THURSDAY, JULY 18, 1912.

BOTANY AND GARDENING.

(1) *Elementary Plant Biology*. By J. E. Peabody and A. E. Hunt. Pp. xvii+207. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 4*s*.

(2) *A Manual of Structural Botany*. An Introductory Text-book for Students of Science and Pharmacy. By Prof. H. H. Rusby. Pp. viii+17–248. (London: J. and A. Churchill, 1912.) Price 10*s*. 6*d*. net.

(3) *Mikroskopisches Praktikum für systematische Botanik (I., Angiospermae)*. By Prof. M. Möbius. Pp. viii+216. (Berlin: Gebrüder Borntraeger, 1912.) Price 6.80 marks. (Sammlung naturwissenschaftlicher Praktika. Band I.)

(4) *Lebensfragen aus der heimischen Pflanzenwelt*. Biologische Probleme. By Dr. G. Worgitzky. Pp. viii+295+iii. (Leipzig: Quelle and Meyer, 1911.) Price 7.20 marks.

(5) *Anleitung zur mikroskopischen Untersuchung von Pflanzenfasern*. By Dr. G. Tobler-Wolff and Prof. F. Tobler. Pp. viii+141. (Berlin: Gebrüder Borntraeger, 1912.) Price 3.50 marks. (Bibliothek für naturwissenschaftliche Praxis, 5.)

(6) *Wild Flowers as They Grow*. Photographed in Colour Direct from Nature by H. Essenhigh Corke. With Descriptive Text by G. Clarke Nuttall. Third Series. Pp. viii+199. (London: Cassell and Co., Ltd., 1912.) Price 5*s*. net.

(7) *Oxford Gardens*. Based upon Daubeny's Popular Guide to the Physick Garden of Oxford: with notes on the gardens of the colleges and on the University Park. By R. T. Günther. Pp. xv+280. (Oxford: Parker and Son; London: Simpkin, Marshall and Co., Ltd., 1912.) Price 6*s*. net.

(8) *Gardening for the Ignorant*. By Mrs. C. W. Earle and Ethel Case. Pp. xxiii+232. (London: Macmillan and Co., Ltd., 1912.) Price 1*s*. net.

(9) *Annuals, Hardy and Half-Hardy*. By Charles H. Curtis. Pp. xi+116+8 coloured plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 1*s*. 6*d*. net. ("Present-day Gardening" series.)

(10) *Irises*. By W. Rickatson Dykes. Pp. xiii+110+8 coloured plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 1*s*. 6*d*. net. ("Present-day Gardening" series.)

(11) *How to Make an Orchard in British Columbia*. A Handbook for Beginners. By J. T. Bealby. Pp. viii+86. (London: A. and C. Black, 1912.) Price 1*s*. 6*d*. net.

THESE eleven books, widely though they differ as to subject-matter, have sufficient in common to make them of interest to the botanist, since they are all concerned with plant-life as studied in laboratory, countryside, garden, farm, and orchard.

(1) This certainly deserves to rank among the best of the many excellent manuals of elementary botany published during recent years, for the authors have worked out a thoroughly practical and interesting course of work for junior students, and have logically and consistently kept in view throughout their conviction that "young students are naturally more interested in activities or functions than they are in mere form or structure; hence, if we wish to work with rather than against the grain, we must put function in the foreground of our discussion." The book will be of great use to teachers in arranging their courses of work, and is equally suitable for classes in day training colleges and in secondary schools.

(2) Prof. Rusby's manual is the very antithesis of the one just noticed. It presents an excellent treatment of the general morphology of plants, a branch of botany which is often badly neglected. It is, however, difficult to agree with the author that his book is "a fairly complete introduction to botany," or to understand why it should be considered necessary to omit physiology from the botanical curriculum of pharmaceutical students, and to present to them only the facts of morphology. This work will be useful for reference, but as an introduction to botany it is a dry and stodgy compilation, containing perhaps the richest collection of technical terms ever compressed into two hundred pages of any botanical work of recent years not avowedly a dictionary. It reminds one of Mark Twain's short poem into which were insinuated the "musical and gurgly" names of sixty-six Australian towns; it might be possible, but would be difficult, to have got more of them into the space. If the terms "anthology," "anthotaxy," and "carpology" are to come into general use for the study of flowers, inflorescences, and fruits respectively, why not go the whole hog and bring in such terms as "phyllology," "cladology," "rhizology," "acanthology," "trichology," &c.—*ad infinitum*? The first sixteen pages are mysteriously absent—perhaps the lacuna represents a mislaid, though badly needed, glossary of technical terms.

(3) Prof. Möbius breaks new ground in this work, which fills a distinct gap among the laboratory manuals hitherto available. The floral structure of Angiosperms is too often scamped in courses of botanical laboratory work, both elementary and advanced. The flowers are hastily dissected, the floral formula written, the floral diagram drawn, the text-book "characters of the order" copied into the student's note-book or

floral schedule, and the thing is done—the mechanism of pollination, inferred from structural characters, may also be noted, if teacher or student be usually wide-awake and biologically minded. Those who do not consider this method sufficient will welcome the present work, which is beautifully illustrated, and may be surprised to learn how many interesting points in floral structure can be made out by taking the necessary trouble, according to the clear directions given by Prof. Möbius.

(4) Dr. Worgitzky's work is largely concerned with floral biology, though it goes much farther afield than this, and contains an interesting and eminently readable series of essays on various types and topics suggested by the successive seasons of the year. The book is well illustrated, some of the ecological photographs being very fine. The author never sacrifices accuracy in his successful efforts at clearness and simplicity, but he has overlooked many results of recent research which might well have been incorporated in his pleasantly written essays. The underground leaves of the toothwort are by no means useless organs; the old fiction about their carnivorous function is not repeated here, though it frequently recurs in popular books, but Groom's demonstration that they serve for excreting as liquid the water which the plant cannot get rid of as vapour is a long time in finding its way into text-books and thence into more popular works.

(5) This excellent and well-illustrated book gives a full but concise description of the various vegetable fibres used in commerce, with instructions for their microscopical examination. Though adapted for use in laboratories of the textile departments of technological institutes, the work is of interest to the purely botanical reader from its interesting description and figures of the sclerenchymatous tissues of plants and their distribution.

(6) The illustrations in this handsome book are well up to the general level of excellence attained in the two preceding volumes of the series, though here again, doubtless owing to difficulties in reproduction processes, some of the colours are scarcely true to life. Some of the plates are particularly fine—for instance, those representing the bramble, the cross-leaved heath, the red rattle, and the field rose. The text is not such as to tax unduly the intelligence of the reader, and is inclined to be hasty and slovenly; even the familiar quotation from Shakespeare about the daffodil in the first sentence of the book is given wrongly—for "deck" read "take." The figures in the text are very poor, being uniformly too small or too diagrammatic, or showing both faults with inaccuracy thrown in.

(7) Mr. Günther is to be congratulated on having produced an excellent guide to the Oxford Botanic Garden, despite difficulties, as to sources of information, which ought never to have existed and would have discouraged a less industrious and enthusiastic writer. The book is bright and gossipy, as a guide to any garden perhaps should be, and here and there a trifle dogmatic and sometimes wrong on botanical topics—also as one expects in a guide. Two of the memoirs listed on p. 161 are attributed to the wrong author, but these and other minor blemishes could easily be rectified in a new edition, which is almost certain to be called for.

(8) Every garden-lover, whether ignorant or not, will welcome this new book by the authoress of "Pot-pourri from a Surrey Garden." It contains many useful wrinkles, and whether or not it can be recommended as the best guide for the novice, it is at any rate a useful and delightful book and a splendid shillingsworth. Mrs. Earle again shows her possession of a style that makes it impossible for her to write a dull page, and this pleasant chat about gardening has nothing more formal in it than the fact that the chapters are headed with the names of the twelve months in due order.

(9, 10) The volumes on annuals and irises in the "Present Day Gardening" series, edited by Mr. R. Hooper Pearson, fully maintain the high standard set in previous volumes, and are illustrated each by eight beautiful coloured plates by Mr. T. Ernest Weltham. The volume on annuals by Mr. Charles H. Curtis will certainly help to popularise the culture of these plants, which have so much to recommend them, and which are now regaining the attention they deserve at the hands of present-day gardeners. On Mr. W. Rickatson Dykes, as Prof. Bayley Balfour justly remarks in his preface, has certainly descended, in the realm of iris, the mantle of the late Sir Michael Foster. This volume, though small, is remarkably concise and compendious, and while it will carry the grower of irises a long way, it will also form an admirable introduction to the author's large book on irises which is to be published shortly by the Cambridge University Press.

(11) Mr. J. T. Bealby is recognised as an authority on fruit-farming in British Columbia, and in this small book on orchards he gives a clear and practical account of the possibilities presented by that country for fruit-farmers wishing to emigrate there.

F. CAVERS.

INTEGRAL EQUATIONS.

Introduction à la Théorie des Équations Intégrales. By Prof. T. Lalesco. Pp. vii + 152. (Paris: A. Hermann et Fils, 1912.) Price 4 francs.

L'Équation de Fredholm et ses applications à la Physique Mathématique. By Prof. H. B. Heywood and Prof. M. Fréchet. Pp. vi + 165. (Paris: A. Hermann et Fils, 1912.) Price 5 francs.

INTEGRAL equations are not a quite modern invention, because a particular example was solved by Abel so far back as 1826. But an immense impetus was given to the subject by the papers of Volterra and Fredholm, especially by those of the latter; and the reason is not difficult to find. In the first place, Fredholm chose a standard form of equation obviously suited for a process of continued approximation; and what is much more important, a happy induction led him to the discovery that the solution could be put into the form of the quotient of one integral function of the parameter (λ) by another integral function. In a certain way this is analogous to Jacobi's expression of his elliptic functions as ratios of theta-functions; and the simplicity and elegance of the formulæ are due to a similar cause.

The two works considered here are to a certain extent complementary. Prof. Lalesco treats the subject from a purely theoretical point of view; Profs. Heywood and Fréchet emphasise the physical applications. From the latter point of view we cannot fail to see that Fredholm's method is really the most "natural" and appropriate one hitherto discovered. In the theory of potential, for instance, it, so to speak, normalises Poincaré's method of exhaustion, bringing it into the range of practical computation: it brings scattered results into a closer correlation; and it throws additional light on the difficult problem of determining Green's function, although it does not completely solve it.

So far, also, the notations and terminology are as simple as could be expected. The so-called "kernel" and the derived "resolvent kernel" have received appropriate names; and it would not be difficult, if it were convenient, to invent an inverse notation, and corresponding names, for the solution of Fredholm's standard equation. It is unlikely, however, that this will be done, because the equation in question is only one of an indefinite series, in relation to which it stands in much the same position as the linear differential equation of the first order stands to other ordinary differential equations. It may be noted that Prof. Lalesco shows that every linear differential equation may be reduced to an integral equation of Volterra's form. We are not surprised, therefore, to find a theory of associated equations analogous to that of a differential equation and its adjoint.

The theories of abstract dynamics and Fourier series have led to the notion of normal functions, and quite naturally a similar theory for Fredholm's equation has been developed by Goursat and others. Again, since the nature of the solution is mainly conditioned by that of the kernel, we are not surprised to find that Hilbert and others have arrived at important results by giving special properties (such as symmetry) to the kernel, and taking into account the distribution of its zeroes and poles. It is most interesting to see how the general theories of integral functions, and even of transfinite numbers, find their applications in the present context: thus illustrating once more the organic connection of all analysis.

Perhaps the pleasantest fact of all is that we have in this subject a nascent theory, equally interesting to pure and applied mathematicians, which, for all that we can tell, may grow into a subject as large as that of differential equations; while at the same time its rudiments are scarcely more difficult than the old problem of the reversion of series. A clever schoolboy, fairly proficient in ordinary calculus, could appreciate the main points of Fredholm's analysis; and there seems to be no reason why some of the theory should not be included in, say, Part i. of the mathematical tripos. Of course, candidates would not be expected to know all the more delicate points of the theory; but neither are they supposed to know all about the conditions for the convergence of an integral, or about the complete theory of the invariant factors of a determinant.

English students may begin the subject with Mr. Bôcher's outline in the "Cambridge Mathematical Tracts," No. 10; they could scarcely do better than go on by reading the two present treatises, each of which is clear and elementary and has special merits of its own; then they could consult the original papers indicated by these authors' bibliographies.

There is one very small point to which attention may be directed. Messrs. Hermann have, in one of these books, adopted a method of emphasising important propositions which is very ugly, and we hope will not be imitated. In other respects they keep up the best traditions of French printing. In Prof. Lalesco's book there are a rather large number of misprints; of these one of the most misleading for a beginner is on p. 10, l. 2, where, instead of the second $\int_0^x$ we should read $\int_\sigma^x$, as is obvious, if we draw a figure.

Perhaps it may not be superfluous to point out how this new development illustrates the international character of science. Apart from Abel, the Norwegian, the pioneers are respectively an Italian and a Swede; the bibliographies supply us with names of Frenchmen, Germans, Italians, Jews, Poles, Russians, Swedes, and Englishmen, not to mention others. Prof. Lalesco is a Roumanian; the obviously missing nations are Greece and Spain and the South American republics. In every sense the prizes go to the scientific peoples; is it not time for Greece and Spain to enter the lists?

G. B. M.

REGIONAL GEOGRAPHY.

Grundzüge der physischen Erdkunde. By Prof. A. Supan. Fünfte Auflage. Pp. x+970+20 maps. (Leipzig: Veit and Co., 1911.) Price 18 marks.

THE fourth edition of Prof. Supan's text-book was published in 1908, and the call for a new issue shows that it maintains its place as one of the standard international authorities on physical geography. The new edition is mainly a reprint of its predecessor, but it has been carefully revised, and has been increased by sixty pages and eighteen additional figures. Amongst other changes is a new morphological map of the world, which shows the increasing influence of the views of Prof. Suess. The classification of the lands is simpler than that of the map which it has replaced.

Prof. Supan divides the world into three main divisions, the Boreal and Austral groups and the zones of folded mountain chains. The Boreal group includes most of North America, Greenland, all the British Isles except the south-western corner of Ireland and England south of a line between the estuaries of the Severn and the Thames, Europe as far south as the southern border of the European plain, and north-western Asia, including northern Persia and all Siberia to the west of the meridian of 130°. The Austral group includes most of South America, all Africa with the exception of the Atlas area, Arabia, the Indian peninsula, and Australia. The third division comprises the great fold-mountain belts which form the western part of the two Americas and extend across the eastern hemisphere along the Alpine-Himalayan mountains; they widen out eastward to include all the eastern coastlands of Asia, Malaysia, and New Zealand.

Important changes have been made in the treatment of erosion. The author adopts the term erosion in a wide sense, and uses it, we are glad to note, to include both the chemical and mechanical removal of material. He divides the mechanical action of erosion into ablation, the general weathering of the surface, and corrosion, the process of cutting deeply into the firm rocks. The term corrasion is not accepted.

For the slow movement of loose material sodden with water down slopes, which Dr. Gunnar Andersson calls solifluction, the author has introduced a new term—"Bodenversetzung." The author discusses the questions of glacial erosion in more detail than in previous editions. Another feature of the new edition is the importance attached to the pene-plane, which Prof. Supan fully accepts and uses in the delimitation of the areas of fold-mountains. A slight geological mistake survives in this edition in regard to the fiord region of New Zealand, which is described (p. 801) as limited to a diorite massif. The fiords are restricted to an Archean area which is composed of a varied series of metamorphic rocks. The new edition gives evidence of great care in revision and of wide acquaintance with recent literature.

J. W. G.

AGRICULTURE IN THE EAST.

Farmers of Forty Centuries, or Permanent Agriculture in China, Korea and Japan. By Dr. F. H. King. Pp. ix.+441. (Madison, Wis.: Mrs. F. H. King, 1911.) Price 2.50 dollars.

THIS volume is unhappily the last we shall get from the pen of Prof. King, for his lamented death took place just as the book was going to the press. It contains an account of the agriculture of China, Korea, and Japan, written during his travels, and illuminated by many discussions and explanations that we had learnt to expect from his ripe experience and sound judgment.

"We have not yet gathered up the experience of mankind in the tilling of the earth," says Dr. Bailey in the preface, "yet the tilling of the earth is the bottom condition of civilisation." The Western countries find it necessary to draw for their sustenance on the accumulated fertility of virgin lands, and must inevitably be faced some day with the problem of living on their income and not on their capital. Eastern countries have already solved this problem: densely populated as they are and long have been, they manage to draw all they want from the soil of their own land, and to do so without effecting any reduction in its fertility.

Three causes that lead to depletion of cultivated soils are the loss of carbon due to the evolution of carbon dioxide, loss of nitrogen due to the formation of gaseous nitrogen and of readily soluble nitrates, and the losses of all substances carried away in the crop. The Chinese cultivator remedies these in two ways: he grows crops to be ploughed into the soil, and he carefully returns to the land all the produce of the crops that he can. The first process causes the addition to the soil of complex carbohydrate material, cellulose, starch, &c., and of protein synthesised by the plant during its growth; these substances make good the loss of carbon and, in some instances, of nitrogen also, and they further supply stores of energy for the numerous organisms of the soil. The second process involves the collection of animal and human excreta, which are returned to the land under the most favourable conditions. Finally, the crop on the land is allowed a perfectly free field and no competition is tolerated; weeds are rigorously kept down, and the most careful tillage obtains.

We need not go into a detailed consideration of the actual methods, but it comes as a shock to read that practices we thought were initiated in our times have long been common among the Chinese. No one can read the book without being struck by the immense patience and industry of the peasants and the remarkable way in which they have reached the same principles of cultivation as the Western farmer. The book can be cordially recommended to the student of agriculture, who cannot fail to be charmed with the farmers and labourers depicted in its pages.

OUR BOOKSHELF.

The Heat Treatment of Tool Steel: an Illustrated Description of the Physical Changes and Properties Induced in Tool Steel by Heating and Cooling Operations. By Harry Brearley. Pp. xvii+160. (London: Longmans, Green and Co., 1911.) Price 10*s*. 6*d*. net.

THE subject of the heat treatment of steel is one which during recent years has received a large amount of attention, and the results of numerous researches in England, on the Continent, and in America have been published before various technical societies. These have, however, for the most part dealt with special branches of the subject, largely from the theoretical point of view, and comparatively little has been published by men who have had to deal with the application of the various theories in their daily practice.

This little treatise, while avoiding the more abstruse theories, brings together in a collected form a great deal of practical information on this important subject, which cannot fail to be of great use both to the practical man and also to those engaged in scientific research. The author, while avoiding any detailed discussion of the various theories of hardening and tempering, has concisely and clearly, if very briefly, explained the phenomenon of recalescence, and the influence of heat-treatment on the structure of steel is illustrated by some excellent photomicrographs.

The chapter on the hardening of typical tools and the special methods of treatment essential to obtain satisfactory results is illustrated by numerous examples from works practice, some of which are of special interest.

The defects commonly found in tools as the result of heat treatment, their cause and prevention, are discussed in another chapter, and many useful and practical hints and suggestions are given which form a valuable contribution to the literature on heat treatment.

The author states that the practical details have largely been compiled from his works notes, made for his own guidance during twenty-eight years, and, as is almost inevitable in such circumstances, certain portions of the book suffer from their being somewhat disconnected; but this is a small matter, and in no way detracts from its value and usefulness.

F. W. HARBORD.

Le Transformisme et l'Expérience. By É. Rabaud. Pp. vii+315. (Paris: Félix Alcan, 1911.) (Nouvelle Collection Scientifique. Directeur: Émile Borel.) Price 3.50 francs.

THIS is a book on the same general lines as Prof. T. H. Morgan's "Experimental Zoology." The author points out how very slowly, and almost, as it were, reluctantly, evolutionists have become definitely experimental—partly because they were preoccupied with applying the evolution-formula as an interpretation and with following the suggestions it offered of further morphological or physiological research, and partly because biological experimentation is really very difficult. Nowadays, however, ætiological experiments are being conducted in many laboratories, and there are several journals specially devoted to their publication. What the author has done is to supply us with a competent introduction to experimental transformism.

The book is particularly strong in its exposition of the influence of the environment upon the organism, and the chapters dealing with the modifying effects of pressures, the chemical medium, humidity, heat and light, climate, and nutrition are very effective. They bring together in a clear and scholarly way a large number of scattered facts bearing on modification. As it seems to us, the author has allowed himself to become dominated by what is certainly a truth, that the environment holds the organism in its grip, and is continually provoking it to change. He has no room for what seems to us an equally certain truth: that the organism is itself an agent, a creative agent, a self-expressing Proteus. But M. Rabaud has no patience with neo-vitalistic vagaries of this sort. And yet is it quite certain that he has done them justice? His reference to "intervention suprasensible," which neo-vitalists are not committed to, does not suggest a complete understanding.

J. A. T.

Reinforced Concrete Design. By Oscar Faber and P. G. Bowie. Pp. xix+332. (London: Edward Arnold, 1912.) Price 12*s*. 6*d*. net.

As the authors point out, the art of designing reinforced concrete structures cannot be acquired solely by studying text-books; practice under supervision is essential. Nevertheless, it is necessary that the engineer should be able to make accurate calculations, and in this work problems hitherto considered almost indeterminate have been successfully tackled. For example, one chapter—vi.—is devoted entirely to the determination of the direct loads on columns, a matter of some difficulty, since the loading may be distributed very unequally over the supported continuous floors; complete mathematical analyses of beams under various conditions of loading and fixing are given in Appendix i.

The resistance of beams to shear is investigated in chapter viii., and the considerations which guide a designer are fully discussed. Engineers and architects who specialise in this branch of constructional work will find this book of great service, because the authors have not shirked the difficulties which face the designer of reinforced concrete structures, nor have they attempted to simplify calculations by neglecting important factors. T. H. B.

Handwörterbuch der Naturwissenschaften. Herausgegeben von E. Korschelt, G. Linck, and others. Erste Lieferung (enthaltend Bogen 1–10 des 1 Bandes)—Abbau-Algen. Pp. 160. (Jena: Gustav Fischer, 1912.) Price 2.50 marks.

This encyclopædia, of which we now review the first part, is of a very comprehensive character, embracing botany, chemistry, geology, mineralogy, physics, physiology and zoology, and other natural sciences. More than 300 authors collaborate in the work; the list of these, given on the covers of this part, although mainly consisting of German names, includes also representative workers in special branches in England, the United States, Italy, Russia, and other countries. A special editor takes charge of each of the branches of science named above.

The articles are arranged alphabetically, the following being a list of the principal articles in part i., with the authors' names and number of pages covered. *Abbildungslehre,* 30, O. Lummer; *Absorption,* 20, K. Schaefer; *Aether,* 8, G. Reddelien; *Aggregatzustände,* 15, R. Marc and F. Noell; *Aldehyde,* 12, G. Reddelien; *Algen,* 40 (uncompleted). This summary will serve to show the general scope and character of the work. The articles are authoritatively written by specialists and admirably illustrated; to each is appended a very useful bibliography.

Numerous short biographical sketches of representative men of science are included; for instance, in this number, E. Abbe, R. Abegg, M. Adenson, Agardh, Agassiz, Agricola, Sir G. Airy, Albertus Magnus, Aldrovandi, and d'Alembert.

Such a book of reference should prove an extremely useful addition to the library of every scientific worker, not merely as regards the actual information imparted in the text, but as a ready reference to the more special literature of each subject. The work will be completed in about 80 numbers, to be issued in the course of three to four years, forming in all ten volumes.

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.*]

Experiments with Kathode Rays.

During a research which is being carried out in conjunction with my colleague, Prof. Norman Collie, two experiments have been made the results of which are of some interest. Sir James Mackenzie Davidson was so kind as to furnish us with four deeply stained X-ray bulbs, which had been long in use, and had been rejected. These bulbs were broken up, the stained glass was placed in a combustion-tube connected with a Töpler pump, and any adhering air was displaced by frequent washing-out with pure oxygen, admitted for the purpose. The tube was then heated to bright redness; and the gas collected was placed in communication with a small bulb of cooled charcoal, in order to condense out all gases except hydrogen, helium, and neon. The residual gas was run up into a capillary tube, in which its spectrum could be examined. The spectrum was mainly that of helium, but there was a trace of neon.

The second experiment consisted in exposing some calcium fluoride, prepared by precipitation, washing, and heating to bright redness, to the continued action of kathode rays. The surface turns purple, and silicon fluoride, oxygen, and carbon monoxide are evolved. In order to maintain the vacuum best suited for kathode rays, a little oxygen was admitted from time to time. The gases evolved during some days' bombardment were rejected, to make sure that no adhering gases were collected in the final experiment. These gases were pumped off four times; the fifth quantity of gas was examined. After absorption of condensable gases, the residue consisted of pure neon, without a trace of helium.

From these experiments it would appear that not merely atoms of helium in rapid motion are capable of communicating sufficient energy to molecules and atoms on which they impinge to cause them to disintegrate, but that electrons in motion, in the form of kathode rays, can be made to play a similar part.

William Ramsay.

University College, London, July 16.

Merlia normani and its Relation to Certain Palæozoic Fossils.

Recently I sent you a short communication (June 6, p. 353) on *Merlia normani,* the siliceous sponge with a supplementary calcareous skeleton, stating that it was of a double nature, and consisted of a sponge living in symbiosis with a chlorophyll-containing organism. Further, I stated that the name *Merlia normani* would have to be applied to the latter. I am glad to find, however, that this transfer of the name is not necessary, and that the sponge will continue to be called *Merlia normani.*

The discovery of the solution of the problem of Merlia is destined to prove of profound importance to palæontologists. For I now have convincing proofs—including, amongst others, the presence of siliceous spicules—that numerous Palæozoic fossils coming under the old-fashioned term "Monticulipora" are of essentially the same nature as Merlia, and that they are the supplementary calcareous skeletons of siliceous sponges. Merlia seems to be a solitary survivor of the Monticulipora type from Palæozoic times, though, of course, it may have acquired its symbiotic character in later ages. The particular kind of symbiosis occurring in Merlia was apparently extremely common and vigorous in the Palæozoic era, for encrusting, massive, laminate, and branching "Monticuliporas" abound, while Merlia is only a thin spreading crust.

I shall shortly publish a paper giving the evidence for the truth of the above statements.

R. KIRKPATRICK.

British Museum (Natural History).

Curie's Constant in the Ferromagnetic State.

IN a former letter to NATURE (August 25, 1910) I remarked upon the analogy which exists between the passage of a fluid from the liquid to the gaseous state, and the passage of a magnetic substance from the ferro- to the para-magnetic state, and that the equation of van der Waals which applies to the former represents the salient features of the latter.

In magnetism it is possible to suppress more or less completely the term representing the mutual attraction of the magnetic molecules by running an alternating current through the magnetic substance. The equation thus simplified represents very well the curves of magnetisation under these conditions at different temperatures, and allows the constant which corresponds to R in the fluid equation to be calculated. Observations on such magnetic isothermals when reduced by the method of least squares yield for this constant the mean value $4{\cdot}35\times10^{-6}$ for iron between air temperature and 700° C., and $21{\cdot}1\times10^{-6}$ for nickel between air temperature and 300° C. The reciprocal of this constant, according to this theory, is Curie's constant, and these numbers are in good agreement with determinations of the same constant by Curie, Weiss, and Bloch, from experiments made *above* the critical temperature.

This constant is therefore independent of the temperature, and may now be applied not only to the paramagnetic state above the critical temperature, but also to the ferromagnetic state below that temperature, and is of fundamental importance in the theory of magnetism.

J. R. ASHWORTH.

July 9.

The International Congress of Applied Chemistry.

I AM told that many chemists are hesitating about attending the eighth International Congress of Applied Chemistry (New York, September, 1912) because of the supposed enormous expense. I ask the hospitality of your columns for the purpose of correcting so utterly false an impression. The minimum expense for comfortable accommodation may be estimated as follows:—

(1) From Liverpool, August 21, by American Line ss. *Dominion* (only one class of cabin passengers), to Philadelphia, thence rail to New York; inclusive fares, single 10*l*., return 20*l*.

(2) From Glasgow, August 23, Allan Line ss. *Numidian* (only one class of cabin passengers), to Boston, thence rail to New York; inclusive fares, single 9*l*., return 18*l*.

(3) From Glasgow, August 24, Anchor Line ss. *California*, to New York; first cabin fares, single 14*l*., return 28*l*.

The first two of these routes afford an opportunity to see Philadelphia and Boston, without additional expense.

Columbia University has offered to members and their families the free use of rooms in the residence halls, which will be available from August 31 to September 13. Until the end of July, rooms will be assigned, in order of application, to guests from abroad exclusively. Application should be made to the Secretary of the Congress, Dr. B. C. Hesse, 25 Broad Street, New York. The expenses in New York are limited, therefore, to the membership fee (1*l*.), the cost of excursions and entertainment (2*l*.), meals, which will be furnished at very low rates, and incidental expenses (say 5*l*.) The necessary expenses per person, including gratuities, &c., in the steamship (2*l*.), are therefore 28*l*. to 38*l*., according to the ship selected.

The inaugural meeting of the congress in Washington, for those who desire to see the magnificent scientific institutions in that city, will involve additional expense of 5*l*.

Following the meetings of the congress, there will be two excursions. The "short trip," lasting eleven days, includes Philadelphia, Pittsburg, Niagara Falls, Detroit, Chicago, Cleveland, and Boston (2513 miles). The total expense of this trip will probably be less than 20*l*. Members desiring to join this excursion should notify Dr. Geo. D. Rosengarten, P.O. Box 1625, Philadelphia, Pa., immediately.

I shall be very glad to reply to inquiries, which may be sent to me at the address below.

ALEXANDER SMITH,
Professor of Chemistry in Columbia University, and member of the Executive Committee of the Congress.

34 St. Albans Road, Edinburgh, July 10.

CRYSTALLO-CHEMICAL ANALYSIS, A NEW METHOD OF CHEMICAL ANALYSIS.

AN important and possibly epoch-making memoir by Prof. E. von Fedorow, of St. Petersburg, is published in the last issue of the *Zeitschrift für Krystallographie*, entitled, "Die Praxis in der krystallochemischen Analyse und die Abfassung der Tabellen für dieselbe." It used frequently to be demanded by chemists of crystallographers, "Of what practical use is crystallography to us?" But the results of recent work have been so striking, and have gone so directly to the root of chemical constitution, that their cumulative effect has for ever rendered it perfectly obvious that crystallography is of fundamental importance to chemistry.

As a natural result of his well-known geometrical work on the possible structures possessing the property of homogeneity, the essential property of a crystal, Prof. von Fedorow turned his attention to descriptive crystallography, and in a series of brilliant papers has shown how the correct mode of setting up a crystal for descriptive purposes may be arrived at and distinguished from among the several possible modes; he has also shown us how to convert the crystallographic elements for any other "setting" or incorrect arrangement into those of the correct one, the latter being the arrangement which brings the directions chosen as the crystal axes into close and concordant relationship with the true internal structural arrangement, that of the nodes or points of the space-lattice or point-system, according to which the molecules of the substance and their constituent atoms are built up. This correct setting is arrived at quite independently of the fortuitous and variable property of external "habit," and is based upon calculations of the "reticular density" (closeness of packing of the nodes or "points" of the space-lattice or point-system) along the planes of the principal faces. For the forms (sets of faces of equal symmetric value) of greatest reticular density are those of most fundamental importance to both the internal structure and the correct setting, and those which, given ideal conditions of development and equal chances of growth all round, grow most slowly and are consequently the best developed, a fact proved conclusively by Wulff. The setting, therefore, which corresponds to primary faces of maximum reticular density is regarded by Prof. von Fedorow as the only correct one on which comparisons should be made.

He has next prepared with consummate trouble a table of the elements and morphological constants of all the hitherto goniometrically measured crystalline substances, arranged in regular progressive order, and calculated on the lines just explained for the correct setting in each case. It will doubtless be with some astonishment that chemists will learn that no fewer than ten thousand crystalline substances of definite chemical constitution have been measured adequately enough to be included in this table. Prof. von Fedorow then proceeds to show that if a few measurable crystals of any one of these substances be subjected, by an observer trained in his method and to whom the name or formula of the substance is not given, to a short goniometrical investigation on the theodolite goniometer, occupying at most two or three hours and possibly only a few minutes, it is possible by a reference to the table of elements and constants to discover and recognise immediately the substance of which the crystal is composed. In other words, provided a chemical substance has once had its crystals measured by a trained crystallographer, it is possible to detect it at any time by merely making a few brief measurements so as to be able to calculate the elements—by a shortened process, partly graphical, which Prof. von Fedorow has perfected—and then searching the table for the substance there recorded as possessing these constants. The constants being arranged progressively in the table, and according to their systems of symmetry, the search occupies but a moment of time, the table being practically an index.

In order to test this new mode of chemical analysis, which has the great advantage that the substance is not destroyed or even injured in the process, the crystals remaining as perfect at its conclusion as they were before it was undertaken, Prof. von Fedorow invited the cooperation of a number of co-workers in crystallography in various countries of Europe and the United States, and the gratifying result has been that a considerable number of well-crystallised substances, which had been the subject of careful investigations, were sent to him in bottles marked with only a distinguishing number and no name or formula label. In all cases—except a very few in which the crystals had either deteriorated, or where the substances were not included in the ten thousand recorded in the table (owing mostly to too recent publication of the results concerning them), or in which they were indistinguishable from an isomorphous substance owing to the faces not being sufficiently perfect to enable the measurements to be trustworthy to within a few minutes of arc—Prof. von Fedorow has identified them with the greatest facility.

Among these test substances were a number which had been sent out by the writer, and had been for the first time investigated by him, and in every one of these cases the substance (often an organic compound of some complexity) was identified by Prof. von Fedorow without hesitation. Several of these cases are described at length by Prof. von Fedorow in his memoir, and it is interesting that in nearly all of them, and also in some of the sulphates and double sulphates investigated by the writer and also examined as unknown substances by Prof. von Fedorow, faces not actually observed during the latter's brief examination for the purposes of identification, but found by him, on calculation, to be important faces with respect to the ideal development and setting, had been observed by the writer in his detailed investigation some years ago. Some of the crystals sent by the writer had, in fact, been measured no fewer than twenty-two years ago. They were dispatched, unlabelled except by numbers, with the aid of Mr. T. V. Barker, of Oxford, who had spent some months with Prof. von Fedorow in his laboratory at St. Petersburg, and had kindly undertaken to collect and send out the contribution of British crystallographers and chemists to this interesting test.

Even at so early a date in the development of this surprising method of crystallochemical analysis, Prof. von Fedorow undertakes that at least three out of every four analyses shall be successful, and when the table is further extended this proportion will be materially raised. Moreover, if an analysis is not successful, it is usually because no result can be arrived at, owing to malformation of the crystals; in no case is an inaccurate result obtained, except, perhaps, in the few cases of isomorphous compounds so closely equiangular that the degree of perfection of faces present is possibly inadequate to enable the observer to distinguish between them. But in these cases an optical determination of refractive index would amply suffice to effect the distinction. Also, of course, the method fails in its simple form in the cases of cubic crystals, in which the angles are always the same; but again an optical test is successful where that of symmetry, elements, and angles fails.

Sufficient will have been said to show that we have in this new mode of chemical analysis a most striking testimony to the value of crystallography to the chemist, and a further imperative reason why the crystals of every well-crystallised substance should not fail to be measured. It forms another stage in the development and the rapid march of this now highly important science. If any readers of Nature should be further interested in the subject, they will find a remarkably correct account of it in English, written eighteen months ago from advance information supplied by Mr. Barker, with Prof. von Fedorow's kind permission, in the writer's "Crystallography and Practical Crystal Measurement" (Macmillan and Co., Ltd., 1911), the account now definitely published in German requiring nothing to be corrected in that forecast.

A. E. H. TUTTON.

MALARIA IN INDIA.

THE fourth number of *Paludism* (Proceedings of the Committee for the Study of Malaria in India), published last March, begins with an interesting account of the proceedings of the second meeting of the general Malaria Committee held in Bombay on November 16–17, 1911. This meeting appears to have been of a very important nature. The president was the Hon. Surgeon-General Sir Charles Lukis, C.S.I., the new Director-General of the Indian Medical Service, and his introductory address is well worth the close attention of all sanitarians in tropical countries. After some preliminary remarks, he proceeded to say that he viewed with concern the tendency amongst malaria workers to divide into two camps, namely, those who advocate anti-mosquito measures, and those who pin their faith on quinine prophylaxis. He directed attention to a previous speech of his, in which he said that—

"whilst agreeing that quinine prophylaxis, properly carried out, was one of the most valuable weapons in the fight against malaria, and whilst admitting that in rural areas it might be the only weapon at the disposal of Government, I felt bound to express my opinion that, if they were to place sole reliance on this measure in Indian villages, they were doomed to disappointment. Quinine prophylaxis should go hand in hand with general sanitation and with the destruction of anopheles breeding grounds wherever this can be accomplished at reasonable expense, and it seems to me that recent observations justify us in thinking that this destruction is not likely to be as costly as has hitherto been supposed. Quinine has undoubtedly conferred inestimable benefits upon the individual; but it never has, and never will, be of equal value to the community as a whole, and you cannot get away from the fact that if there were no mosquitoes there could be no malaria. I fully realise that in some of the hyperendemic areas mosquito destruction may be a counsel of perfection, but even there much good may be done by reducing the numbers of the special species which acts as the carrier, and, I ask you, should we halt in our activity because we cannot attain to an ideal perfection? I recognise the fact that no one method will suffice as a general anti-malarial measure; I recognise the power of each in its proper place, but I hold strongly that wherever possible anti-mosquito measures must be carried out. I also recognise the importance of preliminary investigation, but it must not be carried to extremes; the time has come for definite action on well-considered and practical lines."

This official pronouncement will be looked upon with gratitude by all those who have been urging the wider policy in India for years past, and will, we hope, prove to be the starting point of a new era. The Director-General proceeded to give some good advice on many other points; for instance, that actual operations may with advantage be carried out in conjunction with investigation (page 6), and that, indeed, in certain instances the former may be the only method of investigation—a point which has long required emphasising. He added that—

"if we wait until our experts have made a complete investigation of all the problems connected with the epidemiology and endemiology of the disease, there is the danger that India will remain for many years practically untouched. We require then two classes of men—the scientific experts and the practical workers."

The other proceedings at the Conference showed that this advice is already being largely followed in India. The various provincial organisations for dealing with malaria are described, and several good articles and discussions are given. Both Sir David Semple and Major Robertson (the new Sanitary Commissioner for the Government of India) strongly supported the Director-General's remarks. Captain McKendrick, the Statistical Officer of the Indian Sanitary Department, furnished a very interesting paper on the pathometry of malaria according to the mathematical studies which were discussed by myself and Mr. A. J. Lotka in NATURE of October 5, 1911, and February 8, 1912, respectively. Captain McKendrick, who is a capable mathematician, has also added some interesting remarks on the subject, but these cannot be discussed except at some length. References were made to Major Christopher's very interesting researches in the Andaman Islands and to Dr. Bentley's Report on Malaria Prevention in Bombay; and Colonels Dyson and Adie, Majors Wilkinson, Glen Liston, and Robertson, and others added original information on details. I have only one fault to find, and that is that the printing and get-up of *Paludism* are so very much inferior to the excellence of the matter contained, a fact which may explain why the Director-General has been obliged to ask for more scientific contributions.

RONALD ROSS.

THE 250th ANNIVERSARY OF THE ROYAL SOCIETY.

THE celebrations in connection with the 250th anniversary of the Royal Society opened on Monday last with an evening reception of the delegates in the rooms of the Society. On Tuesday there was a commemorative service in Westminster Abbey at noon; a formal reception of the delegates and presentation of addresses in the library of the Royal Society in the afternoon, and a banquet in the Guildhall in the evening. Yesterday visits were paid to places of interest in London; a garden-party was given by the Duchess of Northumberland at Syon House and a conversazione was held at Burlington House at night. To-day further visits are being paid to places of interest, and fellows of the Society and the delegates are being entertained by their Majesties the King and Queen at a garden-party at Windsor. The following is a list of the delegates from foreign countries and the British Dominions beyond the seas:—

University of Vienna, Prof. F. Exner; Kaiserliche Akademie der Wissenschaften, Vienna, Prof. F. Exner; K.K. Böhmische Karl-Ferdinand University, Prague, Prof. F. Vejdovsky; Kaiserliche Akademie der Wissenschaften, Cracow, Dr. L. Marchlewski; Royal Hungarian University, Budapest, Prof. I. Fröhlich (rector); University of Louvain, Prof. A. de Hemptinne; Académie Royale des Sciences, Brussels, Prof. L. Dollo; University of Copenhagen, Prof. H. F. E. Jurgensen; Kong. Danske Vidensk. Selsk., Copenhagen, Prof. E. Warming; University of Paris, Prof. E. Picard; Faculté des Sciences à la Sorbonne, Paris, M. A. J. F. Dastre; Académie des Sciences de l'Institut, Paris, M. G. Lippmann (president), Prof. C. Barrois, Prince Roland Bonaparte, M. H. Deslandres, and M. A. Haller; Société Française de Physique, Paris, M. E. B. Baillaud; Société Botanique de France, Paris, M. P. de Vilmorin; Société Chimique de France, Paris, M. Hanriot (president); University of Bordeaux, Prof. Pitres; Académie Nationale de Bordeaux, Prof. Pitres; University of Clermont-Ferrand, Prof. Pellet; University of Lille, Prof. A. Schatz; University of Nancy, M. C. Adam (rector); University of Toulouse, Prof. J. Drach; University of Berlin, Prof. W. Waldeyer and Prof. W. Nernst; University of Bonn, Prof. H. Kayser; University of Breslau, Prof. A. Kneser (rector); University of Erlangen, Prof. Varnhagen; University of Freiburg-im-Breisgau, Prof. O. Bolza; University of Giessen, Prof. W. König; University of Göttingen, Prof. W. Voigt (rector); University of Greifswald, Dr. O. Jaekel; University of Halle, Prof. J. Veit; University of Heidelberg, Prof. G. Quincke; University of Königsberg, Prof. G. Winter; University of Leipzig, Prof. E. Sievers and Prof. W. Ostwald; University of Marburg, Prof. E. Korschelt; University of Munich, Prof. von Groth and Prof. W. C. Röntgen; University of Münster, Prof. K. Busz; University of Rostock, Prof. Rudolf Hübner; University of Strasburg, a representative; University of Tübingen, Prof. von Vöchting; Königl. Preuss. Akad. der Wissenschaften, Berlin, Prof. H. Rubens; Königl. Gesellsch. der Wissenschaften, Göttingen, Prof. O. Wallach; Königl. Bayer. Akad. der Wissenschaften, Munich, Prof. von Groth; University of Athens, Prof. A. Andreades; University of Rome, Prof. V. Volterra; University of Palermo, Prof. G. Guccia; University of Pisa, Prof. R. Nasini; R. Accademia della Crusca, Florence, a representative; R. Istituto Lombardo di Scienze e Lettere, Milan, Prof. V. Volterra; Soc. Reale di Napoli, Sir Archibald Geikie, K.C.B., P.R.S.; Stazione Zoologica, Naples, Prof. R. Dohrn; R. Accad. dei Lincei, Rome, Prof. M. E. Paternò di Sessa and Conte U. Balzani; Turin, Reale Accad. delle Scienze, Lord Rayleigh, O.M., F.R.S.; Monaco Oceanographical Institute, Mr. J. Y. Buchanan, F.R.S.; University of Amsterdam, Prof. C. Winkler (rector); University of Groningen, Prof. G. C. Nijhoff (rector); University of Leyden, Dr. F. Pijper (rector); University of Utrecht, Dr. A. A. Nyland (rector), Academy of Sciences, Amsterdam, Prof. P. Zeeman (secretary); Hollandsche Maatsch. der Wetensch., Haarlem, Dr. J. P. Lotsy (secretary); Batavian Society, Rotterdam, Dr. R. H. van Dorsten (secretary); University of Christiania, Prof. W. Brögger; Academy of Sciences of Christiania, Prof. H. Mohn (president); Academy of Sciences of Portugal, Lisbon, Mr. E. Prestage; Acad. Impériale des Sciences, St. Petersburg, Dr. O. Backlund, Prince B. Galitzin, Prof. I. P. Pawlow, and Prof. A. Belopolsky; University of Moscow, Prof. A. P. Goubaroff; University of Dorpat (Juriew), Prof. A. I. Jarockij; University of Warsaw, Prof. P. I. Mitrophanow; University of Finland, Helsingfors, Prof. A. Donner (rector), Société des Sciences, Helsingfors, Prof. J. J. Sederholm; Real Acad. de Ciencias, Madrid, Prof. R. Carracido; University of Lund, Prof. C. W. L. Charlier; University of Stockholm, Baron G. de Geer (prorector); University of Upsala, Prof. G. Mittag Leffler and Prof. A. Gullstrand; Kongliga Svenska Vetenskaps Akademie, Stockholm, Count K. A. H. Mörner (vice-president); University of Berne, Prof. T. Studer; University of Geneva, Prof. E. Naville; Société Helvétique des Sciences Naturelles, Berne, Prof. P. A. Guye (secretary); Eidgenössische Technische Hochschule, Zürich, Prof. P. Weiss; University of Egypt, Cairo, H.H. Prince Ahmed Fouad Pacha (president-rector); Gordon College, Khartoum, Dr. J. Currie (principal); Imperial University, Tokyo, Prof. R. Fujisawa; Imperial University, Kyoto, Prof. J. Yokobori; University of California, Prof. H. C. Plummer; University of Chicago, Prof. E. B. Frost; Clark University, Worcester, Prof. A. G. Webster; Columbia University, New York, Dr. N. M. Butler (president); Cornell University, Ithaca, N.Y., Prof. J. H. Comstock; Harvard University, Prof. B. O. Peirce; Johns Hopkins University, Baltimore, Prof. W. B. Clark; Leland Stanford Junior University, California, Prof. V. L. Kellogg; University of Michigan, Prof. W. H. Hobbs; University of Minnesota, Minneapolis, Dr. A. Hamilton; University of Pennsylvania, Philadelphia, Dr. E. F. Smith (provost); University of Princeton, New Jersey, Prof. J. G. Hibben (president); University of Wisconsin, Prof. C. K. Leith; Yale University, Dr. A. T. Hadley (president); American Academy of Sciences, Boston, Prof. E. H. Hall; Connecticut Academy of Arts and Sciences, Prof. E. W. Brown, F.R.S.; American Mathematical Society, New York, Prof. H. B. Fine (president); American Philosophical Society, Philadelphia, Prof. W. B. Scott (vice-president); Franklin Institute, Philadelphia, Major G. O. Squier; California Academy of Sciences, San Francisco, Mr. J. D. Grant; Carnegie Institution, Washington, Dr. R. S. Woodward (president); National Academy of Sciences, Washington, Dr. A. Hague (secretary); Smithsonian Institution, Washington, Dr. A. Hague; Washington Academy of Sciences, Dr. L. O. Howard; University of Adelaide, Prof. H. Lamb, F.R.S.; University of Melbourne, Prof. H. Laurie; University of Sydney, New South Wales, Prof. T. P. A. Stuart; Royal Society of Tasmania, Hobart, Dr. G. Sprott; Royal Society of Victoria, Melbourne, Mr. H. R. Hogg; Royal Society of New South Wales, Sydney, Mr. C. Hedley; McGill University, Montreal, Dr. W. Peterson (principal); University of Toronto, Mr. R. A. Falconer (president); Queen's University, Kingston, Ontario, Prof. J. Watson; University of New Brunswick, Fredericton, N.B., Dr. C. C. Jones (chancellor); University of Manitoba, Winnipeg, Prof. S. Vincent; University of Ottawa, Rev. Dr. Roy (rector); Royal Society of Canada, Ottawa, Sir Gilbert Parker, M.P.; Nova Scotian Institute of Science, Halifax, N.S., Prof. J. G. MacGregor, F.R.S.; H.H. Maharaj Rana Sir Bhawani Singh, Bahadur of Jhalawar, K.C.S.I., Rajputana; University of Allahabad, Rai Bahadur G. N. Chakravati; University of Bombay, Dr. F. G. Selby (late vice-chancellor); University of Calcutta, Prof. P. C. Ray; University of Madras, Dr. A. C. Mitchell; Asiatic Society of Bengal, Calcutta, Mr. G. H. Tipper (hon. secretary); Mohammedan Anglo-Oriental College of Aligarh, Sir T. Morison, K.C.I.E.; Indian Institute of Science, Dr. M. W. Travers, F.R.S. (director); University of the Cape of Good Hope, Prof. A. H.

MacKenzie; Natal University College, Pietermaritzburg, the Hon. J. C. D. Wilson; Royal Society of South Africa, Sir David Gill, K.C.B., F.R.S.

Sir Archibald Geikie, P.R.S., in welcoming the delegates at the reception, said, according to *The Times*, that no more striking proof than was presented by that assembly could be given of the reality and cordiality of that spirit of frank and loyal cooperation which united into one great brotherhood the students of science in every land and in every language. Two hundred and fifty years seemed in some respects no long span of time in the course of human history, but the 250 years across which they looked back that day had been in the history of science a period of momentous importance, crowded with incident, and full of marvellous achievement. When in the earlier decades of the seventeenth century Francis Bacon was so cogently insisting on the necessity of studying nature by the careful observation of facts and the testing of conclusions by experiment he made but slight practical impression in England. The seed which he sowed had not sprung into life until after he had passed away. About the middle of the century, however, the spirit of eager curiosity and inquiry with regard to the world which spread over all civilised countries reached England also. The earnest desire to seek an explanation of familiar phenomena at last induced a remarkable group of men in this country to organise themselves systematically for the prosecution of that experimental philosophy which Bacon had so longed to see pursued.

The society had counted among its fellows some of the great leaders in all branches of natural knowledge. Starting its career with a notable group of physicists and mathematicians, among whom were Robert Boyle and John Wilkins, it ere long welcomed Isaac Newton into its ranks, published his immortal "Principia," and annually elected him as its president for nearly a quarter of a century. The physical sciences had all along been strongly represented here. It seemed but yesterday that James Clerk Maxwell's voice was heard in those rooms, and that Stokes and Kelvin sat in the presidential chair. That the succession of leaders was still well maintained, the presence that day of Lord Rayleigh. Sir William Crookes, Sir Joseph Thomson, Sir Joseph Larmor, and many others amply proved. Nor had the biological sciences been less prominent in the work of the society. From the early days of John Ray down to those of Charles Darwin, Hooker, Huxley, and Lister, every branch of biology had been illustrated and advanced by their fellows.

As science knew no restriction of country or language, the Royal Society had from its earliest beginning cultivated friendly relations with fellow-workers in research all over the world. This confraternity of the commonwealth of science now reached the climax of its manifestation in their experience, when they received delegates from so many countries, who by their presence expressed the sympathy and goodwill of the various institutions which they represented.

In proposing at the banquet the toast of "The Royal Society," the Prime Minister said that the society had not at any time had any direct financial assistance from the Government. For this the Government might be criticised; but he ventured to think the society is to be congratulated. It is not well that science should be a mendicant for State endowment. He did not forget the annual grants for scientific research which are administered by the society; but their administration is not a benefit conferred on the society by the State, but a service conferred on the State by the society. It would not be possible for anyone to traverse in a few moments the history of the society, or to chronicle the achievements of its fellows without at the same time traversing and chronicling the history of English science itself. There is hardly a year when the roll of the society has not been enriched by a name to which not only we, as Englishmen, but the whole world, is indebted for a share in the slow but steady subjection of nature to the intelligence of man—that process which has been described in Bacon's immortal words, "Natura non nisi perendo vincitur." If we look at the names of Isaac Newton and Locke, Flamsteed and Halley, Sir Hans Sloane, Adam Smith and Grote, Woolaston and Watt, Davy and Faraday, Pringle and Young, or closer to our own time, Darwin, Huxley, Hooker, Herschel, Huggins, Sir Michael Foster, Lord Kelvin, and one whose loss we lamented only a few months ago, perhaps the greatest benefactor in our time of the human race, Lord Lister—the roll contains the names of England's worthiest children in the wide field of work which is comprised in the original project of this foundation. And the Royal Society which honoured them and was honoured by them is remembered when we remember them one and all. It has grown with the growth of England; it has advanced with the advance of science; and it stands now, after 250 years, firmly established in the confidence of the nation and the respect of the world, still faithful, still fruitful in the cause of human progress and human enlightenment.

The president of the Royal Society, replying to the toast, said the society has had from its commencement close relations with the Government. They have never been financial relations. At first the society was very poor and tried hard to get money, and among King Charles's benefits, or his wishes to benefit the society, were the efforts which he made for getting them a larger income. He was sorry to confess that those efforts were entirely unsuccessful. They had from him a college, but two years after he gave it he reclaimed it, and bought it back from them. He believed that 1300*l*. was all the money they received from their founder Charles II., who devised a plan whereby the Royal Society should undertake to examine all applications for patents for philosophical and mechanical inventions. There was no record of any payment for the services thus rendered. Fifty years later Queen Anne made a similar regulation, but again they had no record that any money passed, for services rendered, into the coffers of the Royal Society. Since then the relations of the society and the Government have taken a very much wider and closer form. They administer a number of permanent grants from the Government, not for their own use, but for the general good of science. They are largely charged with the administration of the National Physical Laboratory, and they have to administer also the 4000*l*. a year granted by the Government for the furtherance of scientific research. There are many committees which do not bulk very largely in the public eye, but which cost the society a great deal of time and labour and do excellent service, especially those connected with tropical disease.

Viscount Morley of Blackburn proposed the toast of "Universities at Home and Abroad," and the Archbishop of Canterbury that of "Learned Societies in the Old World and the New."

NOTES.

The retirement, on August 15, of Sir Patrick Manson, K.C.M.G., F.R.S., from the post of medical adviser to the Colonial Office is announced. The duties hitherto discharged by him will in future be divided, and the Secretary of State for the Colonies has appointed Sir J. Rose Bradford, K.C.M.G., F.R.S., to be senior medical adviser, and Mr. C. W. Daniels to be junior medical adviser to the Colonial Office in London. It is also announced that Mr. W. T. Prout, C.M.G., has been appointed medical adviser to the Colonial Office in Liverpool. Sir Patrick Manson has been appointed a Knight Grand Cross of the Order of St. Michael and St. George in recognition of his eminent services in connection with the investigation of the cause and cure of tropical disease.

The Secretary for Scotland has appointed a committee to advise the Board of Agriculture for Scotland in matters relating to forestry. The following gentlemen have accepted the invitation to serve on such an advisory committee:—Mr. John D. Sutherland (chairman), the Right Hon. R. C. Munro-Ferguson, M.P., Sir John Stirling Maxwell, Bt., Sir W. S. Haldane, and Mr. R. H. N. Sellar.

Prof. L. E. Bouvier, of the Jardin des Plantes, has been appointed "Ray Lankester Investigator" for 1912–13, and in the course of this month will enter into occupation of the Ray Lankester table in the laboratory of the Marine Biological Association at Plymouth. At the request of the trustees, the nomination for this first appointment was made by Sir E. Ray Lankester, K.C.B., F.R.S.

At the forthcoming meeting of the British Association in Dundee an innovation will be made which foreshadows a widening, in some measure, of the interests and scope of the association. It has been suggested recently from various quarters that, instead of the one lecture to the "operative classes" hitherto given during the annual meeting by a lecturer appointed by the association, a larger number of lectures should be arranged for the benefit of the classes of citizens at the place of meeting who do not, as a rule, join the association. A somewhat similar idea underlay the arrangement, in 1909, of two "popular lectures to the citizens" of Winnipeg, with the special conditions obtaining in that city in view. But on the present occasion three such lectures will be provided, and will be given in the Gilfillan Hall, Dundee, on Thursday evening, September 5, by Prof. Benjamin Moore, on "Science and National Health"; on Saturday, September 7, by Prof. E. C. K. Gonner, on "Prices and Wages"; and on Tuesday, September 10, by Prof. A. Fowler, on "The Sun."

The following are among the subjects to be dealt with in Section E (Geography) of the forthcoming meeting of the British Association. The president, Colonel Sir C. M. Watson, proposes to deal with the geography of the Sudan, taking up the story where Sir Samuel Baker left it, when he presided over the section at the last Dundee meeting. There will be other papers on the Sudan and adjoining countries. Desert conditions will be treated of by Mr. H. Harding King (the Libyan Desert) and Mr. J. N. Dracopoli (Mexico). Part of one morning will be devoted to the Antarctic regions, Sir Clements Markham contributing a paper on Antarctic discovery, and Dr. W. S. Bruce opening a discussion on the Antarctic continent. There will also be lectures by Sir Wm. Willcocks on irrigated Canada, and by Dr. H. M. Ami on recently opened-up regions of the Dominion.

In response to a joint appeal made by the Royal Society of South Africa and the South African Association for the Advancement of Science to the Union Government, a sum of 500*l*. has been voted during the current financial year as a grant-in-aid for the purpose of assistance in scientific work in or relating to South Africa. A scheme for the administration of this and future funds available for the same purpose on lines similar to that of the Government Grant Fund of the Royal Society has been prepared by a joint committee representing the two above-mentioned societies.

A movement is on foot to erect in Westminster Abbey a memorial window to the late Lord Kelvin. To further the interest of the scheme a large committee composed of representatives of engineering societies of the British Empire and the United States of America has been formed. The honorary treasurer of the fund is Dr. J. H. Tudsbery, 12 Dartmouth Street, Westminster.

In future the Sleeping Sickness Bureau will be known as the Tropical Diseases Bureau, and the offices will be in the Imperial Institute. In October next the "Sleeping Sickness" and "Kala-azar Bulletins" will give place to the "Tropical Diseases Bulletin," in which will be published summaries of all the current literature of tropical and subtropical diseases. A quarterly "Tropical Veterinary Bulletin" will also be issued by the bureau.

A gold medal has been awarded by the Royal Horticultural Society to Prof. R. Newstead, F.R.S., of the University of Liverpool, for his exhibit of insects injurious to cultivated plants on the occasion of the Royal International Horticultural Exhibition held in London in May last.

The American medicine gold medal for 1912 has been awarded to Dr. W. C. Gorgas, Ancon, Panama, as the American physician who in the judgment of the trustees has performed the most conspicuous and noteworthy service in the domain of medicine during the past year.

Mr. B. G. Cooper has been appointed secretary of the Aëronautical Society of Great Britain in the place of Mr. T. O'B. Hubbard, who is resigning the position. The appointment will take effect from August 14.

Reuter's Agency announces the arrival, at Port Chalmers, of the *Aurora*, Dr. Mawson's Antarctic exploration ship. All the members of the expedition were in good health.

It is proposed to acquire the estate of Corstorphine Hill as the site of Zoological Gardens for Edinburgh. The estate will cost 17,000*l*., and 8000*l*. will be required for an initial collection of animals.

AN International Congress of Comparative Pathology is being organised by the Société de Pathologie Comparée to be held in Paris in October next. The subjects for discussion will range over the whole field of pathology, and will include veterinary and plant pathology. Among the problems to be discussed are tuberculosis (pathogenesis), human and avian diphtheria, cancer, variola and vaccinia, parasites common to man and animals, hydrophobia, comparative study of the cirrhoses, vegetable pathology, &c. Those desirous of making communications to the congress or of taking part in the discussions should communicate with the general secretary, 42 rue de Villejust, Paris.

THE ninth International Congress of Zoology is to be held at Monaco from March 25 to 30, 1913. Prince Albert of Monaco will preside. Inquiries should be addressed to Prof. Joubin, general secretary of the congress, Institut Océanographique, 195 rue Saint-Jacques, Paris.

THE twelfth International Geological Congress will be held in Toronto in August of next year, and, according to *Science*, the following topics have been selected by the executive committee as the principal subjects for discussion:—The coal resources of the world; differentiation in igneous magmas; the influence of depth on the character of metalliferous deposits; the origin and extent of the pre-Cambrian sedimentaries; the subdivisions, correlation and terminology of the pre-Cambrian; to what extent was the Ice age broken by interglacial periods? the physical and faunal characteristics of the Palæozoic seas with reference to the value of the recurrence of seas in establishing geologic systems. The honorary president of the congress is to be H.R.H. the Duke of Connaught, the presidential chair being filled by Dr. Frank D. Adams, dean of the faculty of applied science and Logan professor of geology, McGill University, Montreal. Mr. R. W. Brock, director of the Geological Survey of Canada, will be the general secretary.

A FINE skull of the extinct horned reptile Triceratops has just been mounted in a new case in the Geological Department of the British Museum (Natural History). The specimen was discovered in the Upper Cretaceous Laramie formation of Converse County, Wyoming, U.S.A., by Mr. Charles H. Sternberg, who undertook a special expedition to obtain it for the museum. The skull, with the bony crest, measures a little more than 6 ft. in length, while the brain-cavity, of which a cast has been taken, has a length of only 6 in., with a greatest width of 2 in. The comparatively small size of the trunk is shown by the bones found associated with the skull, among which the fused neck-vertebræ, a scapulo-coracoid, and a humerus are especially well preserved. A few isolated horn-cores from the same geological formation and locality are interesting as showing their variation in shape, and also the marks of the blood-vessels which nourished their sheath. It has been known for several years that similar fossils occur further north in Canada, but they have not hitherto been systematically collected. Mr. Charles H. Sternberg is now being employed by the Victoria Memorial Museum at Ottawa to examine these new localities, and he will spend the present summer in exploring the Red Deer river district of Alberta.

AN appeal is being made on behalf of the London School of Tropical Medicine for a sum of 100,000*l*. to provide an adequate endowment fund, to make additions to the laboratory accommodation and residential quarters for the increasing number of students, to provide for the prosecution of research, and to provide a small nursing home for those civilians whose means are inadequate to procure special nursing and medical treatment for their needs. An influential committee, formed at the request of Mr. Harcourt, Secretary of State for the Colonies, and under the chairmanship of Mr. Austen Chamberlain, is issuing the appeal, and has already collected 15,000*l*.

PROF. OTTO JAEKEL, of Greifswald, has issued a circular directing attention to the want of a palæontological society in Germany, which shall serve as a link between zoologists and geologists and shall at the same time define more clearly the ground to be occupied by these two groups. Prof. Jaekel invites the cooperation of palæontologists outside Germany, and looks forward especially to a closer union of workers in eastern Europe. It is proposed that the annual subscription to the new society shall be 20 marks, and that the first meeting shall be held at Halberstadt in the beginning of September. Halberstadt, lying at the foot of the Harz Mountains, is easily reached from all sides, and is an important centre for the study of Triassic fossils, including dinosaurs. Communications as to the society may be made direct to Prof. Jaekel.

UNDER the title "Sea Fisheries Organisation and Research," *The Times* on July 11 published an article of some importance, written by a correspondent who has evidently followed closely the attitude of the Government in connection with these matters in England during the last decade. After reviewing the various attempts at organisation and reorganisation which have occurred, the writer goes on to consider the position as it appears to stand at the present time. "Mr. Runciman and his new Chief of Staff have probably a greater opportunity now than has occurred in the memory of man of organising sea-fisheries research and administration throughout the country so as to unite the various cooperating bodies—all doing useful work in their own way—into one harmonious scheme such as will promote the development of a great national industry." A defence of the scientific man against the charge so often brought by the layman, that his work is not "practical," is then made, and concludes thus:—"It is merely a delusion of the ill-informed that science is unpractical or that the modern scientific man is not an efficient administrator. Science and administration are not antagonistic, ought never to be kept apart, and should surely be most intimately interwoven in the case of an industry like the national fisheries, based on scientific principles and requiring constant scientific supervision and investigation."

After the deplorable attitude recently adopted in Parliament by Mr. Runciman, the Minister in charge of the Fishery Department, such a vigorous statement of the position cannot be too often repeated.

IN the daily Press of July 12 it was announced, on the authority of Reuter's Agency, that Major H. Schomberg, a well-known German big-game hunter, has arrived in Europe from Liberia with five living specimens of the pigmy hippopotamus (*Hippopotamus liberiensis*), these being the first examples to reach Europe alive. Major Schomberg started in April, 1911, on an expedition fitted out by Mr. Hagenbeck in search of these animals, but had to return without attaining his object. Starting again in December, he proceeded from Monrovia into the hinterland, finally reaching Taguerna, a fortified town in the forest, where, in the course of two months, he appears to have procured his specimens. Of these, two have been purchased by the American Zoological Society, while the remaining three are in Germany.

IN the July issue of *Man*, Major A. J. N. Tremearne describes the curious Hammock Dance performed at Sierra Leone. A grass hammock is suspended between two posts some 20 or 30 ft. in height. To the blatant music of a native orchestra the performer climbs into the hammock, and from it swings and balances himself in various remarkable ways. The show usually continues for hours, "until the performers and the audience are exhausted or overcome with drink."

THE American Anthropological Association and Folklore Society have cooperated in starting an important quarterly review under the title of *Current Anthropological Literature*. The first number contains reviews of the more important books issued during the quarter, notes on new publications, and a classified summary of the more valuable articles and papers arranged according to the regions to which they relate. The publication promises to be of much importance to anthropologists, who are invited to send copies of papers in scientific publications to Dr. A. F. Chamberlain, Clark University, Massachusetts, U.S.A.

THE Corporation of Croydon, with the view of popularising the study of the collections in the Grange Wood Museum, has published at a nominal price two useful descriptive pamphlets, by Mr. E. A. Martin, on the pre-Roman and Roman exhibits. The former include eoliths from Titsey Hill and Botley Hill, palæoliths from the driver-drift, and remains from hut dwellings on Croham Hurst and Worms Heath. The most remarkable discovery made in the neighbourhood was that at Waddon, where three arched subterranean chambers were found in 1902. They were apparently used for sepulchral purposes, and belong to the Neolithic age. Three hoards of bronze represent primitive foundries. The Roman remains consist largely of coins. The pamphlets provide a useful account of man in the pre-Roman and Roman periods, and will add much to the educational value of the collections.

The Journal of Genetics for June, 1912 (vol. ii., No. 2) contains two articles—one by Mr. L. Doncaster and the other by Mr. R. Staples-Browne—on the inheritance of colour in pigeons; but in neither case do the results obtained admit of being summarised within the limits of the space at our disposal. The second article is illustrated with a coloured plate showing the colour-effects produced by crossing turtle-doves, collared turtle-doves, and the so-called white Java doves.

IN the July number of Witherby's *British Birds*, Mr. Meade-Waldo—who was largely instrumental in establishing the species in the Midland counties—defends the little owl (*Athene noctua*) from the charge of killing young game-birds, stating that it is mainly insectivorous, although it kills a number of young passerine birds while its young are in the nest. On the other hand, two other correspondents in the same issue reiterate the charge of game-poaching.

IN his annual address to the South London Entomological and Natural History Society, as printed in the Proceedings for 1911–12, the president, Mr. W. J. Kaye, directed attention to the great abundance of butterflies during the hot summer of 1911, the frequent production of second and third broods, and likewise the prevalence of supposed phases. The species that particularly responded to the unusual conditions was the small copper (*Rumicia phloeas*), which multiplied exceedingly in places where it is usually rare, and visited suburban gardens in numbers.

UNDER the title "Hortus Mortolensis" (West, Newman, price 4*s*.), A. Berger has published a catalogue, with interesting notes, of the plants growing in the famous garden at La Mortola, near Ventimiglia, Italy, founded in 1867 by the late Sir Thomas Hanbury. No efforts have been spared to develop La Mortola into an important subtropical botanic garden, from which seeds and plants are now distributed to almost every botanical establishment in the world, and which has been visited and described by many botanists; for instance, a long and interesting chapter is devoted to La Mortola in Prof. Strasburger's "Rambles on the Riviera" (English translation, 1906).

FROM Prof. J. M. Coulter, University of Chicago, we have received reprints of two papers of general botanical interest, one dealing with the problems of plant-breeding and the other with the relations of palæobotany to botany. In the former the eminent Chicago botanist briefly recapitulates the remarkably rapid progress made in plant-breeding since the rediscovery of Mendel's work and the publication of de Vries's mutation theory; touches upon the more recent work of Johannsen, Winkler, Baur, Nilsson, Aaronsohn, and others; and emphasises the "inextricable entanglement" of biological science and agricultural practice, pointing out that any result of scientific plant-breeding, representing as it must additional knowledge of the processes of evolution and of heredity, may become of practical service, while any result of practical plant-breeding, involving as it does extensive experiments with plants, may prove to be of great scientific importance. In the second paper the author indicates some of the recent reactions of modern palæobotany upon the phylogeny of the higher plants, and points out that the great problem of palæobotany to-day is the history of the Angiosperms.

THE annual reports of the West Indian Department of Agriculture are, as usual, very satisfactory, showing continued progress in various directions. The activities of the staff cover a wide range; plants are distributed from the Botanical Gardens; instructors are sent out to show the best methods of cultivation; in some islands prizes are awarded for the best holding; and investigations are undertaken of the numerous insect and fungoid pests. Large importations of Hevea rubber seeds were made at Grenada with the view of diversifying the agriculture; improvements have been effected in the limejuice in Dominica; Para rubber (but not Maniçoba rubber) is proving successful in St. Lucia, while in spite of a bad season, the output of limes from the Virgin Islands was higher than in previous years, and the value of the cotton crop was increased.

AN investigation has been made by Prof. Ewart, of Melbourne, on bitter pit in apples, the results of which are published in the Proceedings of the Royal Society of Victoria, vol. xxiv., part 2. He concludes that bitter pit is not a disease, but a symptom of local poisoning produced in the sensitive pulp cells of the apple, which may be induced by a variety of poisons. In some cases poisonous sprays may be the cause, and the trouble appears to be more prevalent in sprayed orchards than in those that have never been sprayed or had poison applied to the soil. But this is not an invariable rule, and it will be interesting to ascertain what poisons are at work in unsprayed orchards. During the course of the work it is shown that the cells of the apple fruit are extraordinarily sensitive to traces of poison.

IN a note in our issue of May 16 on the proposed substitution of electric for gas lighting in the House of Commons, we expressed doubts as to the necessity for placing the lights behind amber-coloured glass in order to guard against the effects of ultra-violet light on the eye. Our view is confirmed by a paper by Dr. Louis Bell which appears in the May number of the Proceedings of the American Academy of Arts and Sciences, and records the results of a series of measurements of the amounts of ultra-violet light sent out by various artificial lights per candle-power. The quartz mercury arc in its diffusing globe sends out least, and the carbon arc enclosed in quartz most, ultra-violet rays per candle-power, but the numbers for these artificial sources are far exceeded by that for daylight. In these circumstances it seems unnecessary within buildings to protect eyes which prove themselves hardy enough in the daylight outside.

THE value obtained by Prof. Joly twenty years ago for the specific heat of air at constant volume was for many years regarded as too high compared with the values for the specific heat at constant pressure obtained by Regnault and Wiedemann. Three years ago Dr. Swann published results for the latter quantity, determined by the continuous-flow method, which were higher than those obtained previously, and fitted in well with the observations of Joly. A copy of a paper by Drs. Scheel and Heuse, of the Reichsanstalt, which appeared in a recent number of the *Annalen der Physik*, has reached us, which confirms Swann's result, and gives values of the specific heat of air down to -183° C. The method used was that of continuous flow, and the results in gram degrees at 15° C. per gram degree are as follows:—at 20° C., 0·241; at -78° C., 0·243; and at -183° C., 0·253.

MESSRS. A. F. HØST AND SON, of Copenhagen, announce the early publication of vol. i. of the "Report on the Danish Oceanographical Expeditions, 1908–1910, to the Mediterranean and Adjacent Seas." Dr. Johs. Schmidt, the leader of the expeditions, will contribute an introduction, and other chapters will deal respectively with hydrographical observations, hydrography of the Mediterranean and adjacent waters (by J. N. Nielsen), exact determination of the chlorine in some samples of sea water from the Mediterranean (by H. Bjorn-Andersen), determination of the quantity of oxygen in sea water (by S. Palitzsch), the amount of oxygen in the water of the Mediterranean (by J. P. Jacobsen), measurement of the hydrogen ion concentration in sea water (by S. Palitzsch), the deposits of the sea-bottom (by O. B. Bøggild). Other volumes dealing with biological matters will be issued later.

Errata.—By a regrettable oversight the heading of the article in NATURE of July 11 *re* the Provisional Programme of Sections of the forthcoming meeting of the British Association appeared as "The Sheffield Meeting of the British Association." The meeting will, of course, be held at Dundee, as is stated in the article.—In the letter of Prof. MacBride on "Hybrid Sea-urchins," in NATURE of July 4, p. 450, col. i., for *Echinus nuharis* read *Echinus miliaris.*

OUR ASTRONOMICAL COLUMN.

THE MASSES OF DOUBLE STARS.—The following interesting figures concerning the masses of pairs of double stars are published by Dr. Doberck in No. 4583 of the *Astronomische Nachrichten*; the spectral type (Harvard) is shown in brackets:—η Cassiopeiæ (F8), 0·87; 40 o^2 Eridani (G5), 0·43; Sirius (A), 3·26; Castor (A), 72·19; Σ 3121, 371·9; γ Virginis (F), 8·09; α Centauri (G, K5), 1·99; ζ Herculis (G), 0·73; μ^2 Herculis (G5), 1·11; 70 p Ophiuchi (K.), 2·58; and 85 Pegasi (G), 3·07. Excluding Castor and Σ 3121, the former because the orbit is uncertain, and the latter because the parallax is too small, the mean value is 2·46, and as this includes both stars of the pair, the average mass of a single star is approximately equal to that of the solar system, which is taken as unity. The data are, as yet, too meagre to allow of any attempt to correlate average mass and spectral type.

SOLAR PROMINENCES IN 1911.—According to Prof. Riccò's annual summary, published in No. 5, vol i. (2nd series), of the *Memorie della Società degli Spettroscopisti Italiani*, the frequency, size, and magnificence of the solar prominences observed at Catania in 1911 were all considerably less than in 1910. The mean daily frequencies for the four trimestres were:—N. hemisphere, 0·3, 0·6, 0·4, and 0·1; S. hemisphere, 1·3, 1·2, 1·4, and 1·1. Thus for the year the frequencies were 0·4 (N.) and 1·2 (S.), as compared with 1·2 and 1·4 respectively in 1910. The decrease throughout the year was fairly regular in the N. hemisphere, but in the southern there were very marked recrudescences in June, July, and August, and in October and November. On forty-five (24 per cent.) of the days of observation no prominences were to be seen. Taking the distribution of the prominences in 10° zones, there were two maxima, 20° to 29° and 40° to 49°, in the northern, and one maximum, 40° to 49°, in the southern hemisphere.

THE MINOR PLANET 1911 MT.—It appears now that the period of the minor planet 1911 MT. is probably about five years, and that its aphelion lies beyond Jupiter's orbit. The recovery of this small body, after its temporary loss soon after Dr. Palisa discovered it, is a wonderful astronomical achievement, which Dr. Crommelin has likened to the recovery of Ceres by Gauss. As a writer in *The Observatory* points out, Dr. Leuschner's computers had, in the present case, only about one-sixth the length of arc, *i.e.* about half a degree, that Gauss had to work on in the case of Ceres. The new minor planet, according to Dr. Crommelin, is probably not more than four or five miles in diameter, but it can probably be kept sight of in future, and may prove useful in providing data for a determination of the earth's mass from the periodic perturbations produced in its orbit by the comparatively massive earth.

THE VARIATION OF LATITUDE.—Prof. Albrecht's summary of the provisional results secured by the International Latitude Service in 1911·0 appears in No. 4588 of the *Astronomische Nachrichten*, accompanied by the familiar spiral curve showing the pole's wanderings since 1906. It would appear that the maximum departure from the mean position occurred in 1911, and the curve has now commenced to coil up again towards its centre; the uncoiling occupied the years 1906–11. The values along the x, y, and z coordinates for 1912·0, extrapolated, are $+0·216''$, $-0·076''$, and $+0·079''$ respectively.

REPORTS OF OBSERVATORIES.—In his report of the work done at the Oxford University Observatory during the year ending April 30, Prof. Turner states that the new method of obtaining differential places of the reference stars, for the astrographic catalogue, by photography is being given an extended trial; the results first obtained were so promising that one complete zone, +29°, is being observed. Already two-thirds of this zone has been covered, and some 16,450 star images, on seven of the nine plates exposed, have been measured. The Oxford Observatory is also assisting the Vatican Observatory in reducing the measures for the Vatican zones of the Astrographic Catalogue.

Among the many important items mentioned by Mr. Hough in his report of the work done at the Cape Observatory during 1911, we may note only one or two. The reductions of the transit-observations show that the azimuth-marks are remarkably stable, but there is a collimation discrepancy for which, so far, no adequate cause has been found. A new Hartmann spectro-comparator has been presented by Sir David Gill, and of the 1219 stellar spectra taken for radial-velocity and solar parallax work, 875 have now been completely measured and reduced. For the coordination of the stellar magnitudes in the Cape Astrographic zone forty "magnitude" plates, 160 exposures, were taken with the astrographic telescope, and with the photoheliograph 603 negatives of the sun were taken on 293 days.

RECENT WORK IN MINERALOGY AND PETROGRAPHY.

J. C. BRANNER, in studying the "Minerals associated with Diamonds and Carbonados in the State of Bahia, Brazil" (*Amer. Journ. Sci.*, ser. 4, vol. xxxi., 1911, p. 480), comes to the conclusion that the diamonds originated by metamorphic action in the quartzites in which they are occasionally found, together with other minerals characteristic of metamorphic rocks. The description given of these "Lavras quartzites," which may be of Carboniferous age, and the admitted proximity of gneissic and more highly metamorphosed rocks in the country round them (p. 489), make the reader willing to suspend judgment.

E. T. Allen, J. L. Crenshaw, John Johnston, and E. S. Larsen issue a chemical and crystallographic study of the "Mineral Sulphides of Iron" (*ibid.*, vol. xxxiii., 1912, p. 169). Both marcasite and pyrite are shown to arise by the action of hydrogen sulphide upon salts of iron. Marcasite has been artificially formed from ferric sulphate in a closed vessel, which prevents the oxidation or escape of the hydrogen sulphide. The ferrous sulphate and sulphur produced are further acted on (p. 173) under these conditions by the hydrogen sulphide, yielding iron disulphide and sulphuric acid. Pyrite, instead of marcasite, arises where the solution remains neutral or but slightly acid (p. 181). Pyrite can also be made by the attack of a saturated solution of hydrogen sulphide in water on ferric hydroxide in a sealed tube, kept at 140° C. for seven days. These conditions may clearly be realised in nature. It is remarked (p. 191) that ferrous, and not ferric, sulphide has been observed to result from bacterial action in natural waters, such as those of the Black Sea, but an excess of hydrogen sulphide and an influx of air, bringing oxygen, would convert this into iron pyrites. Marcasite cannot exist at temperatures above 450° C., which probably accounts for the occurrence of pyrite in all deep veins. Pyrrhotine is carefully and experimentally considered, and is held to represent a solid solution, which accounts for the presence of sulphur in varying proportions (p. 194). Troilite is an end member of this series of solutions. Pyrrhotine is probably dimorphous, with a rhombic form arising at high temperatures and a hexagonal one at low temperatures.

R. E. Liesegang ("Die Entwicklungsgeschichte der Achate," *Aus der Natur*, 1911, p. 561) shows how the colour-bands in agate can be imitated in a jelly of gelatine containing potassium bichromate. Silver nitrate is introduced in the centre, and the reaction spreads outwards, producing layers of silver chromate alternating with clear ones. The silver chromate first forms a supersaturated solution, but, as it spreads, the concentration causes precipitation. Diffusing through this layer, further silver nitrate repeats the process. It is urged that in nature a cavity may be filled by a silica jelly, and that iron salts may similarly spread through it, producing colour-bands.

W. Hill usefully reviews British varieties of "Flint and Chert," of which he has such wide knowledge, in his address to the Geologists' Association (Proc., vol. xxii., 1911, p. 61).

Strüverite, which has attracted some attention, was first described from a granite dyke in South Dakota by L. Hess and R. C. Wells in 1911 (*Amer. Journ. Sci.*, ser. 4, vol. xxxi., p. 432). Its composition is given approximately as $Fe(Ta,Cb)_2O_6.6TiO_2$.

C. Matveeff has examined specimens of cone-in-cone in anhydrite and calcite from the Ural district (*Travaux de la Soc. imp. des Naturalistes de St.*

Pétersbourg, vol. xli., p. 221, with English version on p. 265). His optical observations show that divergent fibres are not essential in cone-building; but he regards the cones as essentially a type of spherulites. References are made to English instances.

R. C. Burton describes an interesting occurrence of crystallised kaolin replacing fossil shells in Coal-measure shales. He refers the mineral to the removal of part of the associated clays, which were a mixture of hydrated silicates; the unstable members have disappeared in waters containing carbon dioxide, leaving a pure kaolinite to be deposited in the hollows left by the solution of the shells (Proc. Univ. Durham Phil. Soc., vol. iv., 1911, p. 24).

Riebeckite, ægirine, and other rock-forming silicates are critically discussed by C. H. Warren and C. Palache in their account of certain pegmatites at Quincy, Massachusetts (Proc. Amer. Acad. Arts and Sci., vol. xlvii., 1911, p. 125). Incidentally (p. 147), doubt is thrown upon the eutectic origin of graphic granite, since the Quincy examples contain 60 per cent. felspar and 40 per cent. quartz. The same authors (*Amer. Journ. Sci.*, ser. 4, vol. xxxi., p. 533) investigate the "Chemical Composition and Crystallisation of Parisite" in connection with its occurrence in the Quincy pegmatites. Parisite is the rare fluo-carbonate of calcium and the cerium earths. It is suggested that Flink's synchisite from Narsarsuk, in Greenland, first described as parisite, is a true parisite, its additional molecule of $CaCO_3$ being possibly an impurity (p. 545). Riebeckite and other silicates from the same rocks are here again described.

F. Zambonini, in his "Contributo allo studio dei silicati idrati" (Soc. reale di Napoli, *Atti Acad. Sci.*, ser. 2, vol. xiv., No. 1), seeks to show, by a series of determinations of water lost at various temperatures, that our knowledge of the composition of hydrated silicates is still far from complete. The treatment of the zeolites is of special interest, and the author modestly regards this quarto memoir of 127 pages as a step towards future work by others. He concludes that minerals may contain a variable amount of water in solid solution, which accounts for the different analytical results. This reminds us of the remarks made by Allen and others on pyrrhotine, above referred to.

Zambonini also deals largely with silicates, but at the same time with a number of other minerals, in his monumental treatise entitled "Mineralogia vesuviana" (*ibid.*, No. 6). He has here brought together results from a wide range of literature. On p. 56 he gives reasons for doubt as to the composition of Scacchi's melanotallite, and proposes the new name idromelanotallite for the green mineral derived from it on exposure to the air, which has the composition $CuCl_2.CuO.2H_2O$. This memoir, with a good index, occupies 368 pages.

Eero Mäkinen (*Bull. Comm. géol. de Finlande*, No. 26, 1911) describes in German a method for the determination of alkalies in silicates by means of calcium chloride, which he finds to be simpler than that of Lawrence Smith. The process is carried out in an ordinary platinum crucible.

W. T. Schaller's "Mineralogical Notes" (U.S. Geol. Survey, Bull. 490, 1911) contains a revision of the two new borates, hulsite and paigeite, from Alaska. Molybdite (p. 84) is shown to be a hydrated ferric molybdate, and not molybdenum trioxide.

Turning to petrography, H. Dewey and J. S. Flett review the British "Pillow-lavas" (*Geol. Mag.*, 1911, pp. 202 and 241), those interesting greenish andesitic rocks which are so often associated with radiolarian cherts. They show their albitic character, and place them in a family of igneous rocks, the "spilitic suite," which is distinct from Harker's Atlantic and Pacific suites. Albitisation has arisen in them through the action of water containing soda and silica in solution. They are associated with districts "that have undergone a long-continued and gentle subsidence, with . . . no important folding."

It may be pointed out, however, that the extreme uncertainty as to what rocks belong to the Atlantic and Pacific types make a third type at present undesirable in connection with them; G. Steinmann, moreover, has recently connected rocks of this spilitic nature with regions of intense earth-movement and overfolding (*Ber. nat. Gesell. Freiburg-i.-B.*, Bd. xvi., 1905, p. 64).

R. A. Daly again attacks the problem of the rocks rich in alkalies in a paper on "Magmatic Differentiation in Hawaii" (*Journ. Geol.*, vol. xix., 1911, p. 289). He believes that volatile substances rising through the volcanic vent carry up alkalies with them from the cauldron below, and so bring about a differentiation. This is supported by the experiments of Giorgis and Gallo on the removal of soda from Vesuvian lavas by a current of carbon dioxide. L. V. Pirsson ("Geology of New Hampshire, No. v.: Petrography of Tripyramid Mountain," *Amer. Journ. Sci.*, ser. 4, vol. xxxi., 1911, p. 431) points out a region of alkalic syenites for which the theories of Jensen and Daly as to the absorption of sediments will not hold; but Daly's suggestion made in the case of Hawaii might serve also in New Hampshire. It is refreshing, however, to find Pirsson remarking, amid the current ingenious theories of differentiation, that his syenite may perhaps be regarded as an intrusion separate from the associated gabbro.

In 1910 F. Berwerth carefully examined the surface-features of meteorites and of the curious glassy bodies known as moldavites, and concluded that the latter showed no signs of fusion from passing through our atmosphere, but merely etchings due to chemical corrosion in the spots where they are now found (*Tscherm. Mitt.*, Bd. xxix., p. 12). G. P. Merrill has independently examined the moldavites and allied "tektites" (Proc. U.S. Nat. Mus., vol. xl., 1911, p. 481), including "billitonites" and "australites," and observes that the moldavites are comparable to fragments of true volcanic glass which have been etched by corroding vapours or solutions, while none of the "tektites" show the characteristic flutings of meteorites. The origin of these scattered glassy pellets, occurring in superficial deposits, remains unsolved.

In the Proceedings of the American Philosophical Society, vol. l., 1911, p. 519, J. J. Stevenson concludes an elaborate study of literature on the formation of coal. Peat is here considered, and the sixty-four pages devoted to its characters, origin, and occurrence form an important work of geological reference. In dealing with buried forests, the author criticises the wide acceptance of the drift-theory as a means of accounting for coal formed of the remains of trees.

In conclusion, we should note that G. W. Grabham has described the improved form of petrological microscope made under his supervision for the Sudan Survey by Swift and Son, of London (*Min. Mag.*, vol. xv., p. 335). It is a development of the well-known Dick model. The author then discusses illumination, and gives a new explanation, which he attributes to E. M. Anderson, of the "white line effect" due to the juxtaposition of two substances of differing refractive index. This explanation covers the commonly occurring cases where the surface of junction of the substances is inclined to that of the rock-section. G. A. J. C.

VERY HIGH TEMPERATURES.[1]

EXACTLY a century ago this month Michael Faraday entered the Royal Institution for the first time. He was then a youth of twenty, in the last year of his apprenticeship to a bookbinder in Blandford Street. Among the meagre records we possess of Faraday's early life we find the following:—

"I had the good fortune, through the kindness of Mr. Dance, who was a customer in my master's shop and also a member of the Royal Institution, to hear four of the last lectures of Sir Humphry Davy in that locality. The dates of these lectures were February 29, March 14, April 8 and 10, 1812."

It was Faraday's habit to occupy the seat in the gallery over the clock. He made very full notes of the lectures, and afterwards wrote them up, indexed and bound them with his own hands into a volume of 300 pages, which is now preserved at the Royal Institution.[2]

Some months later Faraday writes:—"Under the encouragement of Mr. Dance I wrote to Sir Humphry Davy, sending, as a proof of my earnestness, the notes I had taken of his last four lectures. The reply was immediate, kind, and favourable."

In March, 1813, apparently largely on the strength of the impression made upon Davy by this volume of notes, Faraday was engaged as assistant in the laboratory of the Royal Institution at a salary of 25*s.* a week, with two rooms at the top of the house.

The first lecture of Davy's course referred to was on "Radiant Matter," and dealt, among other things, with the action of electric sparks on gases. Ever since Volta's discovery in 1800 Davy had been occupied with the study of the pile and the effect of the new currents in producing heat and chemical change, thus leading up to his decomposition of the fixed alkalies and the isolation of potassium in 1807.

Following on this discovery, Davy proposed that a fund "should be raised by subscription for the construction of a large and powerful battery, worthy of a national establishment, and capable of promoting the great objects of science, and that this battery be erected in the laboratory of the Royal Institution." The sum required, a little more than 500*l.*, was soon got together, and at the concluding lecture of the 1812 season the battery was put in action for the first time. We read in Davy's "Elements of Chemical Philosophy," iv., p. 110, an account of how he applied the battery to the running of an electric "arch" between two carbon rods. Parts of Davy's battery are still preserved at the Royal Institution.[2]

I begin my lecture thus merely to emphasise once more the truth of the adage of 3000 years ago: "There is no new thing under the sun."

In 1912, when considering the subject of "very high temperatures," we can claim, comparatively speaking, to be capable of little more than Davy accomplished a century ago. In his arc he melted all the most infusible materials known to him, including lime and magnesia, which are among the most refractory materials in use at the present day.

Turning now from the historic to the present aspect of our subject, permit me to begin with a few elementary considerations as to our conception of temperature. I think I am correct in saying that everyone has some idea in his own mind of a temperature scale, a kind of intuition which is generally a fairly useful one for practical purposes. Probably I am not exaggerating when I say that even men of science, who always think for their professional purposes of temperatures on the centigrade scale, find themselves obliged to convert to Fahrenheit for an idea of the temperature of a room or of a summer's day.

I have endeavoured to give a graphic representation (Fig. 1) of the temperature scale as we know it, both in centigrade and Fahrenheit degrees. You will notice the smallness of the interval between the extreme temperatures that prevail in the arctics and the tropics, and how restricted the "cold" region down to absolute zero is compared with the possibilities in the other direction. While, on the one hand, Kammerlingh Onnes by the evaporation of liquid helium under low pressure has succeeded in getting during the last few weeks to within 1·1° C. of absolute zero, the highest recorded terrestrial temperature—that of an electric arc under high pressure—falls short of the sun's estimated temperature by some 2000° C.

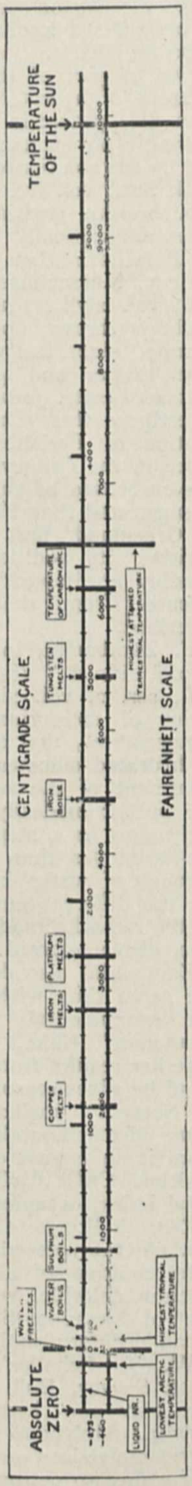

FIG. 1.

Some landmarks in our available range of temperature are given in Table I. It may be remarked that the three substances last quoted in the table are all in extensive use for electric lamp filaments.

TABLE I.—*Various Temperatures.*

		Deg. C.
Absolute zero		−273
Helium boils (0·2 mm.) ...		−272
„ „ (760 mm.) ...		−269
Hydrogen boils		−253
Oxygen boils		−183
Carbonic acid boils ...		−78
Mercury freezes		−39
Water freezes		0
Water boils		100
Tin melts		232
Lead melts		327
Mercury boils		357
Zinc melts		419
Sulphur boils		445
Aluminium melts		657
Common salt melts ...		801
Zinc boils		918
Silver melts		961
Gold melts		1062
Copper melts		1083
Cast-iron melts ...	about	1100
Pure iron melts		1500
Fire bricks soften		1400–1800
Silica softens		1500–1600
Platinum melts		1750
Silver boils		1950
Tin boils		2270
Copper boils		2310
Lime and magnesia melt	about	2400
Iron boils		2450
Tantalum melts ...	about	2900
Tungsten melts ...	„	3000
Carbon melts ...	„	?

Table II. gives examples of various flame temperatures which we have at our disposal.

[1] Abridged from a discourse delivered at the Royal Institution on February 9 by Dr. J. A. Harker, F.R.S.
[2] Exhibited on the lecture table.

TABLE II.

Temperatures obtainable in :—

	Deg. C.
Bunsen burner flame	1100–1350
Méker burner flame	1450–1500
Petrol blow-lamp flame	1500–1600
Oxy-hydrogen flame	about 2000
Oxy-acetylene flame	,, 2400
Electric arc	,, 3500
Electric arc (under pressure)	,, 3600
Sun	,, 5500

Some of the methods for measuring temperature with their limitations are briefly recapitulated in Table III. I have only time to refer to one or two points. We have recently had the opportunity at the National Physical Laboratory of subjecting a number of mercury in silica thermometers to a critical examination. These thermometers, which are made in England, possess in a high degree the qualities of constancy, large range, and such complete freedom from temporary zero change, that I feel safe in prophesying they will inevitably replace the present international standards, which are made of verre dur.

In regard to high temperatures, most of us rely to some extent on colour in estimating temperature. Table IV. gives a very fair notion of the temperature we may reasonably associate with the colour of a fire or muffle furnace (experiment shown). The intensity of the light varies according to well-known laws which have been studied up to sun's temperature. If we know the law of variation we can measure the temperature by the use of some kind of photometer—which is what all optical pyrometers are.

TABLE IV.—*Temperature and Colour of a Fire.*

Colour.	Cent.	Fahr.
"Grey," lowest discernible temp.	About 450°	About 850°
Very dull red	,, 500°	,, 950°
Dull red	,, 700°	,, 1300°
Cherry red	,, 900°	,, 1650°
Orange	,, 1100°	,, 2000°
White	,, 1300°	,, 2400°
Dazzling white	Above 1500°	Above 2750°

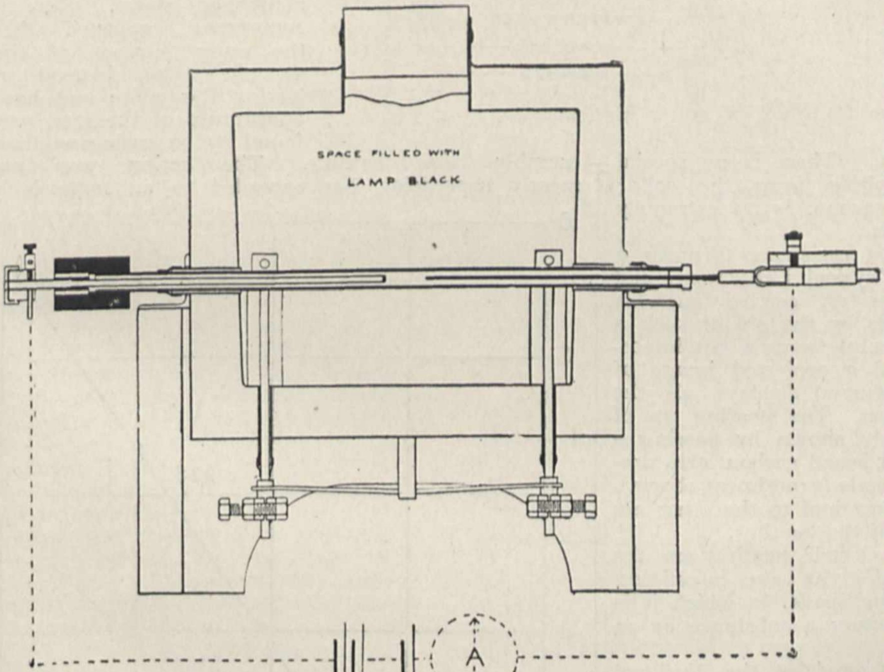

FIG. 2.—Small model straight carbon-tube furnace.

For obtaining really high temperatures electric furnaces are our only resort. Small gas furnaces can reach 1600° with difficulty; large industrial furnaces attain 1800° C. in some instances.

Mr. Cook, of Manchester, has kindly lent me for this occasion a number of electric furnaces. These are constructed by winding tubes of fire-clay or alumina with nichrome or platinum wire or strip: the external lagging is of kieselguhr. Steady temperatures up to about 1000° and 1200° C. respectively can readily be got with power from a commercial circuit of 100 or 200 volts. With thicker wires and current at lower voltage these upper limits can be appreciably extended.

For higher temperatures we have to make use of carbon or graphite, and electric heating was first applied by such means in the form of the arc furnace. Such a furnace has many inconveniences—the heating is intensely local, and there may, for example, be a gradient of 2000° C. in a single inch. There is practically no temperature control, and there is every possibility of the final product becoming largely contaminated with carbon. Most of the early isolated so-called elements have since proved to be largely carbides.

Resistance heating is usually much more convenient, and this is the principle of carbon-tube furnaces, some essential features of which were employed by Prof. Dewar many years ago. They will stand rough use, and are much more controllable than the arc furnace. It is as easy to control a temperature of 2500° C. as one of a red heat.

Such furnaces usually have their end-terminals water-cooled, and are surrounded by lagging of lampblack or charcoal.

The furnace tubes are either straight if made of

TABLE III.—*Some Indication of the Present Range of Temperature-measuring Instruments.*

Method.	Range in Degrees C. Practical.	Range in Degrees C. Extreme.
Expansion thermometers—		
Gas thermometer ...	Up to 1200°	− 272° to 1550°
Mercury in glass ...	− 39° ,, 500°	− 44° ,, 575°
Mercury in silica ...	− 39° ,, 600°	− 44° ,, 700°
Electrical thermometers—		
Platinum resistance ...	− 100° ,, 1100°	− 250° ,, 1400°
Thermocouples :		
— platinum alloys ...	300° ,, 1400°	Up ,, 1750°
— base metals ...	− 100° ,, 1100°	− 250° ,, 1200°
Total radiation pyrometers	500° ,, 1400°	No upper limit
Optical pyrometers... ...	600° ,, 3500°	No upper limit

carbon (Fig. 2), or spiral if made of Acheson graphite (Fig. 3). In the latter case they are provided with an

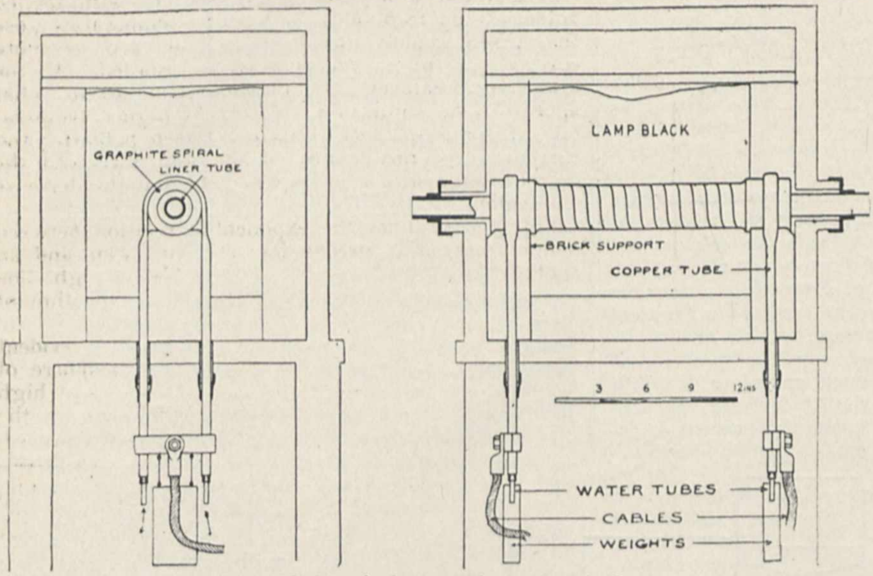

FIG. 3.—Carbon-tube furnace with graphite spiral heater.

internal liner tube of carbon. There is no special difficulty in cutting the spirals from the solid; graphite, unlike amorphous carbon, is an extremely tractable substance to machine.

We have used these carbon resistance furnaces a great deal at the National Physical Laboratory, and Mr. Greenwood, at Manchester, carried out his experiments on boiling metals by the aid of such a furnace. The boiling of a metal forms a not impossible lecture experiment, and a projected image of the surface of boiling tin (shown) displays all the usual phenomena of ebullition. The heating up of carbon is somewhat strikingly shown by passing a heavy current through a thin broad carbon strip provided with water-cooled terminals (experiment shown). The lines of flow from one terminal to the other are well illustrated at one stage of the heating.

Among other methods of electric heating are the induction furnace, which is of great value in refining crude materials, and the flame spark, in which it is possible to volatilise so refractory a substance as an incandescent gas mantle.

Some time ago I endeavoured at the National Physical Laboratory to make a furnace for very high temperatures without employing carbon.[3] The introduction of the Nernst lamp was suggestive. It was found that a great number of substances could be made to act like a Nernst filament, *e.g.* a piece of the stem of a churchwarden pipe, if sufficiently strongly heated, can be made to conduct electricity well enough to become incandescent. Carborundum crystal behaves similarly, and requires no initial heating (experiment shown); in this case the temperature can be raised high enough to volatilise off the silicon, which burns, forming a cloud of silica. A cascade furnace was constructed on these lines: a tube made up of zirconia and a little yttria was raised by means of an insulated nickel winding to 500° or 600°, at which temperature the tube conducts sufficiently well to enable a heating current to be passed through it. There is no difficulty in melting platinum, for example, in such a furnace using a quite small heating current (about 2 amps.). A zirconia tube from such a furnace was taken out after it had been run for six months or so; it was then found to be quite translucent. The possibility of constructing in such a way refractory gas-tight materials at once suggested itself, and we proceeded to manufacture "pottery" at high temperatures. Great difficulties have been encountered in the experiments. Whereas, for example, the potter in baking his wares at temperatures up to 1300° C. looks for a shrinkage of 5 per cent. or so, we were confronted with a shrinkage of 37 per cent. with tubes baked at temperatures up to about 1800° C. For the purposes of the fritting we employed carbon-tube furnaces of one of the types mentioned above. Now it sometimes happened that the outer surface of the zirconia tubes, instead of having the white and hard appearance of the rest, was found to be carburised and crumbly after baking. The action was not merely superficial, but extended to an appreciable

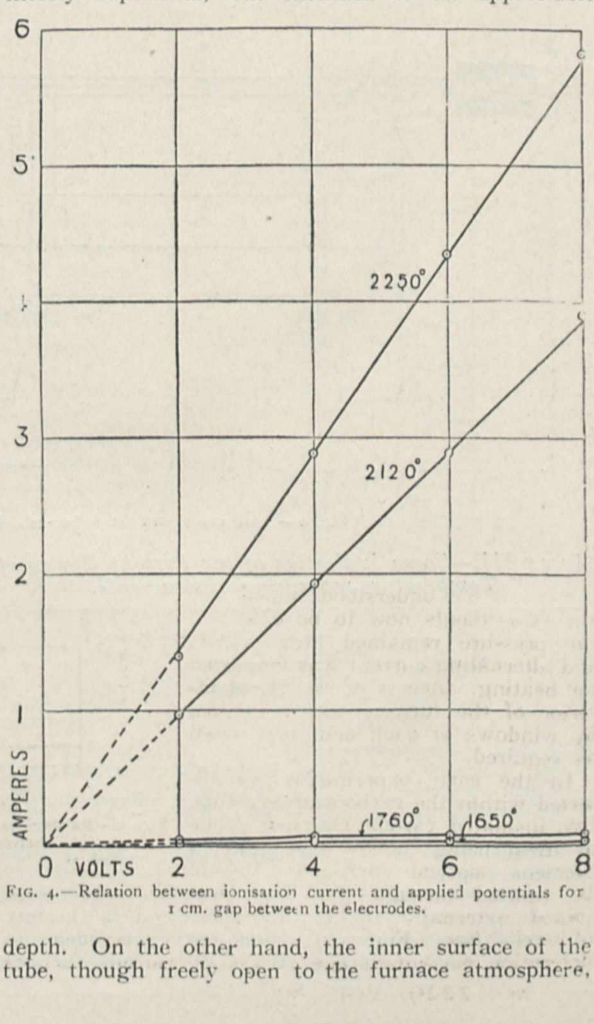

FIG. 4.—Relation between ionisation current and applied potentials for 1 cm. gap between the electrodes.

depth. On the other hand, the inner surface of the tube, though freely open to the furnace atmosphere,

[3] Proc. Roy. Soc., vol. 76 A, p. 235, 1905.

was much less affected. The blackening occurred to a much less extent if the tube was shielded. It seemed as though particles, possibly electrified, were shot off

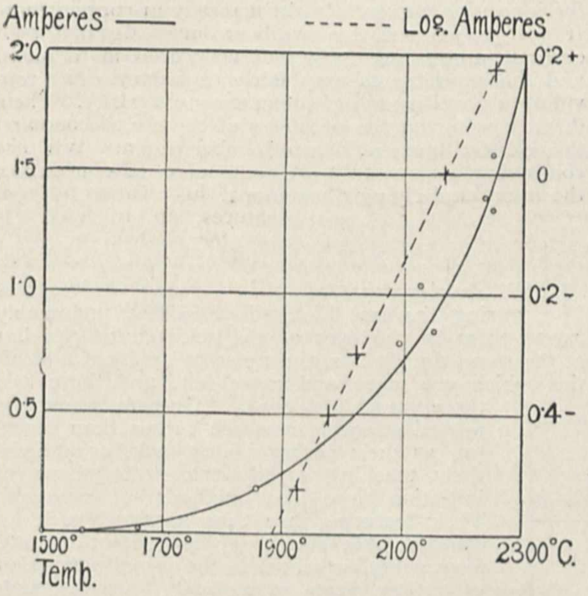

FIG. 5.—The full line curve shows a relation between ionisation current and temperature, for an applied potential of 2 volts on a 1 cm. gap between the electrodes. The dotted straight line is plotted from the log. of the current and the temperature.

from the carbon walls of the furnace across a space of some 5 or more mm. into the material of the refractory tubes.

Dr. G. W. C. Kaye and I were led to investigate the cause of these phenomena, and yesterday we gave an account of some of the results to the Royal Society. I propose to devote the remainder of my lecture to a description of the methods employed and the results obtained in what proved to be a very interesting investigation.

Many experiments have been conducted, notably by Prof. O. W. Richardson, on the corpuscular emission of electricity from carbon at very low pressures, but scarcely anything is recorded for pressures approaching atmospheric. Positive ions and material particles are also discharged by carbon, as well as by hot metals, at suitable temperatures and pressures.

It is to be understood that in all the experiments now to be described the pressure remained atmospheric, and alternating current was employed for heating. Access of air to the interior of the furnace was prevented by windows at each end, perforated as required.

In the early experiments we inserted within the carbon-furnace tube two insulated carbon electrodes, one of them being hollow, so that a Siemens optical pyrometer could be sighted through it. The two electrodes were joined externally to an ammeter and a battery of cells (see Fig. 2), and we proceeded to determine current-voltage curves at various furnace temperatures. Some of these curves are shown in Fig. 4 for an electrode gap of 1 cm. No appreciable current could be detected below 1400° C. with applied potentials up to 8 volts, but as the temperature rose the current rapidly increased until at 2500° or more currents up to 10 amperes were recorded. At the lower temperatures the currents soon attain what appear to be saturation values. At higher temperatures there is a linear relation between potential and current. As the length of the gap increased the current diminished at a regular rate, but the decrease was small.

Fig. 5 exemplifies the exponential relation between temperature and current for a 1 cm. gap and an applied potential of 2 volts. The dotted straight line was plotted to axes of temperature and logarithm of current.

The magnitude of the currents made it evident that in spite of the high pressure the atmosphere of the furnace was ionised to an unusual degree at high temperatures, and we were led to investigate the effect of temperature alone. The battery was accordingly cut out, and one of the two carbon electrodes was mounted on a sliding carriage so that it could, at will, be moved in or out of the hot part of the furnace, *i.e.* away from the fixed electrode or back towards it. The movable electrode would thus be temporarily cooler than the fixed electrode which remained steadily in the furnace. The ammeter in the circuit indicated a current which amounted to 2 milliamperes at 1400°, and nearly 2 amperes at 2500°; the cooler electrode was the positive one. The currents died away when the two electrodes attained the same temperature.

The production of an alternating current of very low frequency is thus rendered possible by the use of some periodic device. In one form of the experiment (shown) the movable electrode is attached to a crank

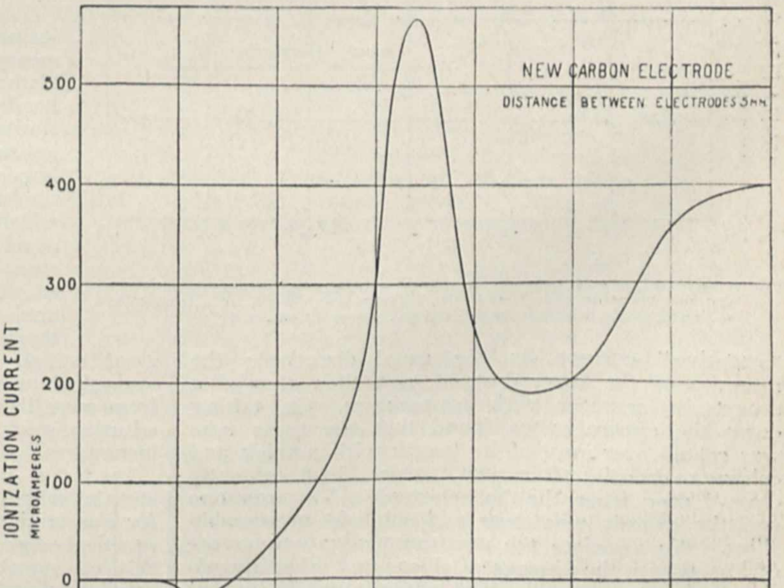

FIG. 6.—Relation between ionisation current and time with a steadily rising temperature. The "cold" electrode was water-cooled; the hot electrode was of new carbon. No potential was applied.

which, rotated slowly by clockwork, performs the necessary displacement of the electrode within the furnace. The ionisation currents produced are sufficient to make a nest of small glow-lamps light up brilliantly, the illumination waxing and waning as the movable electrode moves in and out.

We have been able to repeat some of these results with furnaces of a non-electric character.

In a further series of experiments various modifications were introduced. The two electrodes were replaced by two co-axial tubes, which were mounted within the furnace. The central smaller tube was of brass, through which a rapid current of water was sent; this formed the "cold" electrode. The surrounding larger tube of carbon constituted the hot electrode, and received its heat from the furnace. The electrodes were insulated as before, and into the annular space between them hydrogen or nitrogen was continually passed. No potential was applied, and the currents we obtained with a steadily rising temperature and a new carbon electrode are shown in Fig. 6. It will be seen that there was first a small "positive" current (which would be produced by positive ions crossing from the hot to the cold electrode), which soon changed into a much larger

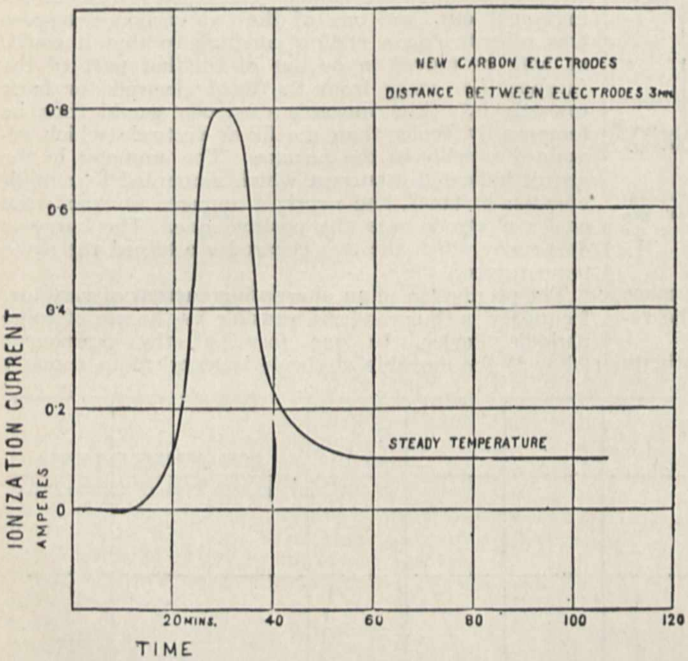

FIG. 7.—Relation between ionisation current and time for two new carbon electrodes, one hot, the other water-cooled. No potential was applied. The temperature was rising for the first fifty minutes, and was afterwards steady.

"negative" current (in the usual direction); the intensity of the latter dropped, and then showed a progressive increase with temperature. On taking down the apparatus we found that the brass tube was coated over most of its length with a thick and coherent deposit of carbon, which had evidently crossed over from the hot electrode. Towards one end the deposit was rarer and whitish—presumably silica. We associate the maximum negative current of Fig. 6 with the passage of silicon and other impurities, which are volatilised at about 2000° C. out of the carbon electrode. On a second heating neither positive rays nor a negative maximum was detected, but the ionisation current increased steadily with temperature. The transference of carbon from the hot electrode to the cold may possibly prove to be an explanation, not only of the contamination phenomena which gave rise to these experiments, but also of the comparatively large accompanying currents.

Fig. 7 illustrates the results obtained when steps had been taken to increase the difference of temperature between the hot and cold electrodes. The carbon was new, and the negative maximum again appears. Afterwards the furnace temperature was steadied, and the ionisation current also kept steady in consequence. It will be noticed that we were now dealing with currents amounting to large fractions of an ampere, and the experiments may fairly be regarded as providing a novel means of generating electricity. Their direct bearing on the problems of the electric arc and the carbon filament lamp is obvious, and we are continuing the research with the view of elucidating the many underlying phenomena.

UNIVERSITY EDUCATION IN GERMANY.[1]

THE development of the German universities during the last hundred years has undeniably raised them in the eyes of the scientific world, but at the same time it has given rise to practical difficulties which are more and more felt, and, here and there, much deplored. German professors regard scientific research rather than teaching as their distinguishing task, or at least their teaching mostly takes the shape of initiation into the methods of research. Their lecturing has thus assumed such an abstract character that the student coming from a higher school in the proud possession of a "certificate of maturity" usually finds the transition to the new atmosphere of thought very hard, and commonly wastes more than one term merely in finding a footing. At the other end, the step from the university into a profession is the reverse of easy; the medical faculty, with its clinical hospitals and similar arrangements, is really the only one which offers a direct training for the future.

A more adequate view of the matter seems, however, to be spreading. In the meantime a year's practical training, complementary to the studies and examinations, has been added to the medical course, and a similar provision has been made for evangelical theology. In the university itself the importance of mental intercourse between the professors and their students is more widely recognised, due to the further development of the university seminaries; even those professors and "privatdocents" who do not conduct official seminaries usually hold so-called "exercises" in addition to their lectures. The throng of students is great on all such occasions; they themselves feel strongly how much less they gain in mental culture from mere listening to lectures. Nevertheless the institution must be regarded as in some respects very incomplete.

In many subjects the seminary deals only with strictly scientific questions (from which the themes for dissertations are frequently drawn), whereas more practical discussions are equally desirable. Besides this the number of those admitted is usually rather small, and indeed not unwisely so, because it is only then that a lively debate becomes possible; a too numerous membership easily tends to make the individuals embarrassed and silent. In most cases, too, only those students are admitted who have already been several terms in the university, whereas it is precisely the freshman who is most in need of help.

[1] Abridged from an article by Prof. Wilhelm Münch, professor of pedagogy in the University of Berlin, in the Report of the U.S. Commissioner of Education for the year ended June 30, 1911, vol. i., just received from Washington.

The whole system is, in fact, capable of much development; for younger lecturers and for older and proved students, a field of useful labour is here opened.

The absence of all unifying personal guidance of the student's course of study is not infrequently felt to be a weakness in German university life, yet few people wish for definite or printed curricula, even if these should be only for the sake of suggestion. Full "academic freedom" proves, as a matter of fact, a benefit only to students of much intelligence and firm character. It is, in fact, only the more distinguished who rise; the ordinary individuals fall back. Some now declare that the lecture system has lived its day and that a method in which dialogue should predominate ought to take its place; others—and such a conspicuous thinker as the late Friedrich Paulsen was among their number—regard the lecture system as the most effective, to be surpassed and replaced by no other.

On the whole it is not strange that the demand should at intervals have arisen for a special "academic pedagogy" as a new science. In an age when all questions of pre-university education are carefully considered and measures taken in accordance, indifference ought not to prevail toward the succeeding years and their educational claims. The academic chair also claims its principles and regulations. There should be no shrinking from a discussion of the problem, for the psychology of the student period deserves an exhaustive observation which it has not yet received.

If it was already hard enough for the freshman to gain a footing in the new mental atmosphere, to understand the abstract language, and to follow the closer line of thought; and if it was at the same time not exactly easy for the professor to find the right way of fascinating the cleverer spirits without repelling the weaker, the difficulty has become still greater for both parties, because pupils have been admitted to the university, not only from the classical schools (humanistischen Gymnasien), but also indiscriminately from the various schools which have a nine years' curriculum.

Now, it had never been intended that the modern and mixed schools should regard themselves thenceforward chiefly as preliminary stages to the university. It was expected that only those few pupils from them who felt a special call to higher scientific studies would take advantage of the new privilege, while the majority would devote themselves as before to more everyday ends. It is, however, undeniable that a much greater percentage of the students in these more practical institutions is streaming into the university than is desirable; and, what is worse, they enter, not for the sake of working in those subjects for which they had been chiefly trained (which were already free to them in the university), but in almost all other subjects as well, with the exception perhaps of theology. The allurement of the new liberty has clearly taken effect here, but just as clearly also the idea of social distinction which accompanies the academic calling. For in Germany, particular industrial districts excepted, university men are still regarded socially as an upper class, to which, in the eyes of the public, only the nobility, the official class, and perhaps the most distinguished artists are superior.

Convincing statistics of the result of the university work of students from modern schools in comparison with that of students from classical schools are at present not attainable. Great importance is not laid on figures and average results; the examinations, which must, after all, be the chief means of information, are affected by many different factors which cannot be weighed and measured, the addiction of the examiners to the method in which they themselves were schooled being possibly one of them. On the whole, however, judging from a number of personal opinions, the results certainly do not seem to denote a triumph for the modern schools. From the classical schools, also, it is true, the number of those is not small whose mental capacity does not mark them for scientific study; and on the other side there are always to be found among the students from the modern schools individuals of conspicuous talent and the highest aspirations who do creditable work in each subject.

The increase in the number of foreigners at the German universities steadily continues, but has recently had to be checked. Too many individuals of doubtful education, and frequently also leading very questionable lives, forced themselves in, particularly from the eastern European countries, and took up the space and the best seats at the practical exercises, crowding aside the German students. Visitors from America or England will scarcely be likely to find the recent measures of restriction an obstacle; their previous education is often excellent. It is, of course, the natural and desirable thing that only those students of a nation should be sent abroad who have distinguished themselves above the average. The dark sides of the German university system above mentioned apply but little to such; the lectures of the most distinguished professors are precisely what they have come for, and the arrangement of their studies can be confidently left to themselves.

As is only natural, the various branches of learning differentiate themselves more and more from one another, and thus, through the splitting up of departments already existing and through the extension of study over quite new fields, new chairs become needed.

Of greater interest for foreign readers are perhaps the movements which are going on in the German student world. To put it briefly, the students' clubs (Corps, Landsmannschaften, &c.) of the older form are losing ground to those which are founded on newer principles. The essential basis of the older corporations was, and is, the firm formation of a powerful community for the cultivation of boldness and courage, steadfast friendship, social and light-hearted enjoyment of youth; in practice, however, this is combined with considerable love of fighting and drinking, preservation of outworn ceremonies, and thoughtless pursuit of pleasure. Many of these bodies have at present but few members. At the same time the spirit which inspired them is by no means dead, and in certain universities, chiefly smaller ones, their characteristic way of life remains to this day. More prosperous, however, are the scientific societies, the athletic organisations, and those based on national, ethical, or Christian principles. And it is in keeping with the spirit of the time as well as with the academic tradition that the societies of similar aims at the various universities bind themselves together into united bodies.

[An addendum to the article shows the distribution of students among the German universities, and from it are taken the numbers given below for the year 1910–11:—

Universities	1910–11	Universities	1910–11
Berlin	9686	Kiel	1439
Bonn	3846	Konigsberg	1387
Breslau	2454	Leipzig	4900
Erlangen	1011	Marburg	1981
Freiburg	2246	Munich	6905
Giessen	1243	Münster	2047
Göttingen	2233	Rostock	816
Greifswald	948	Strassburg	2067
Halle	2661	Tübingen	1883
Heidelberg	2008	Würzburg	1425
Jena	1637		
			54,823

During this year 26,123 students of the total number took the philosophical faculty, which, in addition to mathematics and natural sciences, also includes philosophy, philology, and history.]

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Prof. Malins, on resigning the professorship of midwifery, which position he has held since 1894, has presented the sum of 1000*l.* to the University, "with a profound sense of the many important advantages it [the University] offers to the advancement of knowledge, and the great capabilities it opens to the future in the highest interests of intellectual and material progress in our midst."

CAMBRIDGE.—The degree of doctor of science *honoris causâ* is to be conferred to-morrow upon the following:—Prof. E. B. Frost, director of the Yerkes Observatory; the Marchese Emanuele Paternò di Sessa, professor of chemistry in the University of Rome; Prof. Pavlov, St. Petersburg University; Prof. Picard, University of Paris; Geheimer Regierungsrat Rubens, University of Berlin; and Dr. Warming, formerly professor of botany at Copenhagen.

LIVERPOOL.—Prof. J. M. Beattie, at present professor of pathology and dean of the medical faculty in the University of Sheffield, has been appointed to the professorship of bacteriology. He has also been appointed bacteriologist for Liverpool. Dr. J. Reynolds Green, F.R.S., has been appointed to the Hartley lectureship in vegetable physiology, and Dr. C. Rundle to the assistant lectureship in infectious diseases. The following elections have also taken place:—Mr. H. C. W. Nuttall to the Holt fellowship in pathology; Messrs. R. Kennon and R. Gee to the Holt fellowship in physiology; Messrs. J. H. Rawlinson and T. Thomas to the fellowship in anatomy; and Mr. A. A. Rees to a fellowship in surgical pathology.

LONDON.—At the meeting of the Senate on July 10, the following appointments were made to professorships with funds provided by the new grant from the London County Council:—Dr. J. A. Fleming, F.R.S., professor of electrical engineering (to teach at University College); Dr. Arthur Dendy, F.R.S., professor of zoology (to teach at King's College); and Mr. A. J. Sargent, professor of commerce (to teach at the London School of Economics).

Dr. A. N. Whitehead, F.R.S., has been appointed reader in geometry (to teach at University College).

The Dixon Fund for 1912–13 has been allocated as to 150*l.* to the Brown Institution for researches into leprosy, Jöhne's disease, and toxins and antitoxins by the superintendent (Mr. F. W. Twort); and as to 125*l.* to Dr. J. F. Spencer, of Bedford College, for researches on cerium and its compounds.

Dr. J. S. Bolton has been granted the D.Sc. degree in physiology for a thesis entitled, "The Beginnings of the Localisation of Cerebral Function based on the Clinico-Pathological Study of Mental Disease."

OXFORD.—Mr. G. E. Beaumont, University College, has been elected Theodore Williams scholar in pathology for 1912, and Mr. R. P. Pinsent, of Marlborough College, has been elected to a Williams exhibition in natural science at Balliol College.

MR. R. W. BAILEY has been appointed principal of the Crewe Technical School.

PROF. C. A. M. SMITH, of the East London College, has been appointed professor of mechanical and civil engineering at the newly created University of Hong Kong.

IT is announced that the donor of 10,500*l.* towards the medical school of University College of South Wales and Monmouthshire and the King Edward VII. Hospital, Cardiff, is Mr. W. J. Thomas.

PROF. THEODOR KOCHER has presented to the University of Berne the sum of 200,000 francs for the purposes of research, in celebration of the holding by him for the period of forty years of the chair of surgery in the University.

GRANTS have been promised to the South-Eastern Agricultural College, Wye, by the Board of Agriculture of 262*l.* 10*s.* for research work in hops, parasitic worms, and "struck" sheep; 1000*l.* for advisory work undertaken by the college in entomology and mycology; and an offer of 500*l.* a year is made for a research fruit and hops plantation in the south-eastern district, provided an equal sum be raised locally.

AT the meeting of the Council of the Royal College of Surgeons held on Thursday last the following elections and re-elections took place:—*President,* Sir Rickman J. Godlee; *Vice-Presidents,* Messrs. Clinton T. Dent and G. H. Makins, C.B.; *Hunterian Professors,* Mr. J. E. Adams, Dr. A. Keith, Dr. W. B. L. Trotter, Mr. K. M. Walker, and Mr. W. Wright; *Arris and Gale Lecturers,* Mr. W. B. Bell and Dr. C. G. Seligmann; *Erasmus Wilson Lecturer,* Mr. S. G. Shattock; *Arnott Demonstrator,* Dr. A. Keith.

MR. C. A. BALLANCE, M.V.O., was appointed to represent the college on the occasion of the ninth International Otological Congress, to be held in August at Harvard University.

THE Imperial Conference of Teachers' Associations, promoted by the League of the Empire, was opened at Caxton Hall, Westminster, on July 13, and has continued its meetings this week. The delegates, who represented every part of the Empire, were welcomed on behalf of the Government by the President of the Board of Education. Mr. Pease, after eulogising the work done for the Empire by the teaching profession, went on to say that experts whom the Board of Education sent to the Continent report that we in this country have very little to learn from the European Powers. Even from Germany, with all its scientific advance so far as education in the elementary schools is concerned, we have not much to learn. In regard to the condition of our schools, hygiene, and medical inspection and treatment, we are ahead of other nations on the Continent of Europe.

WE learn from *The Pioneer Mail*, Allahabad, that a special meeting of the Senate of the University of Calcutta was recently held to consider, among other matters, the endowment made by Mr. Tarak Nath Palit for the founding of chairs in chemistry and physics, and for the establishment of a university laboratory. Mr. Palit's gift is of the value of more than seven lakhs of rupees. This sum is to be supplemented by two and a half lakhs from the reserve fund of the University. The Senate is therefore in a position to take the first step towards the foundation of a University College of Science and Technology. The founder stipulates in the trust deed that as his object is the promotion and diffusion of scientific technical education and the cultivation and advancement of science, pure and applied, amongst his countrymen by and through indigenous agency, the chairs founded by him shall always be filled by Indians, but the professor-elect may in the discretion of the governing body be required to receive special training abroad before he enters upon the discharge of the duties of his office. He will during this period be in receipt of suitable allowance and travelling expenses, which will be deemed part of the cost of the maintenance of the chair. The chairs and laboratory will be named after the munificent donor.

THE annual Degree Congregation of Sheffield University took place on July 11. Mr. Balfour was, among others, the recipient of an honorary degree, and during the proceedings addressed the students. He said the great development which has taken place of recent years in universities has been wholly on the right side. The functions of a university are extraordinarily various, dealing with every kind of object in life, and not confined to one sex or one kind of learning. Those who regret that the old curriculum is not maintained in its simplicity are quite wrong from the point of view of general culture, let alone the necessity of giving the opportunity to students to learn those things which may be must useful to them in life. It is, relatively speaking, only in recent years that high scientific training has had a direct and necessary bearing upon every kind of industrial success. The old days of rule of thumb have passed, and the most elaborate scientific training is required in order that we may keep abreast with other countries, and also that all countries may use the powers and resources possessed to the best advantage of mankind. With the advent of this new period have come new functions for our great teaching centres, and there is no place where this high scientific training is likely to produce more fruitful results than Sheffield, and no place where scientific and technical training has been more successfully developed. Speaking subsequently at a luncheon, Mr. Balfour pointed out that the conjunction of those engaged in academic pursuits and the leaders of industry and commerce will produce in the future fruits of university training of which our forefathers never dreamed. Probably when the great university movement started in Europe many centuries ago, the idea of a great industrial centre was in itself alien to the thoughts of men, and the idea of combining industry with university culture, although it did happen in some great Continental cities like Bologna, is nevertheless a relatively modern idea. In these modern days there is no class more sensible of the enormous debt which civic and industrial life owes to university teaching, properly understood, than the great leaders of industry.

SOCIETIES AND ACADEMIES.

LONDON.

Challenger Society, June 26.—Dr. A. E. Shipley, F.R.S., in the chair.—Dr. W. S. **Bruce**: Twenty-three new species of invertebrates taken by the *Scotia* were exhibited. The collection included four alcyonarians, thirteen echinoderms—asteroids, ophiuroids, and holothurians, two nematodes, two pycnogons, and two amphipods. The author also showed two known species, namely, the interesting pycnogon, *Decalopoda australis* of Eights, and his interesting large isopod, *Glyptonotus antarcticus*. The interest of the collection lay mainly in the fact that most of these species had been taken in deep water and in high southern latitudes. A very high percentage of those taken in deep water were new to science. The *Scotia* collections practically disposed of a theory of bi-polarity. Except where species were of universal distribution, Antarctic species were markedly different from those of the Arctic regions.—C. Tate **Regan**: Antarctic fish-fauna: material from the *Scotia* collections. The Nototheniidæ and related families form a natural group characteristic of and peculiar to the Antarctic and sub-Antarctic seas, and about seventy species are known, mostly littoral, but some pelagic or abyssal; some of the species seem to have a circumpolar distribution. Other abyssal and pelagic fishes of the Antarctic are mostly con-generic with forms already known from the Atlantic or Indo-Pacific; the littoral fishes are related to those of New Zealand and Patagonia. The fishes do not support the theory of bi-polarity, and throw little light on the question of a former extension of the Antarctic continent.—H. J. B. **Wollaston**: A new method of working vertical tow-nets. The line from the net, after passing over blocks attached to boat davits, is attached to a weight; the sinking of the weight supplies the hauling power for the net, which rises to the surface at an even speed, readily regulated by the weight used. The advantages of the method are that constancy of speed of hauling is independent of the operator, and nearly independent of the movements of the ship, being approximately uniform even in bad weather.

DUBLIN.

Royal Irish Academy, June 24.—Rev. Dr. Mahaffy, president, in the chair.—J. A. **McClelland** and H. **Kennedy**: Large ions in the atmosphere. Observations are recorded of the number of large ions in the atmosphere for a period of more than a year, with accompanying notes on certain weather conditions. The number per cent. varied between a minimum of 3700 and a maximum of 60,000.—J. A. **McClelland** and J. J. **Nolan**: The electric charge on rain. The observations discussed in the paper cover the period from October, 1911, to May, 1912, and, with results previously published, cover a period of more than a year. Of all the rain examined in the later period 82·6 per cent. was positively charged, the remaining 17·4 per cent. negatively. The positive electricity was 76·9 per cent. of the whole.—G. A. J. **Cole**: The problem of the Liffey Valley. The immature gorge of the Liffey near Pollaphuca is contrasted with the highly mature valleys, which are now practically devoid of streams, to the north near Brittas, and it is suggested that the drainage has become reversed, through the deepening of the floor of the upland near Pollaphuca, by glacial scour. Such a reversal is supported by the northerly courses of the King's River and the Liffey in the upper reaches of their valleys.—A. D. **Cotton**: Marine algæ (Clare Island Survey). An account is given of the algal vegetation found within the Survey area, three formations and a large number of associations and societies being recognised.—G. E. H. **Barrett-Hamilton**: Mammalia (Clare Island Survey). Only two species of strictly terrestrial mammals, viz. the wood mouse (*Apodemus sylvaticus*) and the pigmy shrew (*Sorex minutus*), occur on Clare Island. The hare and rabbit have been recently introduced, and the rat and house mouse probably owe their existence on the island to the same cause.—R. F. **Scharff**: Reptilia and amphibia (Clare Island Survey). Only a single species of reptile and two amphibians, viz. the common lizard (*Lacerta vivipara*), the frog (*Rana temporaria*), and the newt (*Molge vulgaris*), are found within the area of the Survey.—G. P. **Farran**: Fishes (Clare Island Survey). Only a single strictly fresh-water fish occurs on Clare Island, namely the river trout.—W. F. **Johnson** and J. N. **Halbert**: Coleoptera (Clare Island Survey). In this paper there are records of 524 species, of which about 203 were found on Clare Island. At least four of the species are additions to the known Irish fauna.—J. N. **Halbert**: Hemiptera (Clare Island Survey). One hundred and seventy species of Heteroptera and Cicadina are recorded.—J. N. **Halbert**: Neuroptera (Clare Island Survey). The Neuroptera are represented by 120 species, or exactly half the total number recorded from Ireland.—G. H. **Carpenter**: Orthoptera (Clare Island

Survey). The Orthoptera of Clare Island comprise only the common earwig and three widespread acridiid grasshoppers.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts iii. and iv. for 1912, contains the following memoirs contributed to the society:—

July 15, 1911.—K. **Wegener**: Seismic records at the Samoa Observatory of the Göttingen Royal Society in 1909 and 1910.

February 3, 1912.—W. **Voigt** and P. **Collet**: Further communication on the polarisation of light diffracted from the Rowland grating.

February 17, 1912.—O. **Wallach**: Researches (xxv.) from the Göttingen University Chemical Laboratory: (i) the preparation of a new simple bicyclic terpene and tricyclic sesquiterpene; (ii) on ascaridol; (iii) on Δ^4-menthenone-3; (iv) on the constitution of so-called "isocamphor" ($C_{10}H_{16}O$) and its reduction-product ($C_{10}H_{18}O$); (v) on the condensation-products of cyclic ketones with acetone.—G. **Tamman**: The phase-diagram of carbonic anhydride.

March 2, 1912.—E. **Study**: Groups of bilateral collineations.—H. **Schottky**: The changes in heated metallic films due to surface-forces.—J. **Stark** and G. **Wendt**: Serial spectral emission from solid metallic compounds exposed to canal-rays; minimal value of the exciting energy; band-spectral emission under canal-rays.—M. **Lewitskaja**: Some observations on the absorption of light in andalusite.

BOOKS RECEIVED.

Die Veranderungen in der allgemeinen Zirkulation der Atmosphäre in den gemässigten Breiten der Erde. By Dr. A. Defaut. Pp. 208. (Wien: A. Holder.)

Handbuch der regionalen Geologie. Edited by Profs. G. Steinmann and O. Wilckens. v. Band, 3 Abteilung—*Armenien*. By Dr. F. Oswald. Pp. 40+4 Taf. (Heidelberg: C. Winter.) 2.80 marks.

Nigeria and its Tin Fields. By A. F. Calvert. Pp. xvi+488+plates. (London: E. Stanford.) 5*s*.

Regional Geography—The World. By J. B. Reynolds. Pp. vii+360. (London: A. and C. Black.) 3*s*. 6*d*.

Botany. Chapters on the Study of Plants. By Prof. G. S. Boulger. Pp. viii+120. (Halifax: Milner and Co.) 1*s*. net.

Viśvakarma: Examples of Indian Architecture, Sculpture, Painting, Handicraft, chosen by Dr. A. K. Coomaraswamy. First Series: One Hundred Examples of Indian Sculpture. Twelve plates. (London: The Author, 39 Brookfield, West Hill, N.; Luzac and Co.) 2*s*. 6*d*.

Monograph on the Sub-Oceanic Physiography of the North Atlantic Ocean. By Dr. E. Hull. With a Chapter on the Sub-Oceanic Physical Features off the Coast of North America and the West Indian Islands. By Prof. J. W. W. Spencer. Pp. viii+41+plates xi. (London: E. Stanford.) 21*s*. net.

Methods of Organic Analysis. By Prof. H. C. Sherman. Second edition. Pp. xvi+407. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

A New System for Preventing Collisions at Sea. By Sir H. S. Maxim. Pp. xv+47. (London: Cassell and Co., Ltd.)

A Study of the Bronze Age Pottery of Great Britain and Ireland, and its Associated Grave-goods. By the Hon. J. Abercromby. Vol. i., pp. 163+plates i. to lxi.; vol. ii., pp. 128+plates lxii to cx. (Oxford: Clarendon Press.) 3*l*. 3*s*. net.

Experimental Science. II. Chemistry. By S. E. Brown. Pp. vi+140. (Cambridge: University Press.) 2*s*.

Higher Algebra for Colleges and Secondary Schools. By Dr. C. Davison. Pp. vi+320. (Cambrige: University Press.) 6*s*.

Electromagnetic Radiation and the Mechanical Reactions arising from it. By Prof. G. A. Schott. Pp. xxii+330. (Cambridge: University Press.) 18*s*. net.

Gross Männer. Studien zur Biologie des Genies. Edited by W. Ostwald. Dritter Band—Jacobus Henricus van't Hoff. Sein Leben und Wirken. By Prof. E. Cohen. Pp. xv+638. (Leipzig: Akademische Verlagsgesellschaft, m.b.H.) 14.75 marks.

A Primer on Alternating Currents. By Dr. W. G. Rhodes. Pp. viii+145. (London: Longmans and Co.) 2*s*. 6*d*. net.

A Scheme for the Detection of the More Common Classes of Carbon Compounds. By F. E. Weston. Third edition. Pp. viii+108. (London: Longmans and Co.) 3*s*.

La Maladie du Sommeil au Katanga. By F. O. Stohr. Pp. 83. (London: Constable and Co., Ltd.) 4*s*. net.

Explanatory Notes to Accompany the Geological Map of Egypt, with Tables showing Distribution of Geological Formations and Economic Products. By Dr. W. F. Hume. Pp. ii+49+2 plates. (Cairo: Ministry of Finance, Survey Department.) 10 P.T.

Electric Lighting and Miscellaneous Applications of Electricity. By W. S. Franklin. Pp. viii+299. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 2.50 dollars net.

The Golden Bough: a Study in Magic and Religion. By Prof. J. G. Frazer. 3rd Edition. Part v., Spirits of the Corn and of the Wild, in two vols. Vol. i., pp. vii+319; vol. ii., pp. xii+371. (London: Macmillan and Co., Ltd.) 20*s*. net.

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