these machines form the subject of an illustrated article in the *Engineer* for April 19. The stroke of the tup is 7 ft., and the lifting speed is 320 ft. per minute. Power is supplied by a 200-h.p. electric motor. The lifting mechanism consists essentially of a heavy clutch operated through a light relay clutch. The connection between the lifter and tup is made with strong woven belting 15 in. wide. When the tup is held suspended, the power delivered by the motor is dissipated in work done against friction and converted into heat; hence the necessity arises for cooling the clutch by circulating water, which in these machines is maintained in circulation by means of a pump.

AMONG the announcements of forthcoming books of science we notice the following:—"Tidal Lands: A Study of Shore Problems," A. E. Carey and Prof. F. W. Oliver (*Blackie and Son, Ltd.*); "The Production and Treatment of Vegetable Oils," T. W. Chalmers, and a new edition of "Industrial Electrical Measuring Instruments," K. Edgecumbe (*Constable and Co., Ltd.*); "Modern Engineering Measuring Tools," E. Pull, "Military Observation Balloons," E. J. Widner, and "Seasoning of Wood: A Treatise on the Natural and Artificial Processes employed in the Preparation of Lumber for Manufacture," J. B. Wagner (*Crosby Lockwood and Son*); "Savage Survivals," J. Howard Moore, and a selection of the lectures and essays of the late Prof. W. K. Clifford (*Watts and Co.*).

MESSRS. MACMILLAN AND CO.'S new list of forthcoming books includes a new edition of "An Elementary Treatise on Curve Tracing," Dr. P. Frost, revised by Dr. R. J. T. Bell; "The Statesman's Year Book, 1918," edited by Sir J. Scott Keltie, assisted by Dr. M. Epstein; "The Military Map: Elements of Modern Topography" (French School of War), complete in one

volume, with maps; "Examination Papers in Elementary Engineering," R. M. Milne; "Alcohol and Life: A Manual of Scientific Temperance Teaching for Schools," J. A. Hunter, illustrated; "Essentials of Practical Geography," B. C. Wallis (Practical Modern Geographies); "A Geography of America," T. Alford Smith (Practical Modern Geographies).

OUR ASTRONOMICAL COLUMN.

MINOR PLANETS.—Mr. H. E. Wood records a number of minor planets on plates taken last year at Johannesburg. They have been identified by M. Louis Fabry (Marseilles Circular, No. 10). The most interesting is 722 Frieda; this planet had not been observed since its discovery in 1911, so its recovery is fortunate. The *Astronomical Journal*, No. 729, contains elements of an unidentified planet discovered at Washington by Mr. G. H. Peters last November. It may be identical with 293 Brasilia, 1906 WF, or 1911 LU. If new, he proposes the name Washingtonia. Prof. Barnard followed the Wolf planet DB until April 4, when its magnitude was 15. It has been so well observed that it ought to be possible to secure its re-observation at the next perihelion in 1922.

THE CEPHEID VARIABLE SU CASSIOPEIÆ.—Further investigations of this interesting variable star have been made by W. S. Adams and H. Shapley (*Astrophysical Journal*, vol. xlvii., p. 46). Mr. Shapley had already shown that the variation could not be interpreted as the result of the rotation of a simple ellipsoidal body, and the conclusion that the star is a Cepheid has been verified by the new spectroscopic observations. The range of photographic magnitude, according to Parkhurst, is from 6·52 to 6·99, and the variations of radial velocity, −18 to +4 km., are correspondingly small. A period of 1·9495 days satisfies both series of changes, and the epoch of maximum negative velocity precedes the maximum of light by 0·05 day. The spectral type varies from A9 at maximum to F5 at minimum. Taking the visual magnitude as 6·23, as given by Boss, the spectroscopic parallax is identical with that derived by Van Maanen, namely, $+0{\cdot}010'' \pm 0{\cdot}003''$.

NEW DOUBLE STARS.—Mr. R. G. Aitken's twenty-fourth list, giving details of 100 new double stars, appears as Lick Observatory Bulletin No. 306. This observer's systematic survey of the sky was initiated in 1899, and the present list brings his total published discoveries up to 3000, the region covered being from the pole to declination 14° S., and to declination 22° S. from 13h. to 1h. right ascension. All the stars included are under 5″ in distance, and in the present list nearly half are less than 1″ apart, while sixteen do not exceed 0·3″. The brightest star included is 41 Ophiuchi, the components of which are rated as magnitudes 4·6 and 7·6, the position angle and distance being 298° and 0·52″ respectively.

JOURNAL OF THE CHALDEAN SOCIETY.—We have pleasure in directing attention to a small astronomical magazine which is issued quarterly by the Chaldean Society under the title of *The Chaldean*. The publication has now reached No. 10 of the first volume, and while dealing with astronomy generally, its special appeal appears to be to observers of meteors. The recent issue includes an article on astronomical photography, and several notes on meteors by Mr. Denning and others. A feature of particular interest is a facsimile of a page from the observation book of the late Prof. A. S. Herschel, which furnishes a good example of the method of recording meteors. Communications should be addressed to the editor, Mr. J. Hargreaves, Bennington, Stevenage, Herts.

RECENT WORK IN MINERALOGY AND PETROLOGY.

A MINERAL variously labelled johannite and uranopilite in collections has yielded to Messrs. E. S. Larsen and G. V. Brown the composition $RO.UO_3.SO_3.4H_2O$, where $R=Cu,Fe,Na_2$ (the *American Mineralogist*, vol. ii., p. 78, 1917). The new species thus indicated is called gilpinite, from the typical locality Gilpin Co., Colorado; but a Cornish specimen, one of those styled uranopilite, proves to be identical. The authors insist that optical tests under the microscope are characteristic, and that their application shows that more than one-third of the hundred specimens of "secondary uranium minerals" examined from various museums are incorrectly labelled.

Mr. A. E. V. Zealley, in "Notes on Newly Recorded Rhodesian Minerals" (Proc. Rhodesia Sci. Assoc., vol. xvi., p. 17, 1917), includes an account of the stanniferous tantalite of the Victoria tinfield, discovered in 1911, but not hitherto described. Two other Rhodesian occurrences of tantalite are noticed.

Messrs. R. C. Wells and B. S. Butler describe (Journ. Washington Acad. Sci., vol. vii., p. 596, 1917) a mineral sulphide of tungsten, under the name of tungstenite. The composition is probably WS_2, and the specific gravity is near 7·4. It looks like graphite, and has a hardness of only 2·5. This mineral occurs in some abundance in a vein with galena, pyrite, tetrahedrite, and argentite, in Salt Lake Co., Utah.

The view advanced by Mr. J. B. Scrivenor in 1910–14 as to the age of the detrital tin deposits of the Kinta district, Perak (see NATURE, vol. xciv., p. 348), has now been disputed in a detailed paper by Dr. W. R. Jones (Quart. Journ. Geol. Soc., vol. lxxii., p. 165, 1917). Mr. Scrivenor urged that these bouldery deposits were derived from the surface of Gondwanaland during the Permian ice-age, which is responsible for the Talchir Beds of India. Dr. Jones, however, connects the tin ore with the Mesozoic granite now *in situ* in the district, and he brings forward strong evidence to show that there is only one alluvial tin-bearing series in Kinta, instead of two, superposed on one another, and separated by a long geological interval.

Those acquainted with the work of Mr. W. H. Goodchild on the Insizwa Range in the Cape Province (Inst. of Mining and Metallurgy, Bull. 147, 1916) will welcome the publication of Dr. Du Toit's researches in the area, extending from 1903 to 1912 (Du Toit and Rogers, "The Geology of Part of the Transkei," South Africa Geological Survey, Explanation of Sheet 27, 1917). The geological map, showing a magnificent series of dolerite sills, penetrating the Karroo strata up to the highest Stormberg beds, is now also issued, on a scale of 1 : 247600. The Insizwa gabbro, with its copper ores bearing nickel and platinum, is included in the north-east of the sheet, and the memoir contains a map showing the whole of the gabbro-norite masses. The three sulphides—chalcopyrite, pentlandite, and pyrrhotine—have separated from the igneous rock in the order in which they are here named, as a gravitative differentiation-product in the concave floor of a great sill. Forty-five miles of visible contact along the base of this sill await systematic exploration. The occurrence is discussed, in comparison with that at Sudbury, in the recently issued report of the Ontario Nickel Commission.

Prof. R. A. Daly ("Low-temperature Formation of Alkaline Felspars in Limestone," Proc. Nat. Acad. Sci., vol. iii., p. 659, 1917) describes a dolomite from Waterton Lake, on the Montana and Alberta border, which contains 34·5 per cent. by weight of orthoclase and

3·1 per cent. of albite. The author compares this with recorded occurrences of albite in Jurassic and other unmetamorphosed limestones in Europe. Issel's discovery (*Comptes rendus,* February 24, 1890) of albite crystals enclosing radiolaria in a Cainozoic limestone may be added to those quoted. Prof. Daly concludes that the alkaline felspars of Waterton crystallised out, like the European examples, at the sea-floor, or soon after the burial of the associated dolomite, and at temperatures which may have been well under 100° C. Time, he points out, may be an important factor, and this has to be borne in mind in experimental work on such productions.

Mr. W. A. Tarr (*Amer. Journ. Sci.,* vol. xliv., p. 409, 1917) has examined with much care the elongated chert-lumps in the Burlington Limestone of Missouri, a formation of Lower Carboniferous age. Because he finds no remains of siliceous organisms associated with the chert, and only a partial replacement of originally calcareous fossils, he criticises the view that flint is commonly a pseudomorph of portions of the limestone in which it occurs, and remarks that, had the first investigations been made on material collected in Missouri, the theory that attributes the material of flint in other cases to the solution of organic remains would not have been propounded. This shows that the author attaches little weight to the mass of evidence collected outside Missouri; yet his reading has evidently been extensive. No reference is made to the frequent occurrence of silicified oolitic rocks, from the Assynt Limestone upwards, in which all the structure of the original limestone is retained, nor to the remarkable suggestion made by R. Liesegang as to the rhythmic deposition of flint layers by water holding silica in solution. Mr. Tarr does well to emphasise the fact that flint formation goes on at an early stage in the consolidation of limestone, since pebbles of the flint are often found in the next following deposits; but it does not follow from this that flint nodules represent gelatinous matter precipitated directly on the sea-floor. The shrinkage-cracks in the Missouri flint, filled by limestone, and Mr. Tarr's interesting experiments on the precipitation of silica, help towards his conclusion that the flint in the Burlington Limestone is not a replacement of the calcareous rock; but this by no means disposes of the cases where flint masses spread out into successive layers of a limestone, or of the thousands of sections from Cretaceous or Carboniferous material that are stored in European collections. We read this paper with the feeling that, if Mr. Tarr has proved his case for the Missouri example, he has dealt with an exceptional occurrence which certainly deserved description.

It is characteristic of the association of the sciences in technical industries that geologists should be asked to look for "pulpstones." Mr. L. H. Cole has, in consequence, tested certain Canadian sandstones "to determine their suitability as pulpstones" (Canada, Dept. of Mines, Mines Branch, Bull. 19, 1917). These are used in wood-pulp mills, and should tear the fibres apart rather than cut them. In the case of sandstones, the grains should be of medium size and medium angularity, and the stone must resist considerable stresses. Diagrams of the grinding machines add interest to this useful bulletin.

Mr. H. Ries describes a gritty plastic "clay" resembling löss (*Amer. Journ. Sci.,* vol. xliv., p. 316, 1917), which proves to consist of 98·5 per cent. of small crystals of dolomite and 1·5 per cent. of iron oxide and alumina. He suggests that the flat faces of the dolomite rhombs, coming into contact or separated only by a film of water, may account for the plasticity, surface tension holding the grains together, but allowing of slipping along their faces.

The phosphate deposits of Saldanha Bay, north-west of Cape Town, have been reported on by Dr. A. L. Du Toit (S. Africa Geol. Survey, Mem. 10, 1917). The material contains from 10 to 22 per cent. of phosphoric oxide; but this is mostly combined with aluminium and iron, having been produced by the action of ancient guanos on underlying granitic rocks. The author discusses the value of such phosphates as fertilisers, making no attempt in his summary to reconcile the somewhat contradictory statements of agricultural chemists, but pointing out the need for experiments on natural lines under biochemical conditions. His proper mistrust of Germany should not have led him into the error of asserting that the citric acid test of availability of phosphorus was "devised in Germany for the purpose of enabling that country to supply the markets of the world with highly citric-soluble basic slag."

Mr. T. A. Jaggar, jun. (Journ. Washington Acad. Sci., vol. vii., p. 277, 1917), describes the phenomena presented by the *aa* and *pahoehoe* types of Hawaiian lava during the cooling of the mass. He suggests that the quantity of confined gas for each unit of volume of melt may be a controlling factor. The expansion of gas in the *aa* type may be more rapid, but "with so many variables there is no cause for wonder that the distinction is as yet unexplained." The author proposes the term "dermolith" for the *pahoehoe* type, which has a crust or skin as its chief character, and the term "aphrolith" (foam-stone) for types of lava which divide on the surface, like *aa*, into lumpy vesicular units. He prefers "lith" to "lite" as a termination, on the well-established analogy of "monolith."

Prof. R. A. Daly has furnished a useful synopsis of our knowledge of the nature of rocks in the Pacific islands (Bull. Geol. Soc. America, vol. xxvii., p. 325) and urges that much more observation is required. He believes that, so far as can be judged at present, the primary magma under the Pacific is of basaltic composition, giving rise to andesites and picrites by differentiation, and to alkaline rocks by solution of comparatively small proportions of limestone.

G. A. J. C.

THE BIRD CULT OF EASTER ISLAND.

IN the issue of *Folk-lore* for December last Mrs. Scoresby Routledge gives a singularly interesting account of the bird cult of Easter Island. The sacred bird is the sooty tern (*Sterna fuliginosa*), and the valued privilege of securing the first egg is a matter of competition between members of the Mata-toa group, the right to become a competitor being acquired only by supernatural agency. The selection is made through a dream vouchsafed to a divinely gifted individual, the Iviatua. The candidate on selection takes a new name, and the bird-name thus conferred was given to the year in which victory was achieved, thus forming an easily remembered system of chronology. It is also significant that this bird cult is connected with the statues for which the island is famous. The bird-man used to spend his official year on the mountain in which the monoliths were quarried; the bird initiation of children was also performed in connection with the statues, and the ring design on the back of the images was reproduced at the ceremony on the children's backs. There seems reason to believe, says the writer, that the people who originally celebrated the bird cult included in it reverence for the statues. The ancestors of the present inhabitants were, therefore, either the makers of the monoliths of Easter Island, or, if the bird worshippers represent a more

recent migration, the old religion of the images was blended into, and perpetuated by, the more recent culture.

The conclusions of Mrs. Scoresby Routledge have been extended by a second paper in the same issue of *Folk-lore* by Mr. Henry Balfour on the ethnological affinities of the natives of Easter Island. He arrives at the conclusion that the island culture is composite, and exhibits traces of fusion of at least two stocks. The first was a Melanesian migration, which introduced the practice of distending the ear-lobe, a characteristic style in art, certain special types of stone implements, and the cult of the frigate-bird, which was designed as a magical method of increasing the food supply. This Melanesian culture was submerged by a wave of Polynesian immigrants, to whom is due a new bird cult, aiming at increasing in a like magical way the supply of birds and eggs. This culture seems to be closely allied to that of the Solomon Islands, and "it seems likely that the symbolism of many of the ideographic signs employed in the Easter Island script may be explained by a study on the spot of closely similar designs still used in the Solomon Islands, the symbolic significance of which might be ascertained before it is too late." Thus a survey of the materials collected by Mr. and Mrs. Scoresby Routledge, interpreted by the wide ethnographical knowledge of Mr. Henry Balfour, seems to bring us at last within reach of a solution of the mystery of Easter Island. It may be hoped that the clues suggested by him will be followed by some careful local anthropologist.

SCIENTIFIC ACTIVITIES OF THE SMITHSONIAN INSTITUTION.

THE report of the secretary of the Smithsonian Institution for the year ending June 30, 1917, has been received from Washington. It reviews the affairs of the institution, summarises briefly the operations of its several branches, and, in addition, contains, in the form of appendices, detailed reports by the assistant-secretary and others directly in charge of its various activities.

The permanent fund of the institution now amounts to 200,000*l.*, the limit authorised by Congress. The income during the year under review reached 17,730*l.*, and with the cash balance from the previous year the total resources for the financial year amounted to 26,672*l.* The disbursements for the same period were 24,830*l.*

The former secretary of the institution, the late Prof. S. P. Langley, demonstrated in 1896 the feasibility of mechanical flight by a machine heavier than the air propelled by its own power. As an indication of America's debt to his researches, his name is fittingly preserved in the name "Langley Field," a tract of some 1800 acres near Hampton, Va., where important experiments in aviation are now being carried on. The large machine with which Prof. Langley experimented in 1903 proved its worth and its capability of flight during the year reviewed by the report. The institution has established a research laboratory at Langley Field for scientific investigations, and among several sub-committees engaged in the study of aeronautic problems may be mentioned those on aerial mail service, aero torpedoes, aircraft communicating, airplane mapping, the relation of the atmosphere to aeronautics, and the construction and navigation of aircraft.

The usual activities of the institution were continued during the year in carrying out one of its fundamental objects, the increase of knowledge. Various explorations and researches were inaugurated or participated in by the institution, covering the different divisions of astronomical, anthropological, biological, and geological science; but the secretary points out that opportunities for undertaking important lines of investigation are constantly being lost through lack of means to carry them into execution. Moreover, several proposed expeditions to various parts of the world have been delayed temporarily by the war.

The report directs attention again to the work of the Research Corporation, organised in 1912, and having as its officers men particularly interested in the development of industry. The principal income of the corporation is derived from royalties for the use of the Cottrell process for the electrical precipitation of suspended particles. Dr. F. G. Cottrell, the inventor of the process, offered his patents to the Smithsonian Institution, but as it was impracticable for the institution to administer them commercially, the Research Corporation was organised for that purpose. The corporation seeks to do for industry what other institutions are doing for science, for medicine, and for the improvement of social conditions. An annual fellowship has been established "open to general competition for the purpose of encouraging and assisting men of science in the prosecution of their investigations." To the successful competitor the corporation offers an honorarium of 500*l.* and the assistance of the corporation in securing the most favourable opportunity for prosecuting the particular object of study.

The additions to the libraries of the institution and its branches during the year numbered more than 9000 volumes and pamphlets. Among important gifts were a first consignment of 561 volumes and 293 pamphlets, part of the botanical library of Dr. J. D. Smith, of Baltimore, and the scientific library of Dr. E. A. Mearns, an American zoologist who died in 1916.

With the secretary's report for 1917 may be noticed conveniently the annual report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1916, which has now come to hand. This handsome and well-illustrated volume of 608 pages includes the secretary's report for 1916, to which we directed attention last year; but its most attractive feature is the comprehensive general appendix, with its invaluable selection of miscellaneous scientific memoirs intended for the use of correspondents of the institution, teachers, and other workers engaged in the promotion of knowledge. Among the memoirs are original contributions, translations from foreign periodicals, and reprints from scientific serial publications printed in English.

The original contributions include papers by Prof. C. G. Abbot, director of the Astrophysical Observatory of the institution, on news from the stars; Prof. Paul Bartsch, curator of marine invertebrates in the U.S. National Museum, on pirates of the deep—stories of the squid and octopus; Prof. Albert Mann, on the economic importance of the diatoms; Mr. W. E. Safford, economic botanist to the U.S. Department of Agriculture, on narcotic plants and stimulants of the ancient Americans; Dr. J. W. Fewkes, on a prehistoric Mesa Verde Pueblo and its people; and Mr. Van H. Manning, on mine safety devices developed by the United States Bureau of Mines.

The translations include an address by Prof. A. Pictet, professor of chemistry at the University of Geneva, on molecular structure and life, published in the *Revue Scientifique* and the author's "Extrait des Archives des Sciences physiques et naturelles, Geneva, 1915"; a lecture delivered in German in 1914 in Vienna by Prof. F. Berwerth, on the origin of meteorites; and a lecture given in French by Prof. M. Caullery, exchange professor at Harvard University in 1916, on the present state of the problem of evolution.

PHYSICAL WELFARE AND PUBLIC LIBRARIES.

THE fourth annual report, that for the year ending December 31 last, was submitted to the trustees of the Carnegie United Kingdom Trust by the Executive Committee on February 26, and some of the matters dealt with in it are here summarised. The administration of the trust during the year was not an easy task. Restrictions of various kinds arising out of the war have militated against smooth and rapid progress, but the record of work done is, both in quality and amount, satisfactory.

The new developments opened up by the Executive Committee, with the approval of the trustees, are described in the report. The normal income of the trust in 1917 amounted to 124,419*l.*, and the grant promises made by the trustees in connection with these new developments reached for the year the total of 122,174*l.* For the last three years, during which the trust may be said to have been in full operation, the average amount of grant promises per annum has been 127,517*l.*, and the average normal income for the three years in question 11,528*l.* less than that sum. The income for the year 1917 may, however, be regarded as the minimum income available in the future, but even that figure is slightly less than the average grant commitment for the last three years.

Infant Welfare Centres.

The physical welfare of mothers and children, with all that is implied in that comprehensive phrase, has occupied public attention largely in recent months, and the committee's labours have also been directed towards furnishing, within the limits of its powers, some assistance in the solution of this national problem. The elaborate surveys referred to in the last annual report have been completed and published.

The committee has determined to erect and equip buildings for six infant welfare centres in urban areas in the United Kingdom. Broadly speaking, the centres will comprise an infant clinic, pre-natal clinic, school for mothers, and nursery, and the necessary accommodation for the staff. These buildings will be maintained by the local authority concerned by means of local rates and Imperial grants, and will be given on the following conditions:—That a suitable site is provided, and that the plans and estimates for the building prove acceptable to the trustees; that the authority undertakes the efficient maintenance of the centre as a part of its comprehensive system of physical welfare approved by the Local Government Board for the purpose of Imperial grants; and that full reports of the work of the centre are submitted to the trustees annually.

In selecting the urban areas to which the offer described above has been made, the committee has been influenced in the main by the likelihood of the local authority affording to the experimental institution the best chance of permanent success. The following towns have received and accepted the trustees' offer of assistance:—Birmingham, Liverpool, Rhondda, Shoreditch, Motherwell and Dublin.

Central Institutes.

Representation has been made to the committee that it might be extremely useful to Government Departments, local authorities, and voluntary organisations if a central institution were created the activities of which might serve to assist the movement generally. Under suitable conditions and with fully representative management such an institute might be of great value not only to voluntary workers, but also to authorities throughout the country. Its main functions would include the following:—(*a*) To form independent opinions in regard to the desirability or need of certain courses of action or policy, which could, when necessary, be presented to Government Departments or local bodies with the weight of recognised authority behind them; (*b*) to encourage, and to some extent direct and co-ordinate, experimental work by voluntary agencies which, if shown to be successful, could be recommended for official consideration; (*c*) to organise a thoroughly efficient information bureau by means of which inquirers could obtain full, accurate, and up-to-date knowledge of arrangements made both in this country and abroad for maternal and infant welfare, in addition to assistance and advice in regard to any investigation or personal work they desired to undertake; (*d*) to provide an adequate library of reference of English and foreign literature bearing on the subject; (*e*) to organise conferences, meetings, lectures, etc., for the instruction of those interested in infant welfare and for the education of public opinion in matters relating thereto; (*f*) to consider the training desirable for workers in maternity and infant welfare centres, health visitors, etc., and to formulate conditions of training which might be accepted as the standard for the country as a whole.

Accordingly, the committee has decided to provide the necessary accommodation and equipment for two institutes of this character—one to be situated in London and one in Edinburgh. The trustees will be responsible only for the capital outlays involved, and will not be concerned with the provision of the income required to maintain the institutes, although they will need to be satisfied that proper financial support is forthcoming. It is not contemplated that the function of the institutes will, in any way, supersede or encroach upon the proper spheres of the various voluntary and statutory bodies, and funds for their efficient administration ought not to be difficult to find, having regard to their wide sphere of usefulness. Preliminary consideration has already been given to the organisation of the two institutes referred to, and there seems every prospect that the suggestions will prove acceptable.

Travelling Welfare Exhibition.

In connection with the valuable report for Scotland received from Dr. Leslie Mackenzie, the committee's attention was directed to the useful work undertaken by the Travelling Welfare Exhibition inaugurated by the National Union of Women Workers of Great Britain and Ireland. The work consists essentially in preparing the ground and educating public opinion as to the necessity for higher standards of domestic hygiene as applied to mothers and children. In order to extend the opportunities afforded by the exhibition, the committee has agreed to render financial assistance to the National Union of Women Workers in order that a second travelling exhibition may be set on foot in Scotland and two similar exhibitions established in England and Wales. The need for propagandist work of this nature ought to be only temporary, but it is important that it should be undertaken immediately in order that public opinion, particularly in the less advanced communities, may be prepared to welcome the larger ideals of national service to which Imperial and local effort will presently be directed.

Play Centres.

Another aspect of the problem which has engaged the attention of the committee is the question of the fuller provision of play facilities for children. The Government Education Departments have realised the possibilities for good which might arise from the efficient administration of centres, where children may have recreation after school hours, and grants are now

available for the assistance of municipal effort in this direction. In certain cases, however, the initial equipment of ground suitable for the purpose, which has already been acquired by local authorities, might prove an obstacle in the way of the early establishment of play centres. The committee, therefore, proposes to consider favourably applications for grants from local authorities for the preparation and equipment of such open spaces for children's playgrounds, on condition that the authorities are prepared to maintain them.

Library Policy.

The committee expressed the view last year that consideration of library matters should not be deferred entirely on account of the war, and that steps should be taken to strengthen a movement which will occupy a place of increased importance after the cessation of hostilities, when various reconstructive measures—educational and social—will call for prompt attention. Endorsement of this view has been given by the increased interest taken in libraries, and their future position in the educational system of the country, by those who are engaged in the consideration of reconstruction after the war. Probably the library movement has never before received the same degree of public attention as during the past twelve months.

"There is a universal consensus of opinion in the library world that the greatest barrier to progress with which the public library movement is confronted is the present limitation of rate aid; in this view the committee fully concurs. It is useless to expect the library movement to fulfil its enlarged function in the educational system of the future, unless adequate means are forthcoming for its efficient development and maintenance." From time to time suggestions have been placed before the trust to the effect that it might supplement by endowment the meagre incomes at present available, and so make up for the deficiencies which exist in numerous instances owing to the inadequacy of the rate produce. Any step of this character would, in the opinion of the committee, be disastrous, and inevitably postpone the day when larger rating powers are placed within the reach of local authorities.

The Library Association has instituted an inquiry into the existing provision of scientific and technical literature in public and other libraries in the United Kingdom. Probably there is no branch of public library work relatively so neglected at the present time as that which deals with technical literature. The reason is not far to seek. Technical books bearing on industrial operations, scientific and commercial, are costly, and rapidly become out-of-date. The meagre income available for the purchase of books does not, as a rule, allow of extensive outlay in this direction. Book selection committees are apt to look askance at proposals which involve a substantial expenditure for the acquisition of a single work. But in the future, when the public libraries become more closely correlated with the educational system of the country, their reference sections will come to be of increasing importance. The existing state of affairs needs further examination, and the trust has responded to an appeal from the Library Association in order that a complete review may be obtained.

The activities of the Central Library for Students have continued to widen, and its work has promise of considerable importance in the future. The function of the library is to supply students with the loan of necessary books which they are not in a position to obtain otherwise. The books are lent, as a rule, to classes organised under the Workers' Educational Association, the Adult School Movement, or other similar organisations of working men and women engaged in systematic courses of study; they are also lent to individual students. At the present time there is necessarily a considerable number of students who are prevented from following their studies in the usual manner by reason of their absence from the United Kingdom. In neutral countries and in enemy countries hundreds of students are interned, and consequently cut off from access to text-books. The British Prisoners of War Book Scheme is a voluntary organisation expressly constituted to supply books and literature to British subjects so situated. In normal times these students would have enjoyed the facilities provided by the Central Library for Students, and the committee has accordingly made a special grant to the Central Library in order that the organisation named above may supply more adequately books of study to those who are at present abroad. It is hoped that on the cessation of hostilities these books will be returned to this country, and, in that event, it has been arranged that they shall be handed over to the Central Library as a permanent addition to its contents.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. THOMAS J. MACKIE has been appointed professor of bacteriology in the South African Medical College, Cape Town.

THE impending resignation of the chair of materia medica and clinical medicine in the University of Edinburgh by Sir Thomas R. Fraser, F.R.S., is announced.

MR. F. J. HARLOW has been appointed to succeed Dr. R. S. Willows as head of the mathematics and physics department of the Sir John Cass Technical Institute.

DR. T. FRANKLIN SIBLY has been appointed professor of geology at Armstrong College, Newcastle-upon-Tyne, in succession to the late Prof. Lebour. Dr. Sibly has been since 1913 professor of geology at University College, Cardiff, and was lecturer in geology at King's College, London, during the preceding five years. He was an 1851 Exhibition Research Scholar in 1905–7, and is a doctor of science of both London and Bristol Universities.

THE course of public lectures on "Some Biological Problems of To-day" will be continued in the second term at University College, London, on Mondays, at 5 p.m. instead of at 4 p.m., as in the first term. Major Martin Flack, member of the research staff of the National Medical Research Committee, will lecture on "The Physiological Aspects of Flying" on May 6; and Dr. H. M. Vernon, of the University of Oxford, will lecture on "Industrial Efficiency and Fatigue" on May 13. Further particulars of the course may be obtained by sending a stamped addressed envelope to the Secretary, University College, London (Gower Street, W.C.1).

A SERIES of pamphlets urging the national necessity for the passage of the Education Bill, providing compulsory whole-time education until the age of fourteen and compulsory part-time education for some years afterwards, has been issued and distributed by the Messrs. Tootal Broadhurst, Lee Co., Ltd., of Manchester and London. A set of four leaflets is entitled "The Great Decision," and the various parts are called "Now or Never," "Our Success or Failure," "A Just Complaint," and "A First Step." Throughout they urge the paramount importance of improved educational facilities, if the future well-being of the nation is to be assured. Over and above the proposals of the Education Bill, one leaflet urges that "a straight road to the university should be open to all who desire the fullest development of their intellect. Only by

such provision for complete knowledge of the arts and sciences can we as a nation maintain our place in the world." Each of the pamphlets appeals to the reader in the following words:—"For your own sake, your children's sake, your country's sake, do all *you* can to push through the Education Bill. Get in touch with your M.P."

THE following letter from Lord Stamfordham, the King's private secretary, has been received by Mr. Fisher, President of the Board of Education:—"It has given the King and Queen much pleasure to visit recently schools of various types, and thus gain an insight into the daily life of the rising generation at work and at play. Their Majesties are aware of the magnificent response which the educational service throughout the country has made to the demands of the present time, not only in its contribution to the fighting forces, but also in the assistance which it has rendered in many kinds of important war work. Above all, they wish to express their admiration of the self-denial and devotion of the teachers, who, it is evident, while training the mind and body of their pupils, recognise the importance of the formation of character. These visits have brought home to the King and Queen the keenness and patriotism of the youth of the country. They realise the unselfish and hearty manner in which boys and girls, inspired by the example of their teachers, have formed War Savings Associations, subscribed money for charitable purposes, and, by their handiwork, contributed to the personal needs and comforts of the troops. Their Majesties feel that the nation can be proud of its young sons and daughters, whose example during this great war augurs well for the future of our race. I am commanded to request you to convey to the school authorities and teachers the hearty congratulations of the King and Queen upon the admirable manner in which the public service of education is being maintained, the progress of which their Majesties will ever watch with interest and sympathy."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, April 17.—Sir Napier Shaw, president, in the chair.—E. G. **Bilham**: The variations of underground watel-level near a tidal river. The paper is chiefly devoted to a comparison of records from the Kew Observatory water-level recorder and the Richmond Lock tide-gauge for a period of two years beginning May, 1914. The seasonal variations, determined from lunar-monthly means, were found to be very similar, as was to be anticipated on general grounds. A better method of determining the extent to which the variations of subsoil water-level were directly controlled by the River Thames consisted in the analysis of the well records to find tidal oscillations analogous to those which were well-marked in the river. The well responds but slightly to the lunar semi-diurnal tide, but the lunar-fortnightly oscillation is well reproduced with a lag of five days and a reduction of amplitude in the ratio of 1 to 14 (approximately). After allowing for the direct action of the river, the well is found to be very sensitive to local rainfall during winter months. The effects of rainfall upon river-level and underground water-level appear to be in many respects closely similar.—J. **Fairgrieve**: Suggestions as to the conditions precedent to the occurrence of summer thunderstorms, with special reference to that of June 14, 1914. The paper deals particularly with the thunderstorm of June 14, 1914. The meteorological phenomena accompanying the rainfall are put on record. The cloud distribution, the barometric pressure, the wind movements, and the temperature are specially dealt with. From an examination of the data it is evident that the clouds and the rainfields lie in parallel belts, and that the former appear some hours before the rain begins to fall. It is suggested that this belting of wind and rain may be due to rippling on a large scale, the rippling being brought about by the interaction of two currents of different temperatures. If the conditions are unstable, and especially if relief also induces disturbance, thunderstorms will develop along lines of rippling, and will drift with the wind. Thunderstorms have apparently three movements, a development along a belt, a sideways movement in the direction of the prevailing wind, *i.e.* to leeward, and a spread to windward. The first may be due to rippling; the second is a drift; the third may be explained if it is granted that a local ridge of high pressure develops along the axis of the thunderstorm. The thunderstorm then breaks up into two belts, of which the leeward soon dies out owing to the lack of a supply of rising air.

PARIS.

Academy of Sciences, April 8.—M. Paul Painlevé in the chair.—Col. **Vallier**: Obituary notice of Gen. Zaboudski. Gen. Zaboudski, correspondant in the section of mechanics, was assassinated in Petrograd in March, 1917, but his death has only recently come to the knowledge of the Academy.—A. **Lacroix**: Some sodium rocks, lode-like in character, of the Archipelago of Los, French Guinea. Thirteen minerals are described and complete analyses given. Even in the rocks most removed from syenites the alkaline character persists, with a predominance of soda over potash. The connection between the lodes and the surrounding syenites is also indicated.—E. **Fournier**: The causes and effects of the resistance of water to the translation of ships' hulls.—L. **Maquenne** and E. **Demoussy**: The influence of acids on germination. Care has to be taken to prevent the disturbing influence of calcium salts on the experiments, calcium derived either from the water or from the integuments of the seeds themselves. It is concluded that the mineral acids, even in extreme dilution, are poisonous and hinder germination.—E. **Ariès**: The anomalies presented by the saturated vapour pressures of certain diatomic liquids. A comparison of the formula derived by the author in previous communications with the experimental figures for oxygen and nitrogen shows marked differences; the data for nitric oxide are also not in agreement with the calculated figures. The causes of the divergence are discussed.—B. de **Fontviolant**: Strains developed in bridges with straight girders, with double lines, when one line only is loaded.—D. **Eydoux**: Conduits closed at both ends. Accumulators and buffer cylinders.—E. **Baticle**: The determination of the most advantageous dimensions of the principal elements of a hydraulic installation.—A. **Mailhe** and F. de **Godon**: A new preparation of the methyltoluidines by catalysis. The method described in a preceding communication of preparing monomethylaniline and dimethylaniline by passing a mixture of the vapours of methyl alcohol and aniline over alumina heated to 350° to 400° C. is now shown to be applicable to the preparation of the methyltoluidines.—E. **Belot** and C. **Gorceix**: The experimental reproduction of the formation of great mountain chains.—E. **Hesse**: *Caulleryella anophelis*, a schizogregarine parasite of *Anopheles bifurcatus*.—R. **Combes**: The equine paratyphoid bacillus.—A. **Vernes**: The precipitation of an organic colloid by human serum, normal or syphilitic. It is shown to be possible so to regulate the state of a colloidal suspension that it can be flocculated by syphilitic serum, and not flocculated by normal serum.—R. **Dubois**: The synthesis of luci-

ferine. Luciferine can be synthesised by the action of coluciferase upon taurine.

April 15.—M. L. Guignard in the chair.—G. **Humbert**: The representations of an integer by certain indefinite quadratic forms.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: The density of the blood after great hæmorrhage. With loss of blood there is a progressive lowering of the density, and the determination of the density of the blood gives a better measure of the loss through a wound than any other method available.—G. A. **Boulenger**: Considerations on the affinities and geographical dispersion of the Lacertidæ.—G. **Julia**: Rational substitutions.—R. **Garnier**: The irregular singularities of linear equations.—M. **Valiron**: The maximum of the modulus of entire functions.—M. de **Pulligny**: Some new remarks on the approximate quadrature of the circle.—E. **Hernandez-Pacheco**: The Cambrian of the Sierra de Cordoba, Spain.—L. **Gentil**, M. **Lugeon**, and L. **Joleaud**: The age of the pre-Riffian layers and the crushing of the South Riffian Strait, Morocco.—H. **Perrotin**: The nocturnal cooling of the lower layers of the atmosphere.—J. **Legendre**: The biology of the Madagascan perch.—M. **Heitz-Boyer**: An attempt at the mechanical reduction of fractures.

BOOKS RECEIVED.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. iii., Gypsum and Anhydrite, by Dr. R. L. Sherlock and B. Smith; and Celestine and Strontianite, by Dr. R. L. Sherlock. Second edition. Pp. iv+64. (London: H.M.S.O.) 2*s*. net.

Story Lives of Great Scientists. By F. W. Rowbotham. Pp. 266. (London: Wells Gardner and Co., Ltd.) 3*s*. 6*d*.

A Flora of Epsom and its Neighbourhood. By the Rev. T. N. Hart Smith-Pearse. Pp. 107. (Epsom: L. W. Andrews and Son.) 3*s*. 6*d*. net.

The Manufacture of Intermediate Products for Dyes. By Dr. J. C. Cain. Pp. xi+263. (London: Macmillan and Co., Ltd.) 10*s*. net.

A Check List of North American Amphibians and Reptiles. By L. Skejneger and T. Barbour. Pp. 125. (Cambridge, Mass.: Harvard University Press.) 10*s*. 6*d*. net.

British Museum (Natural History). Report on Cetacea Stranded on the British Coasts during 1917. By Dr. S. F. Harmer. Pp. 5 to 21. (London: British Museum (Natural History).) 2*s*. 6*d*.

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. iv., No. 2, Cephalodiscus. By Dr. W. G. Ridewood. Pp. 11–82. (London: British Museum (Natural History).) 12*s*.

DIARY OF SOCIETIES.

THURSDAY, MAY 2.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—Nerve-End Cells in the Dental Pulp: Dr. J. H. Mummery.—The Nature of Growths in Colloidal Silica Solutions: H. Onslow.

ROYAL SOCIETY OF ARTS, at 4.30.—The Freedom of the Seas: Gerard Fiennes.

LINNEAN SOCIETY, at 5.—A New Fresh-water Shrimp (*Caridina*) from Fiji: G. M. Thomson.—(1) *Bennettites scottii*, sp. nov., a European Petrifaction with Foliage; (2) A Survey of the Biological Aspect of the Constitution of Coal: Dr. Marie Stopes.

FRIDAY, MAY 3.

ROYAL INSTITUTION, at 5.30.—The Spinning Top in Harness: Sir G. Greenhill.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—*Discussion:* Employment of Women in Munition Factories. Opener, Miss O. E. Monkhouse.

SATURDAY, MAY 4.

ROYAL INSTITUTION, at 3.—Modern Investigation of the Sun's Surface: Prof. H. F. Newall.

MONDAY, MAY 6.

ARISTOTELIAN SOCIETY, at 8.—Practical Dualism: Miss E. E. Constance Jones.

SOCIETY OF ENGINEERS, at 5.30.—Modern Shipbuilding and Economy in Material: J. W. Isherwood.

SOCIETY OF CHEMICAL INDUSTRY, at 7.30.—The Interaction of Aluminium and (*a*) the Alcohols, (*b*) the Higher Fatty Acids, (*c*) Phenol, Cresol, and Naphthol: Dr. R. Seligman and P. Williams.—The Principles and Applications of Hot-Wire Anemometry: J. S. G. Thomas.

TUESDAY, MAY 7.

ROYAL INSTITUTION, at 3.—Craniologists: Prof. A. Keith.

ZOOLOGICAL SOCIETY, at 5.30.—The Arenaceous Foraminifera of the Genus Thurammina: E. Heron-Allen.—Comparison between the Lower Jaws of the Cynodont Reptiles Gomphognathus and Cynognathus: Dr. Branislav Petronievics.—A New Genus of Extinct Muscardine Rodent from the Balearic Islands: Miss Dorothea M. A. Bate.

FARADAY SOCIETY, at 5.30.—*Discussion:* The Co-ordination of Scientific Publication. Opener, Sir Robert Hadfield, Bart.

RÖNTGEN SOCIETY, at 7.45.

WEDNESDAY, MAY 8.

ROYAL SOCIETY OF ARTS, at 4.30.—The Rubber Planting Industry: Prof. John B. Farmer.

BRITISH ASSOCIATION GEOPHYSICAL COMMITTEE (Royal Astronomical Society), at 5.—*Discussion:* The Movements of the Earth's Pole. Opener, Sir F. W. Dyson.

THURSDAY, MAY 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Contribution to the Theory of Attraction when the Force varies as any Power of the Distance: Major P. A. MacMahon and H. B. C. Darling.—Electromagnetic Integrals: Sir George Greenhill.—Intensity Relations in the Spectrum of Helium: Dr. T. R. Merton and Prof. J. W. Nicholson.—The Outline of a Theory of Magnetic Storms: Dr. S. Chapman.

ROYAL INSTITUTION, at 3.—The Folk-Lore of Bells: Sir J. G. Frazer.

ROYAL SOCIETY OF ARTS, at 4.30.—The Freedom of the Sea: Sir F. T. Piggott.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—*Discussion:* A British Electrical Proving House. Opener, C. Turnbull.

OPTICAL SOCIETY (Imperial College of Science and Technology), at 7.—Note on Spherical Aberration: T. Y. Baker and Major L. N. G. Filon.

FRIDAY, MAY 10.

ROYAL INSTITUTION, at 5.30.—Human Nutrition: Prof. F. Gowland Hopkins.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 5.—The Times of Sudden Commencement of Magnetic Storms: S. Chapman.—The Entropy of a Metal: H. S. Allen.—Tracing Rays through an Optical System: T. Smith.

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