THURSDAY, NOVEMBER 17, 1910.

THE CELLULOSE AGE.

Die Chemie der Cellulose unter besonderer Berücksichtigung der Textil- und Zellstoffindustrien. By Prof. Carl G. Schwalbe. Erste Hälfte. Pp. 272. (Berlin: Gebrüder Borntraeger, 1910.) Price 9 mk. 60 pfg.

THIS work is created by an opportunity, and in producing it the author has obeyed what in another walk of life would be a "call"—Germany not having produced a text-book or systematic work on this subject, the hiatus is a sufficient *raison d'être* for this publication. The author's qualifications as a worker in the field of cellulose promise a worthy fulfilment of his task, and we may say at once, the volume before us—the moiety of the work to be completed in and by a second volume, to appear at the end of this year—is a weighty contribution to the literature of this section of organic chemistry.

The general title presages a systematic treatment of the subject-matter; but the plan and method laid down are not critically selective, and the result is rather a classified account of original investigations, under sectional titles, such as "Cellulose and Alkalis," "Cellulose and Acids," "Cellulose and Salts," and "Colouring Matters" and "Oxidants," &c. The second part of the volume under the main title, "Derivatives of Cellulose," deals successively with "hydratcelluloses," "hydrocelluloses," "oxycelluloses," "hydracelluloses," "acid celluloses," &c.

The result is in effect a compilation, an edited bibliography. In recording this general impression we do not wish to detract from the value of the book; we merely note for the benefit of our fellow-students that there is a certain nonconformity of its matter with the title, and the promise of a pioneer work, which it contains, is still unfulfilled. The sub-title, "with special reference to the textile and wood pulp (zellstoff) industries," also fails to impress itself upon the plan or method of treatment, and therefore a dominating technical aim or *Leitmotiv* is no more in evidence than the critical scientific. The second volume yet to appear may modify these impressions; but we do not anticipate that the work will take rank otherwise than as an exhaustive bibliographical record. If we infer that this may be the author's intention, it is because we have no special or self-revealing preface (*Vorwort*), only a general introduction (*Einleitung*), and the reader is left to form his conclusions.

Following the short introduction in which technical rather than scientific generalities are prominent, we are confronted at once with the full complexity of cellulose in the title of section 1, "Die Baumwollecellulose Luft und Licht." To open with the problems connoted by this title is indeed to build from the top, upon foundations laid in the air. A merely *a priori* analysis challenges all we know *plus* a well-defined estimate of what we do not know of cellulose as a chemical individual, in being. The next section, "Baumwollecellulose und Elektrizität," continues to occupy the reader with problems of much complexity and obviously of the most general import. The phenomena and reactions involved are those of the cellulose aggregate, of which nothing can be affirmed. Section 4, "Die Baumwollecellulose bei Wärmezufuhr," continues the study of the aggregate in relation to energy. The series of decompositions presented by destructive distillation are infinitely varied, and pyrogenetic products of resolution are generally the least simply related to the parent substances or molecules; the author does not attempt this genealogical investigation.

We notice in passing that no mention is made either of the specific heat or heat capacity of cellulose, or of the physical phenomena, such as changes of volume and dimensions, within the range of temperature—*i.e.* up to 150°—which conditions the persistence of cellulose as a chemical individual. Since cellulose and many derivatives are now produced in the form of solids of regular and controlled dimensions, this important direction of physical investigation is opened up.

The following and main sections are devoted to the changes determined in the cellulose complex by the action of acids, alkalis, and salts and oxidants, and its relations to colouring matters and "mordants," generally to such compounds which enter into what it is now fashionable to call "adsorption" combination. It is particularly in the treatment of the complex phenomena attending hydration, hydrolysis, and condensation, that the author should have adopted a critical method. A "genial" drawing is worth a volume of photography, and if the author had trusted himself as impressionist rather than camera artist he would have used his great opportunity to more adequate purpose. No chemist regards "hydrocellulose," "hydracellulose," "hydratcellulose," "oxycellulose," as terms defining chemical individuals; they connote a more or less definite equilibrium of action and reaction within the cellulose aggregate, which is susceptible of infinitely varied "schemes" of degradation; these are better classified in relation to the determining conditions than in terms of presumed end-products. The alternative method, with the conscientious discharge of the duties of an "all-truistic" bibliographer, leaves the reader without mental pictures which are the pleasurable reward of the diligent student. Students of the natural sciences bewail a tendency to over-population of their book-world as of other "worlds." The literature of cellulose is already of formidable dimensions, and yet its fundamental chemistry can be set forth on the proverbial "half-sheet of notepaper."

The present phase of diffuse expansion in the region of "cellulose" and other typical colloids calls for a more critical attitude of workers and investigators, both in the researches undertaken and the extent of their records.

We may note in conclusion that the volume, in paper covers, weighs 733 grams. It involves therefore a considerable weight of cellulose; and, moreover, the printing and finish of the volume are unusually excellent.

DESCRIPTIVE METEOROLOGY.

Descriptive Meteorology. By Prof. Willis L. Moore, Chief of United States Weather Bureau. Pp. xviii+344. (New York and London: D. Appleton and Company, 1910.) Price 12*s.* 6*d.* net.

A TEXT-BOOK by the Chief of the great Weather Bureau of the United States of America will be received with not a little interest, and Prof. Willis Moore, in submitting this treatise, has had before him the definite aim of providing the young men entering the service of the bureau with "a comprehensive introduction to modern meteorology." We think that the author has in most ways successfully realised his aim, though the great prominence given to American methods and the researches of American official meteorologists make the work to some extent unsuitable for adoption as a text-book for students in other countries. The author warmly expresses his obligation for valuable help received from various colleagues —Abbe, Bigelow, Kimball, Henry, Cox, and Humphreys—and the extent of this indebtedness will be appreciated by those familiar with the writings of these specialists in the "Monthly Weather Review" and in various official bulletins of the bureau. We should have been glad, however, if attention had been directed somewhat more fully to the splendid work of A. L. Rotch, for a book such as this should be a source of inspiration to the student, and nothing in American meteorology is more inspiring than a consideration of the history of the Blue Hill Observatory.

To indicate briefly the scope of the work, we may say that the science of meteorology is given the widest possible reference, and that great attention is devoted to the dynamics of the subject. The opening chapters deal very fully with such general questions as the composition of the earth's atmosphere, the physical condition of the sun and its relation to the earth's atmosphere, and radiation waves in their different forms. Passing to a consideration of the vertical and horizontal distribution of temperature, a special chapter is devoted to an interesting study of the so-called "isothermal layer," where perhaps de Bort's term, "stratosphere," might have been adopted. A discussion of atmospheric pressure and circulation follows—where Buys Ballot's name is not mentioned—and Bigelow's work is summarised in considerable detail. Chapters on anemometry and the winds of the globe, on clouds, and on precipitation in its various forms, are good, but the international classification of clouds should have been included. Then follows an admirable discussion of weather forecasting, a chapter on meteorological optics, and a final one on climate —somewhat discursive, but excellent in its treatment of the influence of topographical conditions.

Prof. Moore is a master of the art of condensation and the fortunate possessor of a good sense of proportion, and these qualities have enabled him to cover a wide field in a satisfactory manner. The great organisation the work of which he directs touches the practical interests of the people at many points, and he is at his best in discussing the practical problems of weather forecasting, which are illustrated by an excellent series of weather maps. Again, his brief discussions of such questions of perennial popular interest as the influence of forests on rainfall and the supposed influence of the Gulf Stream on the climate of western Europe are excellent. It was perhaps well practically to exclude mathematical formulæ, but we think that here and there the book might have been strengthened by the inclusion of statistics in tabular form. Thus the vital differences between insular and continental climates would have been most forcibly brought home to the student by actual data for actual places along some given parallel of latitude across, say, the Eurasian continent.

Each chapter concludes with an excellent bibliography, but the attention of American students might have been directed to the research papers issued from the British Meteorological Office during the last few years. And the book properly ends with an index, but a glance at this leaves us puzzled as to what principle was adopted in the inclusion of proper names. Buchan and Rotch are merely mentioned in the book, and their names are not quoted, nor are those of Bigelow and Humphreys, though their work is laid under heavy contribution, whilst those of less well-known authors are given. In a book published in 1910 a different adverb should have been used in a reference (p. 194) to "Sir William Thomson (now Lord Kelvin)."

The publishers have done their work well and the volume is a handsome one. The numerous illustrations and charts are excellent, though the map representing the normal distribution of rainfall over the United States would have been more readily grasped had it been printed in different shades of colour instead of merely with red isohyets running over a white surface.

THEORIES AND PHYSICS OF THE SUN.

(1) *Les Théories Modernes du Soleil.* By J. Bosler, "Encyclopédie Scientifique." Pp. xii+370+xii. (Paris: Octave Doin et Fils, 1910.) Price 5 francs.

(2) *Vorlesungen über die Physik der Sonne.* By Prof. E. Pringsheim. Pp. viii+435. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 16 marks.

IN the first of these two books, dealing with our central luminary, the sun, the author presents his readers with a very well-arranged survey of the more modern views with respect to this important body. The author, who is one of the astronomers at the Meudon Observatory, is in a particularly good position to become acquainted with modern solar researches and opinions, and the solar work in progress at that observatory is second to none.

The book bears evidence of the author's command of his subject, and the method of placing the material before his readers which he has adopted is one that is highly commendable and particularly suitable for the valuable series of volumes which form this "Encyclopédie Scientifique."

Commencing with the general theories of the solar constitution, he makes a brief *résumé* of older views up to 1860, which include those of Herschel, Kirch-

hoff, Zöllner, Secchi, &c. Then at some length the circular refraction and anomalous dispersion theories by Schmidt and Julius respectively are discussed. The temperature of the sun comes next under review, followed by a chapter on the dynamic and thermal equilibrium of the sun. Lastly, the electromagnetic field of the sun and the theories concerning the corona are taken in hand, and the views of Schuster, Bigelow, Deslandres, Ebert, Nordmann, Arrhenius, &c., are contrasted. This chapter also includes an account of Hale's work on the magnetic field in sun-spots, and recent researches carried out at Meudon on the high level strata of the solar atmosphere.

The text is well illustrated with numerous reproductions from recent solar researches, and the volume contains good bibliographical author and subject indices.

(2) Prof. Pringsheim's book is the outcome of a set of lectures which extended over a series of years at the Berlin University. These lectures were not restricted to astronomical students only, so that the subject was dealt with in a little more popular manner than otherwise would probably have been the case.

The twelve lectures which form the subject of this volume comprise a comprehensive survey of the past and present views relative to the physics of the sun, and the author has managed to include a great deal of material in these lectures. The information has been brought well up to date, and the monochromatic work accomplished by the aid of the spectroheliograph in the hands of Deslandres and Hale has been thoroughly dealt with, and forms a valuable chapter. The volume is well illustrated, contains a great number of references, and is accompanied by useful subject and name indices. It will be found a serviceable book for students and a good readable volume for those who wish to become acquainted with the progress in our knowledge of the physics of the sun.

SOME ASPECTS OF PHYSICAL CHEMISTRY.

(1) *The Elements. Speculations as to their Nature and Origin.* By Sir William A. Tilden, F.R.S. Pp. xi+139. (London and New York: Harper and Brothers, 1910.) Price 2*s.* 6*d.* net.

(2) *The Relations between Chemical Constitution and Some Physical Properties. (Text-Books of Physical Science.* Edited by Sir William Ramsay.) By Prof. Samuel Smiles. Pp. xiv+583. (London: Longmans, Green and Co., 1910.) Price 14*s.*

(3) *Physical Chemistry. Its Bearing on Biology and Medicine.* By Prof. James C. Philip. Pp. vii+312. (London: Edward Arnold, 1910.) Price 7*s.* 6*d.* net.

THE discovery of radio-activity has, by the introduction of a new idea, reawakened interest in many outstanding problems of physical science. Prominent among these is the fascinating question of the nature and origin of the elements. Chemists with the periodic table of Mendeléeff before them, in spite of the warnings of its author, have been unable to resist the idea that some close genetic relation exists between the different elements of the nine groups of which the table consists, certainly along the vertical lines and probably also along the horizontal series. As to the nature of this relationship, nothing very definite was known or even imagined beyond the fact that it was accompanied by increase in atomic mass, and the probability that it was the result of condensation of some primal matter or protyle, under the influence of changing conditions, of which temperature was possibly one of the chief factors.

(1) The effect of recent work on the views entertained by chemists on this question forms the subject-matter of the latter portion of Sir William Tilden's book, the former half being devoted to a brief and clear exposition of the ideas which led to the formulation of the periodic law. The interesting account given of the various theories of the evolution and constitution of the elements which have recently been proposed culminates in a tentative and most suggestive genealogical table of the elements, which cannot fail to arrest the attention of all chemists. The author favours the idea that the elements of the seven chief vertical groups (with exception of the families headed by copper, chromium, and manganese) are directly "descended" from the seven elements from sodium to chlorine, the members of the odd and even series forming separate families with a common ancestor. The remaining elements (Group 8 and the exceptions just mentioned) are more or less directly descended from iron, which itself is placed in genetic relation with aluminium. The elements sodium to chlorine are direct descendants of the corresponding elements of lower atomic weight, lithium to fluorine, and these are themselves formed by the condensation of varying proportions of the two primal constituents of all matter, positive and negative protyle, as to the nature of which nothing is known. It is, moreover, by the addition of further amounts of these two primal substances that one element is derived from another of lower atomic weight.

Hydrogen is a progenitor of lithium, and a new unknown element, of atomic weight 3, is postulated as a precursor of fluorine. The elements of the zero-group (the helium gases) are supposed to be by-products of the disintegration of elements of high atomic weight, possibly long extinct. In this connection it may be noted that the radium emanation is stated to be wholly converted into helium, a conception at variance with the generally received idea.

Such a scheme, in the nature of things, teems with doubtful points, and the author is to be congratulated on his courage in exposing his ideas to the shafts of criticism which are sure to be winged against them. His table, however, undoubtedly expresses much that has been vaguely in the minds of many chemists, and removes some of the chief difficulties inherent in the classification of the elements in the strict order of their atomic weights. Where it appears to be deficient is in the expression of the relations between the members of the horizontal series. It must also be remembered that the only positive evidence of genetic relationship at present

available, which is afforded by the disintegration of the radio-active elements, seems to indicate that devolution occurs primarily along the horizontal series, and that the highest known member of the helium group—the newly-christened niton—takes its place in the chain of descent along with the other elements, and cannot be regarded simply as a by-product.

Enough has been said, however, to indicate the great interest attached to this short work, and the service rendered by the author in presenting in a collected form the ideas of chemists, enriched by his own suggestions, on this fundamental problem of the science.

(2) Dr. Smiles treats of a subject much more amenable to experiment than the disintegration of the elements, and the perusal of his bulky volume shows how difficult it is to arrive at any but empirical relations between physical properties and chemical constitution, even when the effect of every minute change in constitution can be examined experimentally. The work deals with the chief physical properties of the elements and their compounds (with certain exceptions which have already been considered in other volumes of the series), and provides an extremely useful compendium of the work which has been done in this connection. The author has, however, not allowed his subject, great as is the mass of detail comprised in it, to overwhelm him, but has throughout paid special attention to the applications which have been made of the knowledge acquired to the solution of problems of constitution, and to the effect of progress in this branch of the subject on the general trend of chemical theory. The interest is further increased by a preliminary clear account of the nature of each physical property in turn, and a historical sketch of the progress of knowledge with regard to it. The author's final conclusion that further advance will depend essentially on a more complete solution of the problem of valency will probably commend itself to most chemists, and there seems little doubt that, as foreshadowed in many parts of this book, the study of physical properties will be an important factor in the attainment of this result.

In his exposition of the general principles of physical chemistry (3), Dr. Philip has aimed at giving an account of the subject which will be of special value to workers in the borderland regions of biology and chemistry, and has therefore adapted his book both in scope and treatment to attain this end. Without any sacrifice of scientific accuracy, he has given a sound and readable account of the subjects of chief interest to biologists, and has illustrated them wherever possible by reference to problems of a biological nature. In addition to the ordinary fare of works on elementary physical chemistry, special attention is paid to osmosis, permeability and impermeability of membranes, the properties of colloids and adsorption. On the whole, the author has succeeded admirably in his purpose, and has provided a valuable and interesting introduction to the subject, not overburdened with detail and almost free from those mathematical subtleties which are too frequently the despair of biologists. ARTHUR HARDEN.

CHEMISTRY FOR FIRST-YEAR STUDENTS.

(1) *A College Text-book of Chemistry.* By Prof. Ira Remsen. Second edition, revised. Pp. xxiii+702. (London: Macmillan and Co., Ltd., 1908.) Price 10*s.* net.

(2) *Outlines of Chemistry. A Text-book for College Students.* By Prof. Louis Kahlenberg. Pp. xix+548. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 11*s.* net.

(1) THE first edition of Prof. Remsen's "College Chemistry" was somewhat unfavourably reviewed in these columns [NATURE, vol. lxv., p. 314 (1902)], and, unfortunately, most of the faults then pointed out recur in the present edition. Notable exceptions are, however, the treatment of the ionic hypothesis and of the determination of molecular weights from measurements of osmotic pressure. The least satisfactory portions of the work are those dealing with physical and electro-chemistry. Even on the purely chemical side there are some passages which might be amended. Thus it is not generally true, as stated on p. 144, that metals can be distinguished from non-metals according to whether they do or do not liberate hydrogen from hydrochloric acid to form chlorides. (A better criterion is, however, given on p. 169.) On pp. 185–6 volumetric analyses are calculated on the objectionable system based on a consideration of the weights of the reacting substances in the respective measured volumes, instead of by the straightforward "equivalent" method.

These faults are the more to be regretted since the book is in many ways admirably suited for the purpose for which it is intended. Thus Chapter V., dealing with the atomic theory and the determination of atomic and molecular weights, is, for the most part, a model of clearness. Attempts have been made to bring the work up to date by the insertion of short references to the phase rule, catalysis, the electron theory, radioactivity, &c. Within the scope allowed, the systematic descriptive portion is excellent. The experimental exercises given at the end of each chapter are well chosen; but, unfortunately, few first-year students in this country would have the time or the laboratory facilities for carrying them out.

(2) Prof. Kahlenberg's book is, like the preceding, intended for first-year students, and of necessity covers much the same ground; but there the resemblance ends. The general plan, as set forth in the preface, is to lead up to general theories through the fundamental facts and laws instead of first laying down general propositions and then illustrating these by facts. Accordingly, no mention of the atomic and molecular theories or of chemical nomenclature and symbols is made until the sixth chapter is reached.

Physical chemistry does not occupy a prominent place in the book; nevertheless, seeing that Prof. Kahlenberg is practically the only opponent of the generally accepted ionic hypothesis to be taken seriously, we turn with interest to the pages dealing with this part of the subject. On p. 429 we find the remark: "The main difference between the Clausius and Arrhenius theories is that the latter assumes the

presence of a very much larger percentage of dissociation"; and on p. 432, "The reader will have no difficulty in comprehending books that still use the nomenclature of the theory of electrolytic dissociation by remembering that the term *ion* as used in expressing chemical change means the same as atom or radical" (*sic*).

The periodic law is discussed in Chapter XX., but in the arrangement of the descriptive matter it is entirely ignored. This is a great drawback, as inorganic chemistry without the periodic law and the ionic hypothesis becomes a mere jumble of disconnected facts, difficult to remember, and still more difficult to assimilate. Otherwise the book contains as much pure chemistry as a student of medicine or engineering, who can devote only one year to the subject, requires. There are also short accounts of the chief processes in applied chemistry.

OUR BOOK SHELF.

Super-organic Evolution. Nature and the Social Problem. By Dr. E. Lluria. With a preface by Dr. D. Santiago Raman y Cajal. Translated by Rachel Challice and D. H. Lambert. Pp. xix+233. (London: Williams and Norgate, 1910.) Price 7*s.* 6*d.* net.

"MAN is a product of universal mechanics."

"*The solution of the social problem is contained in the law of evolution.*"

"There exists an irrefragable law which has made man out of a conglomeration of matter, and this same law, sooner or later, will have to be followed, in order that man himself may attain the state of happiness that is his legitimate aspiration."

These aphorisms lie at the root of Dr. Lluria's philosophy. The researches of Don Santiago Raman y Cajal into the phylogeny and ontology of the nervous system have greatly impressed him, and a third of the volume is occupied with an account of them. He assumes that the nervous system of man will continue to increase in complexity. "The brain of man still continues its psychic evolution." While agreeing that this is "a conclusion of paramount value," we fail to trace the logical steps by which it is reached, and the same may be said of the further inference, "In society, super-organic organism, the rapidity of change will be greater than in any other."

With the best will in the world, it is not easy always to follow the author, as, *e.g.*, when he tells us that "Society lives in a profound error as to property. It has chosen the paltry medium of money instead of the grand inheritance of Nature, which belongs to it by right, confirmed by the theory of evolution." But it is not only society that is to blame. "The responsibility falls particularly on many men of science who have not understood the theory of evolution, giving it, for example, such a false and iniquitous interpretation as *the struggle for existence*—a dreadful distortion of the natural course of ideas."

It is unfortunate that the translator is evidently unfamiliar with the technical terminology which is inseparable from a treatise of this description. There is no index.

The Romance of Modern Astronomy, describing in Simple but Exact Language the Wonders of the Heavens. By Hector Macpherson, Jun. Pp. 333. (London: Seeley and Co., Limited, 1911.) Price 5*s.*

COMMENCING with a chapter on our place in the universe, the author proceeds in the established sequence with chapters on the earth's motions, the sun, Mercury, Venus, &c., completing the discussion of the solar system with comets and shooting-stars. At more remote distances the suns of space, stellar motions and systems, and nebulæ are the subjects claiming the writer's pen. Some forty pages are devoted to tides, the spectrum and other incidental subjects, while five chapters deal with popular aspects of astronomical history.

The treatment, though generally clear and accurate, seldom rises above the commonplace. A feature which cannot be commended is the persistent introduction of somewhat lengthy quotations from other writers on astronomy. This method of providing "purple patches" discounts the individuality of the writer, whether it be due to modesty or otherwise.

Though steering clear of error in his elementary exposition, the author is not guiltless of loose statements, such as that silver-on-glass reflectors "have a light-gathering power far exceeding the telescopes whose mirrors are constructed of speculum metal."

Many of the illustrations are new, and, on the whole, well done, the artist being successful in finding picturesque settings for some of the more common astronomical happenings. The frontispiece, however, is very misleading; here an enlarged drawing of the head of Halley's comet fills the picture above a portion of landscape, put in doubtless for effect, the whole giving the impression that the coma stretched from zenith to horizon.

The Practice of Soft Cheesemaking. A Guide to the Manufacture of Soft Cheese and Preparation of Cheese for Market. By C. W. Walker-Tisdale and T. R. Robinson. Second edition, revised. Pp. 94. (London: Office of the *Dairy World*, 1910.) Price 1*s.* net.

A SECOND edition of this little book having been called for, the authors have taken advantage of the opportunity for introducing a certain amount of new matter. With true commercial instinct, they have put in a section describing fully the preparation of Bulgarian sour milk and sour cheese, but their chief object is to give a number of recipes for making soft cheese—often known as cream cheese—likely to sell well and at a good profit.

Soft cheese is a much simpler matter for the producer than ordinary cheese. No great capital or strength are required; the uniformity desirable for butter-making is not needed, so that comparatively small volumes of milk suffice, and the best demand exists precisely at the time when milk is in greatest abundance, *i.e.* in spring and summer. It is therefore essentially a product that the small holder can go in for, and the recognition of this fact by the authors adds greatly to the value of the book. The process of manufacture is simple, and consists merely in adding rennet to milk or to a mixture of milk and cream, then separating the coagulum, and allowing it to drain. There are, however, numerous details that require attention, but these are fully set out.

The book will be found very useful for dairy students and small holders, as well as for the growing class of dwellers in the country who keep a cow for their own use.

Twelfth Report of the Woburn Experimental Fruit Farm. By the Duke of Bedford, K.G., F.R.S., and S. U. Pickering, F.R.S. Pp. iv+51. (London: Amalgamated Press, Ltd., 1910.) Price 1*s.* 7½*d.* (post free).

IN this, the twelfth report issued from the Woburn fruit farm, the authors deal with the silver-leaf disease of plums and other fruit-trees in the thorough manner that characterises all their work. This disease is caused by the fungus *Stereum purpureum*, but the

relationship is less obvious than usual, because the fungus only fructifies on the tree that it has killed, and the mycelial threads are only discoverable with difficulty on the living wood. The proof lies in the fact, well brought out in this report, that inoculation of a healthy tree with a piece of the fungus nearly always causes the disease.

As its name implies, the disease is characterised by the silvery look taken on by the leaves, due, apparently, to a disconnection of the cells. Changes in nutrition processes are, no doubt, the immediate cause, but it is suggested that the final cause is a poison formed during the growth of the fungal threads, which then spreads into the tree. This hypothesis explains, among other things, why the fungus is never found on the diseased leaves. The disease is usually fatal. All kinds of fruit are not equally susceptible; plums come first, followed by apples, laburnums, Portugal laurels, and pears as the least susceptible. If a tree recovers, it may still be badly attacked again; there was nothing to show that previous infection tends to immunise trees against subsequent attacks.

In New Zealand, where this disease is also troublesome, the application of ferrous sulphate is recommended as a remedy, but the authors cannot find that it is of any value. Indeed, no method of treatment seemed trustworthy, and all that the grower can do as yet is to burn affected trees and so prevent the disease from spreading.

Elementary Treatise on Physics, Experimental and Applied, for the Use of Colleges and Schools. Translated from Ganot's "Éléments de Physique." By Dr. E. Atkinson. Eighteenth edition, edited by Prof. A. W. Reinold, F.R.S. Pp. xiv+1225. (London: Longmans, Green and Co., 1910.) Price 15*s*.

ALL teachers and most students of physics know Ganot's "Physics," and will be interested in the appearance of another new edition. On examining the new volume they will find changes in the arrangement of subjects and chapters. In the section dealing with heat, the subjects of solution, equilibrium, and liquefaction have been put into separate chapters. Radiation is now dealt with under light. In numerous parts of the book extensive additions have been made, and much new matter on modern subjects of physics of great importance has been added. But to prevent an undue increase of size, sections dealing with matters of no interest to students of to-day have been omitted. In its new form the treatise is likely to continue its popularity. When another edition is necessary the editor should substitute a modern form of rain-gauge for that on p. 1146, and revise the section on the Gulf Stream on p. 1172, where several time-honoured fallacies are repeated.

Dunkelfeldbeleuchtung und Ultramikroskopie in der Biologie und in der Medizin. By N. Gaidukov. Pp. vi+83+Tafel v. (Jena: Gustav Fischer, 1910.) Price 8 marks.

THIS booklet gives a brief but fairly complete summary of the researches which have been pursued by means of dark ground illumination and the ultramicroscope in the domain of biology and medicine. Thus the structure of colloids and of "sols" and "gels" and the minute structure of various animal and vegetable cells as revealed by these methods are epitomised. But the methods themselves receive but the scantiest notice, the theory of the subject and the apparatus being dismissed in the space of a couple of pages. Those who desire to work at the subject will therefore have to seek instruction elsewhere. In some cases we do not think justice is done to ordinary methods of illumination; in Fig. 5, for example, a comma bacillus is depicted as being practically structureless when viewed by transmitted light, whereas with care a certain amount of structure can always be made out. Dark ground illumination no doubt does much to elucidate the finer structure of minute unicellular organisms; how far the ultramicroscope will help remains to be proved.

The work concludes with a very useful bibliography, and is illustrated with numerous figures in the text and five plates, two of which are coloured.

R. T. H.

LETTERS TO THE EDITOR.

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

The Limiting Line of Sedimentation in Wave-stirred Areas.

IF you can spare the space I think I can put your reviewer (October 6, p. 433) in the way of obtaining the information he seeks as to the "limiting line of sedimentation" in "wave-stirred areas." The presence of tidal and other currents is assumed.

In a paper to the Royal Society in 1882 I chanced to hit upon this limit, experimentally and incidentally, in the following observation:—

"Dried peas placed on a glass plate in a slight depression on a sandy bottom in 6 inches of water were rolled off by waves about 12 inches long and about 1 inch high. . . .

"Shorter waves 1½ inches high had much less effect on them. A little sand that had collected on the glass was beautifully rippled with ⅛-inch ripples" (Proc. Roy. Soc., 1882, p. 16).

According to this chance experiment the limit was rather more than half the wave-length.

In 1884 I submitted to the late Sir G. G. Stokes, F.R.S., the case of a soda-water bottle, trawled at about 40 fathoms in the English Channel, which exhibited evidence that it had been subjected to long periods of quiescence, with intermittent disturbance. Sir George Stokes replied in the very important letter published in my paper on the Skerries Shoal (Trans. Devon. Association, 1887, p. 498). For publication in the same paper I had asked Lord Rayleigh to give me some simple formula for ascertaining the practical limit of wave-action. His reply was:—

"For each step downward of $\lambda/8$ divide by 2·2." I may mention that λ represents the wave-length.

Now according to this formula the disturbance at a depth of half (or four-eighths) of the wave-length is about one-twenty-third of that at the surface, whereas at the depth of five-eighths it is about one-fiftieth. I believe that one-fiftieth is negligible, whereas one-twenty-third is not always so.

Thus the limit of disturbance lies between half and five-eighths of the wave-length.

This exactly agrees with my accidental tank experiment.

For further confirmation I may refer your reviewer to Stevenson's interesting discussion on the "Level assumed by Mud a Measure of Exposure" (Stevenson on Harbours, second edition, p. 16).

I will not trouble your reviewer with my own papers except to mention one in the Linnean Society's Journal, Zoology, vol. xviii., p. 263, "On the Influence of Wave-currents on the Fauna inhabiting Shallow Seas."

At the recent inquiry on coast erosion Mr. R. H. Worth cited a delightful zoological proof of a local limit of disturbance. Speaking of *Alcyonium digitatum* and several other hydroids, Mr. Worth stated that:—

"Somewhere below 35 fathoms they will attach themselves to light bodies; above 25 fathoms they will never

attach themselves to anything but heavy bodies" (Royal Commission on Coast Erosion, Ans. 4059).

A steady current has often no disturbing effect on the sea bottom, as the upper strata slide over the lower ones, but the slightest wave-action on the bottom, with its alternating currents, is most effective; and, as Sir George Stokes pointed out (I believe for the first time), the combined action of wave and tidal current may be very energetic, as in the case he cites, in which the combination of a steady tidal current of two miles an hour, combined with a reciprocating flow of one mile, would result "in a flow rapidly changing between one mile and three miles." I doubt whether this important fact had ever occurred to anyone else; and, up to the present time, no one has taken any notice of it, so far as I am aware.

Torquay. A. R. HUNT.

Two Notes from India.

I AM writing to report a rather curious freak lily which I have lately seen out here. It was a garden variety, and it possessed a perianth of eight segments, which, however, is not unusual, but it also possessed eight stamens, the anthers of which were joined together in pairs, the remainders of these organs being separate. The union began about two-thirds of the way down from their apices, and from then up was complete. If any of your readers can suggest a cause I shall be glad to know it; I have never seen such a condition before. I may say that the rest of the organs were normal (there was only one flower on the plant), and both flower and plant were very healthy.

The second note which I might record as well, I think, though I know my statements about it will perhaps make some people doubt my veracity, is that while on duty one day, in the evening, about twenty miles away from Sangor, Central Provinces, in January a year ago, I was driving back through the jungle to Sangor about 7.30 p.m. when I distinctly saw what I consider to be an aurora borealis. The sun had set, and there was no moon out at the time. Suddenly faint streaks, and later distinct and many bright streaks, of light appeared across the sky, and I got out of the tonga and watched it about a quarter of an hour. There was continual vibration and movement of the light as a whole and of individual parts. The light was a plain white one, and very like a zig-zagged comb. No lights of any kind were near, nor could I see the fires or lights of any native villages except faintly in the distance, and these were quite distinct and easily distinguished from the sky phenomena. I pointed it out to my tonga wallah, who shook his head and said he did not know what it was. The stars were out, but that it was not a planetary light I am certain. I imagine the occurrence of this phenomena must be most uncommon in tropical countries, and I noted it in my diary.

J. H. BARBOUR.

Jubbulpore, Central Provinces, India, October 20.

Instruction in Methods of Research.

IN NATURE of November 3 appeared an address by Sir W. A. Tilden on modern scientific research.

The technical chemist may hardly agree with his conclusions that the art of scientific discovery cannot be communicated from one person to the other when the matter is considered in its wider aspect, and although it may be true that the great discoveries of the future will be made by the "inspired amateur," yet there is plenty of evidence that in Germany, at any rate, the general increase of knowledge and progress is to a great extent made up in detail work, without which it may also be stated that the great discoveries would never be made. Progress in this detail work to a great extent seems to be influenced, if not controlled, by training in research.

It is interesting to note that some authorities seem to have the impression that in this country the proportion of research men to chemists is higher than abroad.

In the columns of NATURE and elsewhere I have previously advocated the teaching of the principles of research in class in all our chief colleges, and I believe that the student when entering them looks for some such training and expects it. This training would be of great value to the majority of chemists, who will naturally find their future work in industry. Its influence must be felt in the conduct of their future work.

The greater part of the time of the industrial chemist is taken up with dealing with unseen difficulties and overcoming them. This may not be research in its proper sense, but these difficulties can only be overcome in one way, and this when examined in detail will be found to be very similar, if not identical, with that necessary for the conduct of research. In fact, such work might be defined as the application of such principles of research to industry. It is not the application of ordinary academic chemical knowledge. That is certain.

So that with such a training, I would venture to point out, the man who has not that "combination of mental powers which is called insight" will derive great benefit, for it seems difficult to think that the student who has passed the entrance examination and gone through the college course can be entirely devoid of some such quality, even if he has not it to a superlative degree. The latter men must be trained, for has not Newton said that "zeal without knowledge is like expedition to a man in the dark"?

Some two years ago I put the question Sir William Tilden mentions of the establishment of central research stations for the chief industries before a textile society in the north.

It was then suggested that there were many difficulties in the way of a technical nature. One of the advantages of such a scheme would consist of the training which might be given to the younger men who are entering industrial work, and it may be that this could, to a great extent, take the place of the practical training in the colleges themselves, which Sir William Tilden, perhaps rightly, depreciates when it is carried too far.

W. P. DREAPER.

Royal Societies Club, St. James's Street, S.W., November 5.

The Armour of Stegosaurus.

PARDON me for saying that there is not the slightest reason to believe that the restoration of Stegosaurus with a double row of plates is incorrect, in spite of the statement of the reviewer in NATURE for October 13. Not a single plate of this animal has been found with a symmetrical base, the base always being at an angle to the vertical axis of the plate; this implies that the plates were not placed on the median line, but to one side of it. Furthermore, in the only specimen in which anything like a complete series of plates has been preserved the linear extent of these plates is, roughly speaking, 40 feet, and it is a physical impossibility to arrange them in one series on 20 feet of back. These plates lie in position overlapping one another.

The only point at issue between Dr. Lull, who has studied the Stegosaurs most carefully, and myself is in regard to the arrangement of the plates. Dr. Lull believes that they were arranged in pairs. My own view is that, reasoning by analogy, they *should* have been thus arranged, but the facts in the case point to their having been placed alternately on opposite sides of the median line. No pair of plates has ever been found, and, making the greatest allowance possible for individual variation, it seems incredible that differences of several inches should exist between the plates from the two sides of the body if they were arranged in symmetrical pairs.

F. A. LUCAS.

Museum of the Brooklyn Institute.

THE above letter from Mr. F. A. Lucas shows that my apologies are due to the author of "Extinct Monsters and Creatures of Other Days." It is Marsh's restoration of Stegosaurus with a single row of dorsal plates that is incorrect, as was pointed out in a notice of Dr. Lull's restoration in the *American Journal of Science* for March, 1910, in NATURE for the present year. In writing the review of Mr. Hutchinson's volume I must have trusted to memory, which played me false. R. L.

THE CARNEGIE INSTITUTION OF WASHINGTON AND ITS WORK.

QUESTIONS of the organisation, the objects, and the activities of the Carnegie Institution of Washington are of widespread interest. The demand, indeed, for popular and technical information concerning this institution is far greater than the available supply. It should be stated, however, that it is not practicable to explain in any brief compass the history of the development of so novel an establishment. There has been scant time thus far for those engaged in this development to step aside and write anything but an abstract of current events. It should be stated also that the complexity of the subject is much greater than might appear to casual observation. The institution has recently issued the eighth of its series of year-books, or annual reports. These year-books contain upwards of two thousand pages of condensed history, and when one considers that they embody what is probably the most complicated miscellany of contemporary literature, it may be seen to be no easy matter, even if one had the time, to gain first-hand knowledge by reading these books; and it may also be seen to be no easy matter even for one participating in their publication to give a comprehensive summary of their contents. Only the barest outline, therefore, of this history can be given in the present article, while some major and many minor considerations of interest doubtless to individuals may be referred to only casually or not at all.

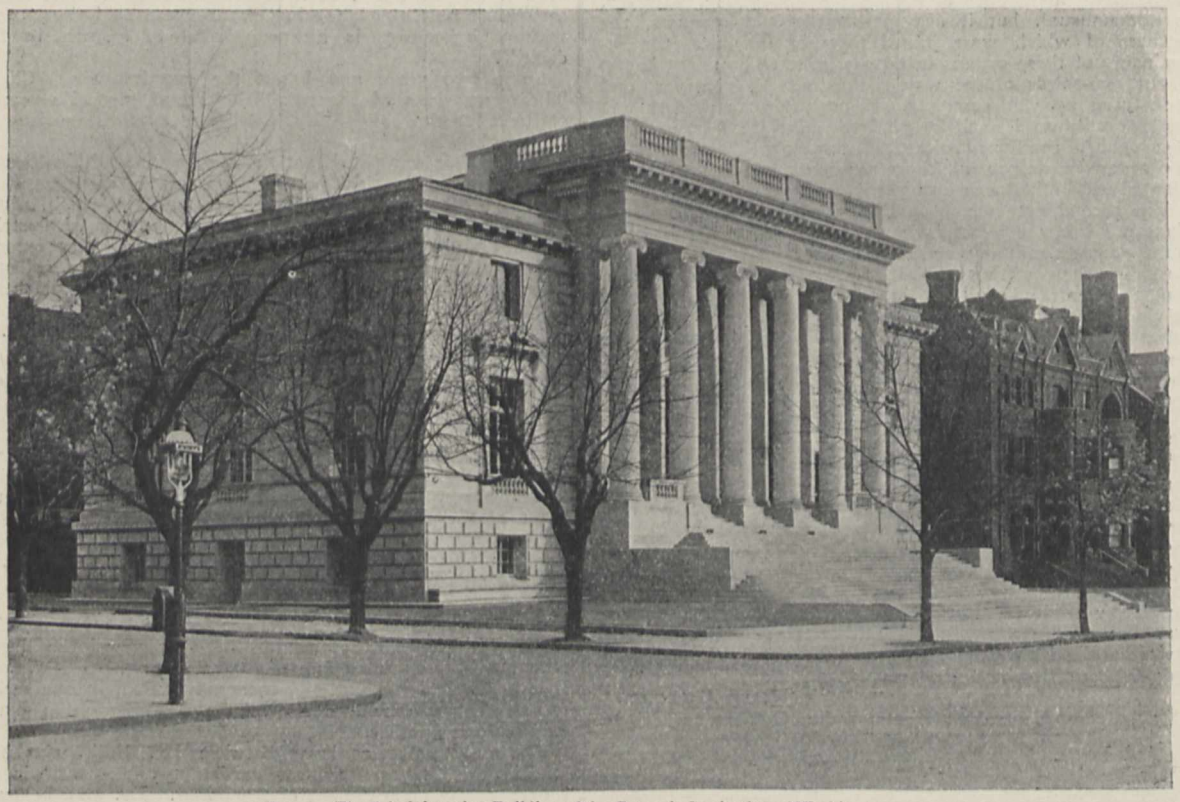

FIG. 1.—The Administration Building of the Carnegie Institution of Washington.

On January 4, 1902, a committee of incorporators held a meeting in Washington, D.C., for the purpose of considering articles of incorporation, looking to the establishment of what was subsequently called the Carnegie Institution. This committee consisted of John S. Billings, Daniel C. Gilman, John Hay, Charles D. Walcott, Edward D. White, and Carroll D. Wright. Articles of incorporation were duly approved on the same date, and a board of trustees was thereupon elected. These included the President of the United States, the President of the Senate, the Speaker of the House of Representatives, the secretary of the Smithsonian Institution, and the President of the National Academy of Sciences as ex-officio members, along with twenty-two other members. On January 29, 1902, the trustees of the proposed institution assembled in the diplomatic room of the Department of State, under the chairmanship of John Hay, and received from Mr. Carnegie his recommendations for the foundation of the proposed institution, his outline of its general aims, and his deed of trust, by which he transferred in perpetuity to the trustees as an endowment fund 2,000,000*l.* worth of United States Steel Corporation bonds. These bonds bear 5 per cent. interest, payable semi-annually, so that the original income of the institution was 100,000*l.* In December, 1907, this endowment was increased by 400,000*l.*, so that the present income is 120,000*l.*

The institution was originally incorporated in accordance with the provisions of the laws of the District of Colombia, under the title Carnegie Institution. Subsequently, however, it was re-incorporated by an Act of the Congress of the United States, approved April 28, 1904, under the title of *Carnegie Institution of Washington*, which is now its corporate designation.[1] By this new Act of Incorporation, the institution was placed under the control of a board of twenty-four trustees, all of whom had been members of the original board referred to above. This

[1] The reader's attention may be called to the facts that the Carnegie Institute, located at Pittsburg, Pennsylvania; the Carnegie Foundation for the Advancement of Teaching, with headquarters in New York City; and the Carnegie Institution of Washington are separate and independent corporations.

board is self-perpetuating, but none of its members may be such by reason of official connection with the United States Government or with other organisations. Thus the institution is now, like any other private corporation, neither subject to any special restrictions by, nor benefited by any special privileges from, the Government.

FIG. 2.—General View of Station of Department of Experimental Evolution, Cold Spring Harbour.

The trustees meet annually in December to consider the affairs of the institution in general, the progress of work already undertaken, the initiation of new projects, and to make the necessary appropriations for the ensuing year. During the intervals between the meetings of the trustees the affairs of the institution are conducted by an executive committee. This committee consists of seven members chosen by and from the board of trustees and the president of the institution, who is a member *ex-officio*, and acts as chief executive officer.

Amongst the aims of the institution specifically set forth in the founder's deed of trust are the following:—

(1) To promote original research, paying great attention thereto as one of the most important of all departments.

(2) To discover the exceptional man in every department of study whenever and wherever found, inside or outside of schools, and enable him to make the work for which he seems specially designed his life-work.

(3) To increase facilities for higher education.

(4) To increase the efficiency of the universities and other institutions of learning throughout the country, by utilising and adding to their existing facilities and aiding teachers in the various institutions for experimental and other work, in these institutions as far as advisable.

(5) To enable such students as may find Washington the best point for their special studies, to enjoy the advantages of the museums, libraries, laboratories, observatory, meteorological, piscicultural, and forestry school, and kindred institutions of the several departments of the Government.

(6) To ensure the prompt publication and distribution of the results of scientific investigation, a field considered highly important.

No great amount of reflection is needed to reach the conclusion that the fields of work thus clearly mapped out by the founder could not be entered without some difficulties. That the organisation of such an institution would be no easy matter might have been inferred also from the experience of the closely similar establishment, the Smithsonian Institution, seventy years earlier, for it may be recalled that the wisdom of the Congress of the United States debated the question of the proper functions of Smithson's foundation for a full decade before arriving at a definite programme for action. Even amongst those best qualified to judge of the merits of the ways and means available for the inauguration of this new enterprise, a great variety of opinions arose. Indeed, the volume of excellent advice and suggestion received by the

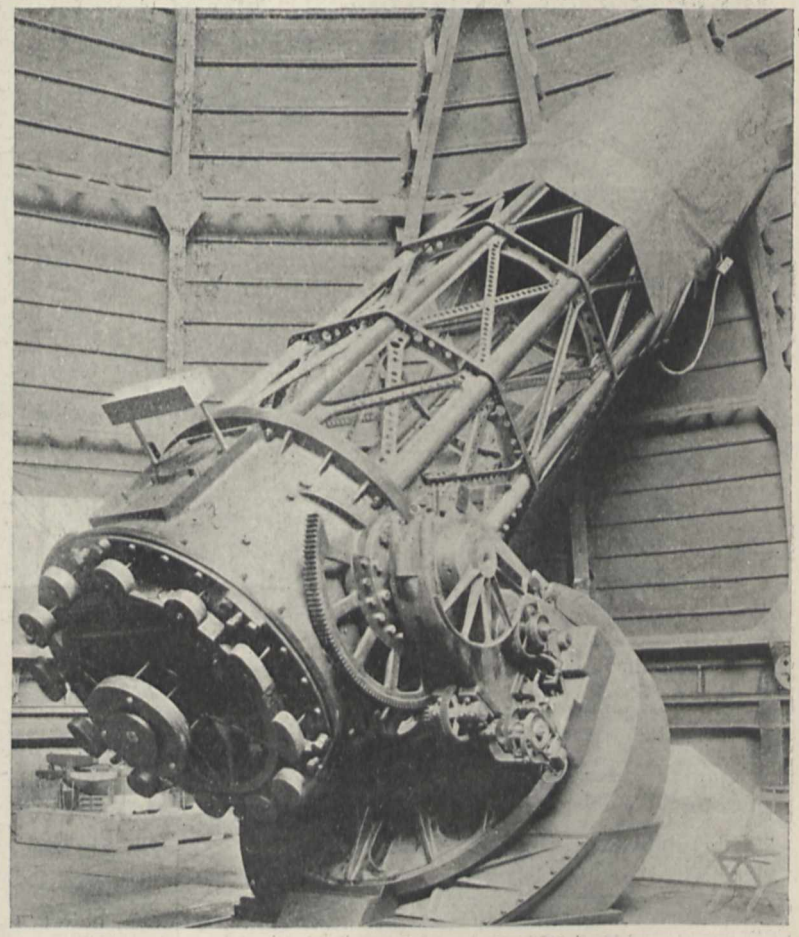

FIG. 3.—Sixty-inch Reflecting Telescope of Solar Observatory.

trustees of the institution during the first two years of its existence was overwhelming in abundance. The severity of the situation thus developed, however, was relieved by a humorous aspect found in the fact that it became possible to quote equally expert opinions on all sides of any question relative to the objects of the institution. In order, therefore, to accomplish anything in addition to correspondence it became necessary for the trustees to proceed in a way which has appeared in some degree arbitrary and without due regard to all interests concerned.

The productive activities of the institution have been developed thus far along four principal lines of work. These are, first, large projects organised under and conducted by the institution itself; secondly, minor projects carried on by individuals who are for the most part connected primarily with other institutions; thirdly, the work of research associates and assistants who are temporarily attached to the institution, and who are for the time being engaged chiefly in work of research; and, fourthly, the issue of publications, including especially the results of the investigations accomplished under the first three heads just mentioned, and the publication of investigations of special merit not likely to be cared for under other auspices.

Under the head of large projects, ten departments of work have been established. Two of these departments are devoted to astronomical investigations; three to research in biology; one to economics and sociology; one to research in geophysics; one to historical research; one to investigations in nutrition; and one to research in terrestrial magnetism. To these not inappropriately may be added the divisions in charge of the work of publications and the work of administration, making thus twelve different departments or divisions of work within the institution itself. Each of these principal departments of investigation is in charge of a director who is primarily responsible for the organisation and the conduct of the work entrusted to him. Annual appropriations are made to these departments in conformity with carefully specified budgets drawn up by the directors in cooperation with the president of the institution. Within the limits of his annual appropriation each director is given the largest freedom of action in the prosecution and in the development of the work he has in charge.

Under the head of minor projects many researches in widely separated fields have been undertaken by individual investigators. In round numbers about three hundred of these investigators have been connected with academic institutions. Similarly, limited numbers of eminent research associates have been and still are attached to the institution. In its earlier experience there were appointed also a limited number of research assistants, who were young men and women of promise, but had not yet demonstrated capacity for the accomplishment of fruitful research.

Next in importance to the work of research is the work of publication carried on by the institution. For this object 10,000*l.* to 15,000*l.* are now allotted annually, and the institution is publishing books at the rate of twenty to forty volumes per year. These publications are distributed gratuitously to a limited list of the greater libraries of the world. They are

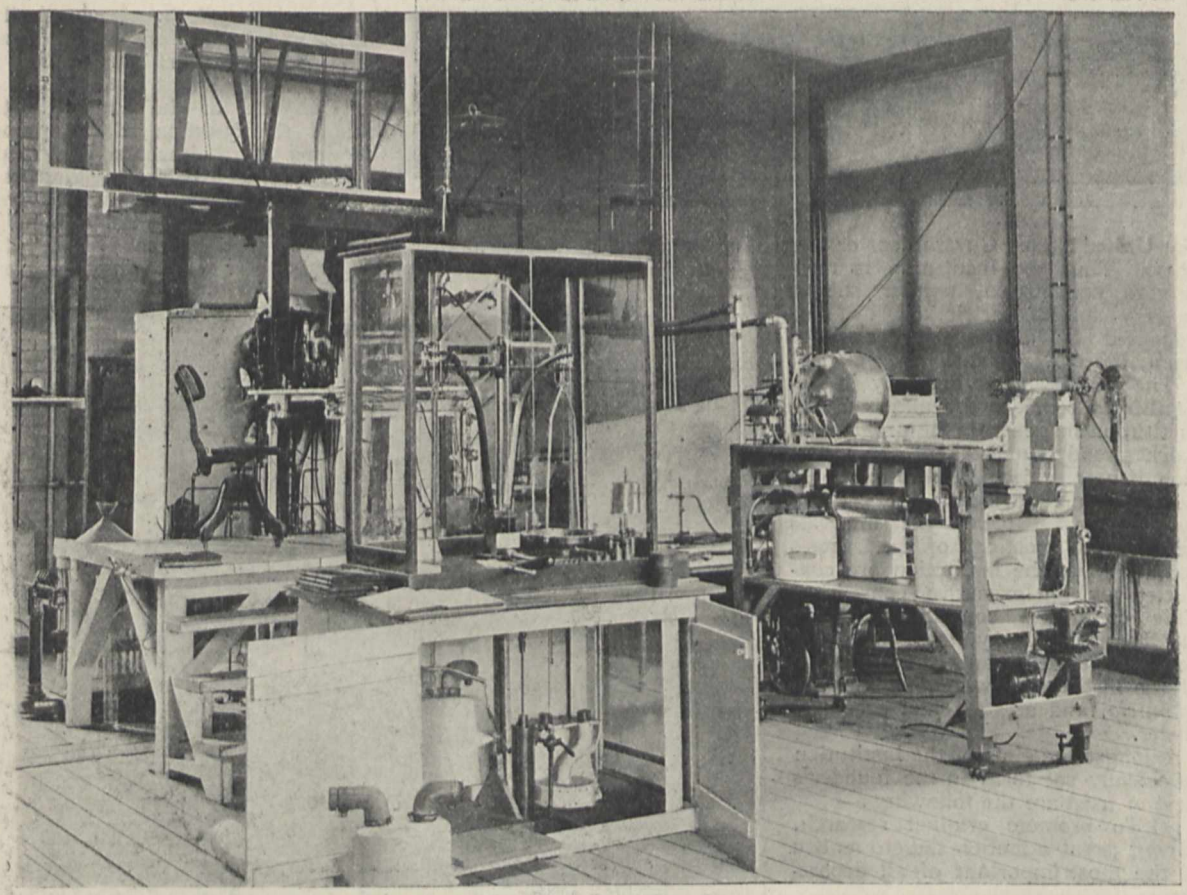

FIG. 4.—Interior View of Nutrition Laboratory.

also offered for sale at the mere cost of production and transportation to purchasers, which cost is about half that which would be charged if the works were issued through commercial publishing houses. The expense entailed by this work prohibits the issue of large editions for free distribution; in fact, any attempt to meet the public demand for a free receipt of the institution's publications would speedily curtail the prosecution of research.

In addition to the productive work referred to above, there falls to the administrative division especially, in the institution, a large amount of unproductive work. This arises from a very general misapprehension as to the aims, objects, and capacities of the institution. Grossly exaggerated estimates of its income have generated, and tend to maintain, an

FIG. 5.—Non-magnetic Ship *Carnegie*.

extensive aggregate of fruitless correspondence. Deluded enthusiasts and designing charlatans, amateurs, dilettanti, arc-trisectors, circle-squarers, perpetual motion men and women, and all sorts of paradoxers press for endorsement, if not for pecuniary aid. It appears to be a serious defect of existing social conditions that there is no way of preventing those who have nothing to communicate to the world from interfering with those who have.

In closing this brief account of the institution, the effective work it has thus far accomplished may be summarily indicated by the following statement:—

Since its organisation, in 1902, upwards of one thousand individuals have been engaged in investigations under the auspices of the institution, and there are at present nearly five hundred so engaged. Ten independent departments of research, each with its staff of investigators and assistants, have been established. In addition to these larger departments of work, organised and conducted by the institution itself, numerous special researches, carried on by individuals, have been subsidised. Two observatories and five laboratories, for as many different fields of investigation and in widely separated localities, have been constructed and equipped. A building in Washington, D.C., for administrative offices and for storage of records and publications, was completed and dedicated in December, 1909. For ocean magnetic surveys a specially designed non-magnetic ship with auxiliary propulsion was constructed and put in commission during the year 1909. Work in almost every field, from archæology and astronomy to thermodynamics and zoology, has been undertaken, and the geographical range of this work has extended to more than forty different countries. One hundred and fifty-five volumes of researches, with an aggregate of forty thousand pages of printed matter, have been published. Upwards of one thousand shorter papers have been published in the current journals of the world by departmental investigators, by associates, and by assistants. The total amount of funds expended to date in the consummation of this work is, in round numbers, 900,000*l*.

R. S. WOODWARD.

THE ROOSEVELTS IN AFRICA.[1]

NO one can read this interesting book by Mr. Roosevelt, sen., without realising how much the record owes to the work of Roosevelt, jun., of Kermit, the boy of nineteen to twenty who, before he had reached his twentieth year, had contributed some of the finest trophies to the expedition, who, though slight of build and boyish of aspect, confronted great dangers with calm resourcefulness, who took admirable photographs, and assisted the work of the expedition as a collector with the greatest zeal and usefulness.

The book under review is not without its defects and incongruities, and the expedition of which it is the record has received heavy censure from a good many people interested in the preservation of the world's fauna. Theodore Roosevelt, its author, has the defects of his qualities. His remarkable disposition and character have somewhat (as in the case of the late Sir Henry Stanley) prejudiced the judgment of a good many critics. In the first place, Mr. Roosevelt has not had sufficient leisure in which to do himself justice as the writer of a book on real natural history. Being a poor man when he left the Presidency, he was obliged, to a great extent, to pay the expenses of his very costly expedition by writing an account of it to be published week by week by the newspapers, a full diary, so to speak, of the day's events. Then, taking advantage of a brief rest at Khartum, he puts this diary together in book form, and has barely time to glance at the proofs before leaving England for the States in June. In addition to this, his publisher has thought it wise (and this reviewer feels bound to say that he thinks it unwise) to add to this work on natural history two speeches delivered by Mr. Roosevelt in Egypt and in London; while the author himself, not content with his wonderfully successful expedition and his own vivid appreciation of the African fauna and African landscapes, has further added, under the form of a dissertation on his "pig-skin" travel-library, a dissertation on the world's best books, ancient and modern.

[1] "African Game Trails." An Account of the African Wanderings of an American Hunter Naturalist. By Theodore Roosevelt. Pp. xvii+534. (London: John Murray, 1910.) Price 18*s*. net.

With the speeches delivered at the Muhammadan University of Cairo and at the Guildhall, London, the reviewer in NATURE has nothing to do, since they treat of politics, but he thinks they are out of place in a natural history book. They should have been published with the next volume of Mr. Roosevelt's public speeches, and with them should have been given the other side of the picture, the things he also observed but did not mention publicly, or, if he did so, were not reported by patriotic British stenographers or editors. As it is, these speeches do not give by any means a full statement of Mr. Roosevelt's views on Egypt. As to the "pig-skin library," it is perhaps a dangerous thing for a person of the world-wide influence of Theodore Roosevelt to set up an *index commendatorius* of books ancient and modern, with the inference that books dealing with the subjects he prefers, but not mentioned by him, are not worth the traveller's attention.

The fact is, that a second edition of this work should be brought out, stripped of these unnecessary appendices and the at first necessary, but after wearisome, records of thanks and obligations to a hundred-and-one personages. We should like to see Mr. Roosevelt's book take its place in the ranks with Bates's "Naturalist on the Amazons," Schillings's "With Flashlight and Rifle," and works of such character. He is a good zoologist and a peculiarly accurate and discriminating observer. Although he has traversed lands visited already by some of the great naturalist-explorers of the world, he has still made discoveries himself, or through others, and records a great many facts not hitherto known about the life-history of beasts and birds in equatorial East Africa. He is careful to note the seasons at which the young of different antelopes and other large game appear. He brings home to us, as no previous traveller has done, the extent to which this wild game is persecuted and infested with ticks, to which, however, they seem to have become so habituated that they dread them much less than the biting-flies, though the ticks are probably quite as much spreaders of disease, and even where they do not introduce disease germs must be extraordinarily weakening as blood-suckers. Many birds are devoting themselves in Africa to little else than the picking off and eating of the ticks and flies that infest the mammals. Where these birds are killed by European sportsmen, a great deal of future trouble is no doubt being prepared for us. For example (though I do not think this is mentioned by Mr. Roosevelt), certain types of heron (egret) are perpetually snapping at tsetse-flies, or other flies, which settle on oxen or game, and, if fully protected, might account for a considerable proportion of these disease-carrying creatures.

He has much that is new and interesting to say on the subject of the chita hunting-cat, really a little-known and little-studied carnivore in its wild state, both in Asia and Africa. The ordinary rhinoceros and its funny habits receive full illustration at his hands, and the square-lipped, white rhinoceros is revealed to us in its gentler, less aggressive disposition, as well as its association with the white egrets which, in accompanying it for its protection from ticks, whiten its broad back with their guano. (May this fact, equally possible in South Africa with the same kind of white heron, be an explanation of the otherwise absurd description "white rhinoceros"?) He pictures it for us in words, sitting down on its haunches like a dog (and, like its relation, the tapir), and shows us that due importance in description and pictures has not hitherto been given to the hump over its vertebræ at the shoulders. Grevy's zebra and the northern type of *Equus burchelli* (Grant's zebra) are rightly contrasted in appearance, habits, and cry. Some other peculiar features in both zebras, not hitherto recorded by naturalists, are set down here. Besides a good description of the vivid colours of the topi, or bastard hartebeest, he tells us that he has met with forms of the topi which develop a white blaze on the forehead. This is possibly a local sport, but is interesting as being a parallel to the white forehead of a southern type of topi, the blesbok. (This white forehead would seem to arise from exaggeration of the two white, frontal chevron marks which are liable to occur and re-occur in certain types of hartebeest and gnu.)

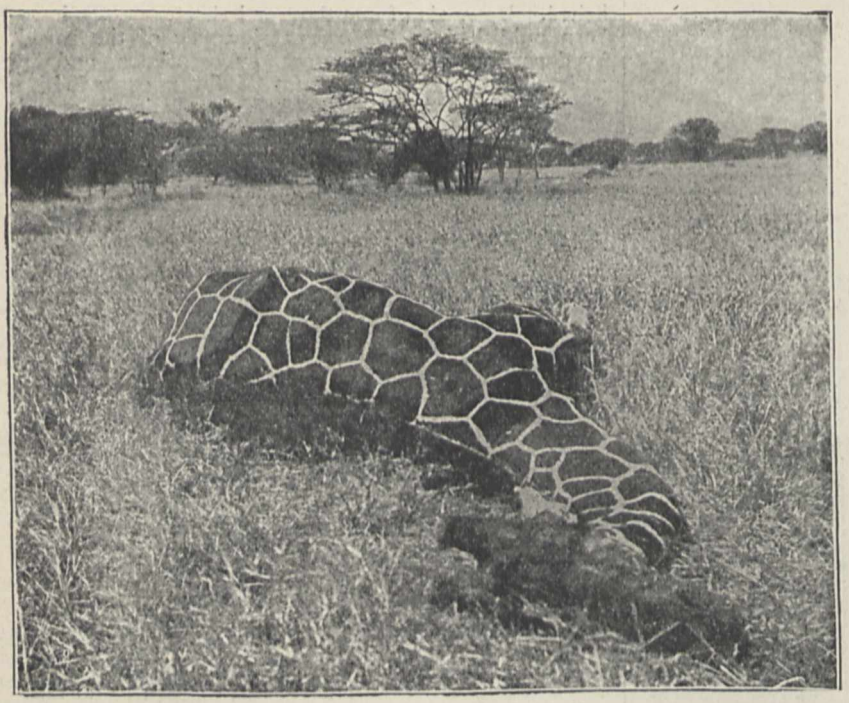

Photo.] [*Theodore Roosevelt.*

FIG. 1.—The Reticulated Giraffe. From "African Game Trails."

Mr. Roosevelt gives interesting particulars as regards the lion's method of killing most of the larger antelopes and zebra by springing on the back and biting through the vertebræ of the neck. It is possible that in the case of the stronger zebras or wild asses, the lion flings himself on to the neck itself and drags down the animal's head, biting at the vertebræ not far from the base of the skull. (This is well illustrated by a drawing in Mr. Millais's "Breath from the Veld.") In the case of full-grown buffalo, the lion's attack is generally made in concert, two or three young male lions, or a lion and lioness, working together, but also with the same object of severing the neck vertebræ. Failing this, attempts are made

to hamstring the beast by biting through the tendons of the hind legs, and once it is prone it is eviscerated by claws and teeth.

The alternation of the red-gold Jackson's hartebeest and the black and white Grant's zebra (looking silvery often in a slant of sunlight) is charmingly described; in fact, the book is full of verbal pictures, meet subjects for treatment by a painter. Indeed, on this score Mr. Roosevelt's remarks on the importance of pictures, as well as of photographs, in the effective illustration of wild life, are very sensible.

He describes to us the speed of the chita and its peculiar attitudes and cry, "a bird-like chirrup"; the dancing habits of the male widow-finches (Chera); "the rhinoceros standing in the middle of the African plain, deep in prehistoric thought"; the zebras and when at bay. He gives interesting and precise information regarding the spitting-cobras, describing the venom as it is ejected through the point of the hollow tooth "like white films or threads." He quotes a fellow-traveller to the effect that the giraffe when fighting with other giraffes or other foes, makes little or no use of the short ossicones as a weapon, but strikes with the strong chisel-like teeth of the lower jaw, the blow being delivered with all the force behind it of the immense, heavy neck. The boldness of the hippo in regions where he has not as yet been taught to be afraid of man, is vividly described—the angry combats in the water between rival males, and the departure on shore of the vanquished bull, who, straight away, in a rhinoceros-like rage, attacks on land the native cattle, or even men and women cross-

Copyright Photo [*Kermit Roosevelt.*

FIG. 2.—A Herd of Elephant in an Open Forest of High Timber. From "African Game Trails."

their stamping-grounds and their boldness in attacking dogs with teeth and hoofs, and not unreadiness to attack the white man also; the lions with their black and yellow manes (he might also have alluded to the frequency with which East African lionesses are boldly spotted with leopard-like markings, black below, and tawny-brown above); the large cuckoos "which eat mice," and the mice they eat, striped like miniature zebras; the fantastic little elephant-shrews with their probosces; the variety and beauty of the water-birds (not forgetting that creature of lovely tints, the ibis-stork, Pseudotantalus); the white-tailed ichneumons, never sufficiently hitherto commented on in descriptions of East African nature; the bold roan antelopes, with their large mouths and reported habit of biting as well as horning their foes, and squealing savagely ing his angry trot. Roosevelt's notes on baboons, hyenas, elephants, white rhinoceroses, water-birds (especially p. 298), Grévy's zebra, white-bellied hedgehogs, the hyraxes, and the forest and mountain rats, are all most interesting, and in nearly every case novel, even to those acquainted with the East African fauna. Excellent in every way are his descriptions of the life of the savage men (invariably kindly towards this expedition), amongst whom and with whom he travelled. His descriptions of the botanical aspects of the country are full of colour and actuality, but are unfortunately marred here and there by the correctly described tree or plant being given the wrong name, either botanically or in the vernacular.

In short, Mr. Roosevelt has written a book which would have been quite as noteworthy and of as lasting

interest if it had been written by an unknown personage. But in its permanent form the relatively trivial press errors and slips of the pen should be corrected and all extraneous matter not connected with natural history, cut out.

The illustrations—drawings as well as photographs—are admirable. Mr. Roosevelt deserves praise for having carefully photographed the small mammals as well as the big.

Special triumphs of the expedition were the shooting by Mr. Theodore Roosevelt of the rare Somali reticulated giraffe, and by Mr. Kermit Roosevelt, of the East African sable antelope. In regard to this achievement, the writer of this review has enjoyed some satisfaction. In describing his own journey to Kilimanjaro in 1884, he stated that he had seen the sable antelope on the way thither. This statement was somewhat rudely derided by a succeeding traveller, who declared that the sable antelope was never found north of the region opposite Zanzibar Island.

H. H. JOHNSTON.

ATMOSPHERIC ELECTRICITY AND RAIN.

THE fact that raindrops often bring down a measurable charge of electricity has been known for twenty years, but numerical measurements have been comparatively few, and data of even moderate trustworthiness are scarce. A recent memoir of the Indian Meteorological Department[1] contains an account of the important work done on this subject in 1908 and 1909 by Dr. G. C. Simpson. This work is partly observational, partly experimental, and partly theoretical. To see its true bearing, reference is necessary to some other aspects of atmospheric electricity.

If we denote by v the electric potential at a height z above the ground, and if dv/dz represents the rate of increase of v with height just above ground level, then treating the conductivity of the air as negligible the earth must have a charge the surface density σ of which is $-(dv/dz)/4\pi$. In ordinary fine weather v increases as we go upwards, and so σ is negative. In practice one usually derives dv/dz from the difference of potential between two points in the same vertical one metre apart. This quantity, termed the *potential gradient*, varies much from day to day, or even hour to hour, and the average value seems to vary considerably at different parts of the earth. If, for example, we suppose it to be 150 volts, then remembering that the centimetre is the unit of length, and that the electrostatic unit equals 300 volts, we deduce $\sigma = -(1/4\pi)(1{\cdot}5/300) = -4{\cdot}0 \times 10^{-4}$ E.U. (or electrostatic units).

Atmospheric air is in reality not a perfect non-conductor. If one gives a body in air on a perfectly insulating support a charge, whether positive or negative, this is gradually lost. Of the numerous observations on the rate of loss of charge those made by Mr. C. T. R. Wilson, with an apparatus which he devised a few years ago, appear least open to criticism. In a paper published in 1908, Wilson[2] gives the result of a considerable number of observations on the loss of negative electricity under fine weather conditions. His mean rate of loss exceeded 8 per cent. of the charge per minute of time. In other words, a charge equal to the earth's charge at any instant was lost every twelve minutes. During these observations the mean value of the potential gradient was 187. This answers to a surface density of $-10^{-4} \times 4{\cdot}97$ E.U., or $-16{\cdot}6 \times 10^{-14}$ coulombs. Taking an 8 per cent. loss per minute, the loss per second—*i.e.* the value of an upwardly directed negative, or downwardly directed positive current—is $(8/60)10^{-2} \times 16{\cdot}6 \times 10^{-14}$, or $2{\cdot}2 \times 10^{-16}$ in amperes. If this represented average conditions, we should have in the course of a year from each sq. cm. of the earth's surface a loss of 7×10^{-9} coulombs, or 21 E.U. of negative electricity. During rain the potential gradient is often negative, but the total duration of negative gradient in the course of a year is not large. We are thus led to the conclusion that whilst 21 E.U. is probably an overestimate of the charge lost annually per sq. cm. of surface by conduction through the air, it is unlikely to be much in excess of the truth unless the conductivity of the air is exceptionally high at times when the gradient is negative. The question thus arises: How is the earth's charge maintained?

Of the hypotheses advanced of late years, the one that has met with most approval is due to C. T. R. Wilson, who suggested that while districts enjoying fine weather are losing negative charge, other districts are deriving a corresponding amount of negative electricity from falling rain, the circuit being completed below by earth currents, and overhead by horizontal currents at a considerable height. Our knowledge of earth currents at the present moment does not enable us either to affirm or to deny a systematic transfer of electricity between wet and dry areas.

When Wilson's suggestion was made, it was believed that while the electricity brought down by rain was sometimes positive, still negative largely predominated, that being the result arrived at by Elster and Geitel, who were the chief of the early observers. Dr. Simpson's first contribution to the subject was the invention of an ingenious apparatus giving a continuous record of the amount and sign of rainfall electricity. This apparatus has been in operation at Simla during the monsoon or rainy seasons of 1908 and 1909, and the results are of an unexpected character. What the apparatus really does is to collect and record rainfall electricity for two-minute intervals. The data represent the total charges received for each successive interval and the corresponding rainfall. During the two monsoons 172·1 cm. of rain were recorded, with 44·0 E.U. of positive and 13·8 E.U. of negative electricity, or a balance of 30·2 E.U. of *positive*. The two-minute intervals during which a positive charge was measured amounted in all to 4·16 days, as against 1·70 days of negative. During about 37 per cent. of the total duration of rainfall no sensible charge was measured. Snow is rare at Simla, but for such snow as fell there was much the same relative excess of positive electricity as in the case of rain, the chief difference being that snow brought down more electricity than an equal weight of rain. An annual rainfall of 86 cm. is normal enough, and if the corresponding balance, 15 E.U., of electricity had been negative, it would have fitted Wilson's theory well so far; but being positive, it adds to the mystery respecting the source of supply of the fine weather current.

There are some features which raise doubts as to whether Simla phenomena are fairly representative. Rain there seems to be accompanied by much thunder and lightning, and the excess of positive electricity was especially prominent during the very heavy rain accompanying thunderstorms. In 1908, when rain was falling at a less rate than 0·17 inch per hour, the time during which negative electricity was recorded was about 90 per cent. of that during which positive was recorded, and the mean charge per c.c. was 2·2 E.U. for negative, as against 1·7 E.U. for positive, so that in the lightest

[1] Vol. xx., part 8, "On the Electricity of Rain and its Origin in Thunderstorms." By Dr. George C. Simpson, Imperial Meteorologist (also in Trans. and Proc. R.S.).

[2] Roy. Soc. Proc., A, vol. lxxx., p. 537.

rains negative electricity was slightly in excess. The charge per c.c. tended to be larger the lighter the rain, but the fall in two minutes was so small in light rains that it seems by no means improbable that with a more sensitive apparatus there would have been a smaller total excess of positive electricity recorded. Observations covering the complete annual precipitation, whether rain or snow, at a number of stations in different latitudes will be necessary before we can safely draw conclusions respecting the earth as a whole.

It was discovered by Lenard many years ago that in the case of an ordinary waterfall, or when water falls on a solid obstacle, the water drops formed take a positive, the surrounding air a negative charge. Lenard believed, however, that no such separation occurred when drops split up without falling on an obstacle. Simpson found a similar absence of charge when experimenting with Simla tap-water, but on trying distilled water he found that the splitting up of drops by means of a vertical air jet is accompanied by a marked separation of electricity, the water taking the positive charge. The breaking up of drops, each containing about 1/4 c.c. of water, gave the water a charge of about $+23\times10^{-3}$ E.U. per c.c. If the drops were already charged, this additional charge was added when they broke, so that the action is cumulative. Raindrops become unstable on attaining a certain size, and tend to break, so that natural conditions approach those of Simpson's experiments. A rational explanation is thus given of a positive charge on rain if it behaves as distilled water. This we should expect it to do, except perhaps in smoky districts, but further experiments on actual rain-water in various localities seem desirable. The presence on some rain of negative electricity is ascribed by Simpson to a transfer of charge from air which has previously surrounded breaking raindrops.

The theoretical problem mainly considered by Simpson is the relation of rain to thunderstorms. He believes that there are normally present in thunderstorm areas upward currents of air with velocities of at least 8 metres per second (18 m.p.h.). Such currents prevent raindrops from falling, and Simpson supposes the drops to go through frequent repetitions of the cycle; growth, breaking up (with separation of electricity), fresh growth, and so on, at a nearly constant height in the atmosphere until the charge is so great as to produce at a certain level a gradient larger than 30,000 volts per cm., which he takes to be the electric strength of air. When this limit is reached, a lightning flash neutralises the accumulated charge over a limited area, and the process goes on repeating itself. There are various difficulties in the way of accepting this explanation as complete, but some represent our present ignorance rather than positive knowledge. We should like to know, for instance, whether vertical air currents such as Simpson postulates really do exist near the precise level where the air breaks down, also what the true nature of a lightning flash is, whether unidirectional or oscillatory, what charge passes, and what is the expenditure of energy. For all we know, the air may be in a strongly ionised condition, possibly even there may be separation of the constituent gases, and a potential gradient much under 30,000 volts per cm. may suffice to cause a discharge. In the meantime, Simpson's theory of thunderstorms had better be regarded as a hypothesis, but, unlike some hypotheses, it promises to be useful in suggesting promising lines for observation and experiment. The separation of electricity by the breaking up of raindrops may not play quite so fundamental a part as Simpson supposes, but assuming it to take place with natural rain, it can hardly fail to play an important part in thunderstorm phenomena.

The memoir as a whole is most original and suggestive, and is one on which the meteorological service of India deserves to be congratulated. As many readers of NATURE are doubtless aware, Dr. Simpson's services have been lent by the Indian Government to the present British Antarctic Expedition, principally with the view of his studying electrical conditions in high latitudes, and we may, I think, entertain high hopes that the resulting increase of knowledge will be eminently satisfactory both to India and to this country.

C. CHREE.

THE PREVENTION OF PLAGUE.

A MEMORANDUM on plague has recently been prepared by Dr. Newsholme, medical officer of the Local Government Board, and has been sent to the sanitary authorities of England and Wales, with a request that their officers should endeavour to secure the adoption of the suggestions contained therein. The memorandum gives an interesting conspectus of the essential features of the disease, and deals mainly with its methods of spread and the measures which, in the light of recent researches, must be taken for its prevention. Fortunately, plague, although a disease capable of manifesting itself as an epidemic of a widespread and virulent character, is now so well understood on its epidemiological side, that the direction which preventive measures should take is obvious. The situation may be summarised in the dictum—"no rats, no plague." Practically, however, the matter is perhaps not so simple as it may seem.

The first section of the memorandum describes briefly the symptoms in plague. The injected eyes and the thick, "drunken" speech are noted as characteristic signs of the disease. There is no mention, however, of the tendency to "shouting" delirium and the impulse to get out of bed and wander off, utterly heedless of their condition—well-known symptoms in the natives of India. The "acute" ward of a plague hospital is at times a very noisy place, and mild restraint requires to be put upon patients to prevent their unconscious excursions.

The "ambulant" form of plague is referred to, and it is stated that persons with this type of the disease may spread the infection. Spread of infection by such persons would seem, however, to be very doubtful, by direct personal contagion at least, and it is equally doubtful whether effective carriers of the disease in the sense of typhoid carriers exist. The evidence for the existence of such carriers is not satisfactory, and although the possibility of the occurrence of "pneumonic" carriers must be considered, the rarity of this type, at least in India, and its extreme fatality, considerably limit its importance from this point of view.

The statement that there is little or no liability to infection from contaminated food is a comforting one, and is justified by the accurate observations on the pathology of human plague made some years ago in Bombay by the Austrian Plague Commission, and by the results of experiments on susceptible animals.

The memorandum accepts in its entirety the results of the recent investigations of the Plague Research Commission, viz., that the sole infective agents in an epidemic of bubonic plague to be reckoned with are the infected rat and the infected rat flea—the former an indirect agent and the latter the immediate infecting agent. It follows that the measures suggested for attempting to stamp out the disease are directed solely towards the destruction of rats and their parasites. It has indeed been claimed that domestic

animals, such as cattle, pigs, fowls, ducks, &c., are susceptible to plague infection, but extensive experiments made by competent observers in several parts of the world completely agree in opposition to this belief.

In the memorandum the importance of preventing the access of rats to or their entrance into buildings is emphasised. It is pointed out that a cat in the house is a safeguard against domestic invasion by rats and mice, although it must be borne in mind that the cat is in some degree susceptible to plague. Major Buchanan, of the Indian Medical Service, has strongly urged the advisability of stocking the villages in India with cats as a preventive measure, but it must be said that no very definite evidence in support of the proposal has been produced.

With regard to the extermination of rats it is admitted that complete extermination is perhaps impossible. A material diminution in the rat population would undoubtedly lessen the spread of infection amongst them, but the fertility of the rat and the fact that it overruns the whole country in enormous numbers make the task of permanently suppressing the rat community in this country an extremely difficult one. It is certain that only a never-ceasing and complete organisation for rat destruction will appreciably reduce their numbers, and it is perhaps not sufficiently realised by some of the advocates of a general rat campaign that in order to be thorough and effective such a campaign would involve a most extensive and, in the aggregate, a most costly organisation. In this connection the experience of rat destruction gained in Japan is instructive. Kitasato has reported that in five years 4,800,000 rats were killed *in Tokio alone* at a considerable financial outlay, but that at the end of this time no appreciable decrease in the rat population could be detected. Kitasato attributed this to the circumstance that the rate of destruction, vigorous as it was, did not keep pace with the natural increase in the rat population. Recent experience in India appears to point in the same direction.

It is beyond question, however, that so far as plague prevention is concerned a great deal can be done in this country by diminishing or, preferably, abolishing rat infestation in human habitations and in their immediate neighbourhood.

G. F. PETRIE.

DR. THEODORE COOKE.

WE announced with regret last week the death, on November 5, of Dr. Theodore Cooke, C.I.E., formerly a member of the Bombay Educational Department. Born at Tramore, co. Waterford, in 1836, Dr. Cooke entered Trinity College, Dublin, where, after a distinguished career as a student, he graduated in 1859 in the faculties of arts and engineering. In the former faculty he was Hebrew prizeman, first honoursman, and senior moderator and gold medallist in science; in the latter he obtained special certificates in mechanics, chemistry, mineralogy, mining, and geology. Pursuing his profession as an engineer, he joined in 1860 the service of the Bombay, Baroda and Central India Railway, then under construction; during this service he built for the company the great iron bridge at Bassein. Five years later the Government of Bombay secured the services of the talented young engineer as principal of the Civil Engineering College, which later with widened scope became the College of Science, at Poona. The post proved congenial to Dr. Cooke; his wide and varied knowledge, with which were associated much tact and great administrative gifts, enabled him to fill it with signal success until he retired from India in 1893.

Throughout his service Dr. Cooke had taken a keen interest in botanical studies, and field-work connected therewith was one of his chief recreations. What he did as a pastime was, however, characterised by the thoroughness that marked his official work; he soon became a recognised authority on the vegetation of Bombay and Scinde, and it was only fitting that when, in 1891, the Botanical Survey of India was organised, Dr. Cooke should be placed in charge of the survey operations in western India. Encouraged thereto by Sir George King, then director of the survey, Dr. Cooke made preparations for the production of a "Flora of the Presidency of Bombay." Difficulties over which neither Sir George King nor Dr. Cooke had control at first prevented the realisation of the scheme, and when Dr. Cooke retired in 1893 his energies found an outlet in a post to which he was appointed at the Imperial Institute.

The difficulties that had stood in the way of the publication of a local flora of Bombay having at last been overcome, Dr. Cooke was able, some years later, to settle at Kew and commence the preparation of the work in the herbarium there. The first part was published in 1901; the seventh and concluding part appeared about two years ago. The work is marked by the thoroughness and attention to detail characteristic of all that Dr. Cooke did; nothing is taken for granted; every previous statement is carefully verified or refuted; and the "Flora" will remain a lasting memorial to Dr. Cooke's critical acumen, industry, and energy. On its completion Dr. Cooke continued to work in the herbarium with undiminished ardour, assisting as a volunteer in the preparation of the great "Flora Capensis," edited by Sir W. T. Thiselton-Dyer, until laid aside by the illness which has ended his career. Dr. Cooke, on whom his university had already conferred the degree of LL.D., was created a C.I.E. in 1891, and was a Fellow of the Linnean and the Geological Societies.

NOTES.

THE Nobel prize for chemistry has been awarded to Prof. Otto Wallach, professor of chemistry in the University of Göttingen.

WE regret to see the announcement of the death, on November 13, of Mr. W. R. Fisher, formerly assistant professor of forestry at Coopers Hill College.

THE Royal Geological Society of Cornwall at its annual meeting at Penzance on November 8 awarded Dr. George J. Hinde, F.R.S., the Bolitho gold medal for his valuable papers and services in connection with the geology of the county.

A REUTER telegram from Pisa states that on November 10, in the presence of King Victor Emmanuel and a Government Commission, Signor Marconi received wireless telegrams direct from Canada and Massowah by means of his extra powerful installation at Coltano.

MR. A. E. BROWN, secretary of the Zoological Society of Philadelphia, has died suddenly of heart disease in his sixty-first year. He was vice-president and curator of the Academy of Natural Sciences in the same city, and a frequent contributor of zoological and biological articles to various scientific journals.

DR. C. WILLARD HAYES, chief geologist to the U.S. Geological Survey, is now visiting Panama by the direction of President Taft to make a preliminary study of

geological formations in the "canal zone," with special reference to the excavations at the Culebra cutting. Upon the results of his investigations will depend the decision whether a geologist will be permanently assigned to assist the canal commission.

A REUTER message from Munich announces the election of the following corresponding members of the Munich Academy of Sciences:—Dr. F. G. Kenyon, director and principal librarian of the British Museum; Dr. L. Fletcher, F.R.S., director of the Natural History Museum, South Kensington; Principal Miers, F.R.S., the University of London; Dr. D. H. Scott, F.R.S.; Profs. Wilson and Osborn, Columbia University, New York.

PRIOR to the anniversary meeting of the Mineralogical Society in the Geological Society's rooms at Burlington House on Tuesday, November 15, Dr. Lazarus Fletcher, F.R.S., was presented with his portrait, painted by Mr. Gerald Festus Kelly, in recognition of the invaluable services he had rendered to the society during the past quarter of a century, the presentation being made by Prof. W. J. Lewis, F.R.S., on behalf of the members and other subscribers. For three years, 1885–8, Dr. Fletcher was president, and for twenty-one years, 1888–1909, general secretary, of the society, and it is to his genial and stimulating influence that its present prosperous condition is largely due. Dr. Fletcher resigned the secretaryship upon his appointment as director of the Natural History Museum.

A CAREFULLY planned effort is being made by the authorities of the American Museum of Natural History in New York to popularise the resources of that institution. On a recent afternoon they gave a reception to from 1500 to 1800 of the school teachers of the city, having invited the principal of each school and two delegates whom he should appoint. The programme of this "Teachers' Day" included a personally conducted tour of the building, an introductory address by the president of the museum, Dr. H. F. Osborn, and six ten-minutes' talks by experts, interspersed by orchestral music, and followed by tea in the ornithological hall. The object of the reception was to show the teachers of New York what the museum had to offer both for themselves and for the children in their classes.

DR. W. H. BREWER, professor emeritus of agriculture at the Sheffield Scientific School of Yale University, has died at New Haven from the infirmities of old age. He was born in 1828. Before his appointment to the Yale chair in 1864 he had been professor of chemistry and geology at Washington College, Pennsylvania, and professor of chemistry in the University of California. He became professor emeritus in 1903. He had served on several important Government commissions, and had been president of the Connecticut Board of Health, of the Connecticut Academy of Sciences, and of the Arctic Club of America. In an editorial note on his career, the New York *Evening Post* describes him as one of the fast disappearing representatives of a stirring type. It quotes from a friend who once spoke of him as an "eminent geologist, an expert mining engineer, an Arctic explorer, an art critic, an author, and a charming companion," and adds that, like Shaler and Holmes, he "was the product of no system other than that prescribed by his own capacity of learning, and perhaps for that very reason possessed a vitality and range which are seen but seldom in the younger generation."

AT the annual general meeting of the London Mathematical Society, held on November 11, the following were elected to be the council and officers for the session 1910–11 (the names of members not on the retiring council are printed in italic type):—*President*, Dr. H. F. Baker, F.R.S., *vice-presidents*, *Mr. J. E. Campbell, F.R.S.*, Major P. A. MacMahon, F.R.S., Sir William Niven, K.C.B., F.R.S.; *treasurer*, Sir Joseph Larmor, F.R.S.; *secretaries*, Prof. A. E. H. Love, F.R.S., Mr. J. H. Grace, F.R.S.; *other members of the council*, Mr. G. T. Bennett, Dr. T. J. I'A. Bromwich, F.R.S., Dr. W. Burnside, F.R.S., Mr. E. Cunningham, Mr. A. L. Dixon, Dr. L. N. G. Filon, Dr. E. W. Hobson, F.R.S., *Prof. H. M. Macdonald, F.R.S.*, and Dr. A. E. Western.

VERY great vigour has characterised the conduct of the Tacubaya Observatory of late, and therefore the severe loss the institution has suffered by the death of the director, Dr. F. Valle, will be keenly felt, for he made the observatory a centre for scientific activity throughout all Latin America. Dr. Valle played a foremost part in promoting scientific usefulness and maintaining an efficient standard throughout the Republic of Mexico. The "Annuaire," for which he was mainly responsible, appeared with great regularity, and supplied a mass of information connected with geodesy, meteorology, and physics that would be particularly useful in the society in which it circulated, while the articles on astronomy quickened local and popular scientific effort. But of greater importance in general, and on what the reputation of the late director will rest, was his ardent prosecution of the work of stellar photography in connection with the *Carte du Ciel*, the observatory being responsible for the zone 10°–16° south declination. When the last report was issued, only 22 fields remained to complete the 1200 for the catalogue, and these must have long since been supplied. No fewer than 800 plates had been measured, and the catalogue plates were being actively pushed forward. Such activity contrasts very favourably with the results obtained at some observatories engaged on the southern zones, and the zeal displayed is the more commendable, as it is known Dr. Valle had to contend with very great difficulties in regard to the figure of the object-glass of his photographic refractor. Dr. Valle did not only measure his plates, but he used his meridian circle vigorously for determining the position of standard stars used in the reduction of the photographic plates. Add to this record the work of the observatory in spectroscopy, magnetism, seismology, and meteorology, and it will be admitted that Dr. Valle's energy went far to remove the stigma of indifference and lassitude which at one time was inclined to rest on the observatories of Spanish America.

THE account of the work of the Port Erin Biological Station given by Prof. W. A. Herdman to the Liverpool Biological Society on November 11 shows that the station continues to develop. It is expected that the much needed extensions now in progress will be completed and equipped by Easter of next year. During last summer vacation Prof. Herdman, Dr. Dakin, and Dr. Roaf conducted, for the first time, a valuable course of work in the science of oceanography (including hydrography and planktology). The work consisted partly of lectures and demonstrations in the biological station, partly of collecting and observing work on the seashore, and partly of expeditions at sea in the steam yacht *Ladybird* and in the Lancashire Sea Fisheries steamer. The operations of the fish hatchery at the station have resulted in the hatching and setting free at sea of upwards of 8,000,000 plaice fry and more than 5000 lobster larvæ—a substantial advance upon the work of any previous year. Plankton observations were carried out on the same lines as in the previous three years, three collections being made twice a week in the sea off Port Erin the whole year round. During July Prof. Herdman

took a series of vertical plankton hauls from various deep localities off the west coast of Scotland. A comparison of the collections show (1) that there is a constancy year after year in the nature of the plankton at certain localities, and (2) that some of the localities, not very far apart, differ considerably from one another in the nature of their plankton at the same time of year (July).

THE general committee of the Mansion House fund for providing a memorial to King Edward in London has had under consideration numerous proposals as to the form the memorial should take. The only decision which has as yet been arrived at is that, apart from the provision of a larger memorial of his Majesty, a statue of King Edward VII., with suitable accessories, be erected in some prominent and appropriate position in London, and that a fund be immediately opened for the purpose. Other schemes are still under consideration. Originally 164 proposals were received by the committee, but, according to the daily papers, these have been ruled out, with a few exceptions, as unsuitable or impracticable. The general committee has still to decide finally; but among schemes recommended to them by the executive committee are Lord Esher's proposal for an historical museum in London on the lines of the Musée Carnavalet in Paris. Secondly, the scheme of Lord Avebury for the building of a great hall for the University of London, to be used for degree and ceremonial purposes, and also for examinations. Thirdly, Lord Northcote's suggestion that a portion of the fund should be devoted to a scheme "for the protection of human life in the tropics by a great extension of that campaign against tropical disease which has already abated so largely the sum of human suffering." This last proposal has the support of the Society of Tropical Medicine and Hygiene, and a letter, signed by Prof. Ronald Ross, F.R.S., and other officers of the society, outlining the valuable work for the Empire which could be done by such an endowment of the study and prevention of tropical diseases, appeared in the *Times* of November 5. Lord Rosebery, as Chancellor of London University, has, in a letter to Lord Avebury, expressed his hearty approval of the scheme put forward by Lord Avebury.

ON November 8 Major Sykes delivered an interesting lecture to the Royal Geographical Society describing two short journeys which he took recently in north-eastern Persia the ancient Parthia, and Hyrcania. This district has always been one of special interest to the historian. It formed part of the patrimony of the earliest Persian kings; in it originated both the religion of Zoroaster and the Parthian dynasty, which measured its strength successfully with Rome; it has always been the debatable land on the border between Iran and Turan; and now it seems within measurable distance of falling, finally, into the possession of Russia, without any of the clamour, nay, danger, of war which such an advance of the Muscovite would have caused in England a few years ago. Such are the ways of high politics. The cities of north-eastern Persia are interesting also. Meshhed is a great centre of caravan-routes; ancient Nishapur is renowned as the birthplace and abiding-place of Omar Khayyâm; Turshiz is the traditional town of Zoroaster, where the great prophet converted Vishtâspa the king and planted the sacred cypress; Budjurd and Astrabad are interesting as really Turanian rather than Iranian towns. The dividing line between Hyrcania and Parthia was never drawn definitely. In the inscription of Darius the Great at Bisitûn (Behistun), the lands of "Parthva and Varkana" are mentioned together. The name of Hyrcania (Varkana) survives in that of the modern river Gurgân. Major Sykes had previously visited the valley of the Atrek, in which Budjurd lies. His route on this journey was taken from Meshhed to Budjurd, thence to Astrabad, and back by way of Shahrud, Subzawar, and Nishapur (the well-known old trade-route) to Meshhed. On the way he made several interesting explorations, and identified some ancient sites, notably that of Paras, which is probably the ancient Parthian capital. On his second journey he went to Nishapur and Turshiz. At Nishapur he identified the sites of several ancient cities which have been built near the spot from the original Niv-Shapur of Sapor I. to the mediæval Nishapur of Omar Khayyâm and the entirely different modern town. At Turshiz Major Sykes also made interesting discoveries.

IN spite of having presented his unrivalled collection to the nation, Lord Walsingham, as evident from a paper on Madeiran Tinerinæ in the November number of the *Entomologist's Monthly Magazine*, continues to devote attention to his favourite Micro-Lepidoptera. Two new species are described in this communication.

WITHERBY'S *British Birds* for November contains a long list of birds marked in the British Isles which have been recently recovered in various places, either at home or abroad. Among the items may be noted a teal marked in Essex in February and taken off Schleswig in August, and a tern ringed in Cumberland in July and captured south of Oporto in September.

IN a paper on the tooth-billed bower-bird (*Scenopœetes dentirostris*) published in the *Emu* for October Mr. S. W. Jackson states, as the result of continued observation, that, as a rule, during the height of the breeding season these birds do not visit their play-grounds or indulge in mimic vocalisation in the daytime, but reserve the latter performance for the periods before sunrise and after sunset, when they are in the tree-tops. During the nesting season the play-grounds are silent, unoccupied, and, most significant of all, untidy.

TO the November number of *Pearson's Magazine* Mr. Walter Brett contributes an appreciative notice of the bird groups mounted in the Natural History Museum at New York. According to the author's own words, the birds in these groups "positively breathe with life. Their pose is natural; their surroundings are true to nature; their throats almost tremble with the song one expects to hear. And the reason of this is that these birds are life studies, scientifically correct as well as artistically perfect. The visitor knows they are stuffed only because he is aware that they are in a museum, not in an aviary." The article is illustrated with reproductions from photographs of several of the groups.

NO. 1766 of the Proceedings of the U.S. National Museum is devoted to an account, by Miss Rathbun, of a collection of stalk-eyed crustaceans from the coast of Peru and adjacent parts of South America. The most notable additions to the fauna include a small crab of the genus Dromidia—the first of its group from western South America—and *Panopaeus bermudensis*, previously known from the Atlantic, while examples of two species hitherto represented by the types were also obtained. A noticeable feature is the abundance of Xanthidæ and Inachidæ and the scarcity of Parthenopidæ and shrimps of all kinds. Many of these Peruvian crustaceans, especially hermit-crabs, are used either as food or for bait.

AT the commencement of a review of the species of venomous toad-fishes of the genera Thalassophryne and Thalassothia, published as No. 1765 of the Proceedings of the U.S. National Museum, Messrs. Bean and Weed state that these fishes differ from all other members of the class by possessing grooved or perforated spines, analogous to

the fangs of venomous serpents, for introducing the poison they secrete into the bodies of their victims. In a specimen of *Thalassophryne reticulata* examined by the authors the poison-sac was found to occupy the whole length of the under side of the spine. The position of the sac is such that any pressure tending to drive the spine into the skin of another animal would produce a pressure on the sac, and thus inject the poison with considerable force into the wound.

THE ova and larvæ of teleostean fishes taken at Plymouth in the spring and summer of 1909 form the subject of the chief article in the Journal of the Marine Biological Association (October). The work was specially directed to practical questions connected with the fishing industry, such as the location of spawning areas, the duration of the spawning period, and the relative extent of the breeding of various kinds of fishes in the Plymouth area rather than to details of purely biological interest, and accordingly the descriptions of the eggs and larvæ forming the subject of the article bear special reference to the means of ready identification at different stages of development. A striking feature in the collection of pelagic eggs was the overwhelming preponderance of those of non-marketable species, such as rockling, rock-wrasse, boar-fish, and dragonets. It may be assumed, if sufficient samples be taken, that the relative abundance of eggs in the plankton affords a trustworthy index to the proportionate numbers of adult fish at the spawning season, and it may therefore be expected that in inshore areas such eggs should be largely those of rockling and wrasse. But this does not explain the predominance of dragonets, boar-fish, &c., over whitings, dabs, plaice, and soles. Although the latter are the objects of attention on the part of trawlers, it is still an open question to what extent the present state of affairs may be attributed to trawling.

IN the *Biologisches Centralblatt* (October 15) is published the first portion of an article, by Prof. K. Goebel, on sexual dimorphism in plants, discussing the extent to which diœcious plants are modified apart from the sexual organs. Examples of specific differences in seed plants are rare. *Cannabis sativa* is often quoted as a good example, although the author doubts if there is much distinction in a præfloral stage; he also questions whether it is possible to distinguish staminate and pistillate specimens of Cycas, Taxus, and Juniperus when not in flower. Amongst cryptogams better examples occur, notably in the case of such liverworts as *Symphyogyne leptothele*, which is figured. The fundamental reason for the differences lies in the necessity for providing more nourishment for the products of the egg cell, and this also explains the positions of the sexual organs in monœcious plants.

THE current number of *Tropical Life* (No. 9, vol. vi.) contains several articles on cotton cultivation both in the British Empire and the United States. In Egypt, Mr. Foaden points out, cotton occupies from one-half to one-third of the total acreage of cultivated land in those provinces where the conditions are suited to its growth, while the value of the crop is from 25,000,000*l.* to 30,000,000*l.* annually. Unfortunately, there has been a gradual fall in yield per acre during the past few years, the cause of which has been variously attributed to a rise in the subsoil water brought about by increased irrigation, to an increase in insect pests, and to soil exhaustion. Though the fertility of the Nile Valley is proverbial, the soils are usually deficient in nitrogen; crops show remarkable increases when nitrate of soda is applied or when a crop of clover—berseem—is ploughed in.

IN the current number of the *Fortnightly Review* Mr. J. Saxon Mills writes on the production of sugar from sugar beet, which he regards as one of the most hopeful schemes yet suggested for the benefit of rural districts. All the arguments in favour of the crop are set out concisely, and some very persuasive statistics are given. Field trials in Lincolnshire, Suffolk, Essex, and at Newnham Paddox have shown that crops varying from 15 to 20 tons per acre can be obtained containing 16 to 18 per cent. of sugar, while the Continental crops are lower both in quantity and in sugar content. Indeed, sugar beet is actually grown on a commercial scale in parts of the eastern counties, but is shipped to Holland to be worked up in the Dutch factories. It is contended that factories would prove highly advantageous in English country districts, and would also prove a remunerative investment. As several factories are already being started in England, it ought not to be long before very definite information is forthcoming on this question.

THE report on the Experiment Station, Tortola, Virgin Islands, for 1909–10, is to hand, and records certain improvements and additions to the station in connection with the sugar and cotton work and the water supply. The export trade in sweet potatoes and limes shows signs of increasing, while it has also been shown that a limited quantity of cacao could be produced for export. The cotton industry received a check owing partly to a fall in price and partly to bad weather; early planting is recommended as an improvement in cultivation. The report on the Botanic Station, Agricultural School and Experimental Plots, St. Lucia, 1909–10, shows that continued and steady progress is being made. During the year no fewer than 77,557 plants were sent out for distribution from the station, against 43,492 for the previous year. A scheme for prize-holdings competitions has been introduced, and will, it is hoped, raise the general level of cultivation.

IN a paper read at the November evening meeting of the Pharmaceutical Society, Prof. H. G. Greenish and Miss D. M. Braithwaite described a method by which the presence of the drug-room beetle (*Sitodrepa panicea*) may be readily detected in powdered drugs. The quantity of beetle present in an infested drug is so small that its direct examination under the microscope is practically impossible, and it is therefore necessary to separate the particles of insect from the drug before they can be observed. The process of separation devised by the authors is dependent upon the fact that the hardened parts of the mature beetle are of such a highly chitinous character and so extremely resistant to the action of acids, alkalies, and oxidising mixtures that it is possible to destroy the organic matter of the powdered drug without destroying the beetle. It is possible by means of the process described to detect particles of beetle in a powdered drug containing 0·00001 gm. of beetle in 5 gms. of powder. By the use of this method it can be shown whether a powdered drug is prepared from "worm-eaten" or sound material. In the course of their investigations the authors found that while the larvæ of the beetles undoubtedly ingest considerable quantities of starch, only a small proportion of this appears to be digested. It seems probable that the substances chiefly utilised as nutriment by the larvæ are not carbohydrates, but nitrogenous substances, such as the remains of protoplasm, &c.

BLACKHEAD is a highly infectious disease of turkeys prevalent wherever they are domesticated, and causes great financial loss each year. The symptoms are voluntary isolation, stupor, loss of appetite, drooping of the wings,

and emaciation; the disease is characterised by pathological changes in the cæca, intestines, and liver, while there are invariably present in the organs encysted stages of a coccidium, and also an amœba known as *A. meleagridis*. In a long Bulletin issued by the Agricultural Experiment Station of the Rhode Island State College Drs. Cole and Hadley give a detailed summary of the work so far done on the disease, and add a number of observations of their own. Although but little advance is recorded in the methods of prevention and treatment, the bulletin will be found very useful to those interested in diseases of birds, both by reason of its completeness and for the evidence it offers that the cause is a coccidium.

THE United States laws dealing with commercial fertilisers go further than our own in that they require the name of the firm to be published along with the analytical data dealing with the manures and feeding-stuffs supplied. Bulletin 141 of the Purdue University Agricultural Experiment Station gives the results of analysis of several hundred fertilisers and feeding-stuffs, together with the guarantee and the name and address of the manufacturer. Any case of fraud is thus at once exposed. The law is fully explained in the bulletin, and several illustrative cases are quoted. There are also tables showing the average composition of normal feeding-stuffs, and of the materials used as adulterants. Altogether, the bulletin gives a very good idea of the work of an agricultural analyst in the United States. A smaller bulletin on the same lines is sent us by the West Virginia University Agricultural Experiment Station.

IN one of a series of papers on the foraminifera of the shore-sands of Selsey Bill, Sussex, Messrs. E. Heron-Allen and A. Earland have described the forms derived from Cretaceous sources (Journ. R. Microscopical Soc., 1910, p. 401). In all cases these have been compared with specimens obtained from the hollows of flints in the same deposits; 118 species are identified, some of which are new to the records from the Upper Chalk. Mr. Heron-Allen offers a copy of a privately issued paper on Chalk foraminifera, printed in 1894, to any worker who may apply for it (address: Large Acres, Selsey). This earlier paper contains complete directions as to preparing material from the Chalk, as well as records of a number of species found at Twyford, many of which were previously known only in Cainozoic strata. It is pleasant to see that the veteran Mr. Joseph Wright, of Belfast, remains an active adviser on the work published in 1910.

COPIES have reached us of the valuable meteorological charts of the North Atlantic and North Pacific Oceans for December, and of the South Atlantic and South Pacific for the season December, 1910 to February, 1911, issued by the U.S. Weather Bureau. In the North Atlantic chart Prof. Moore continues the useful practice of exhibiting, by daily synoptic weather charts, specimens of the typical cyclonic storms which occur in that month. One of these disturbances, which was central near the Azores on December 18, 1909, moved quickly across Great Britain to the North Sea. The synchronous chart of December 21 shows that another storm dominated the entire northern part of the ocean, that typical cyclonic circulation prevailed from the American to the European continent, and that its disturbing influence was felt so far south as Madeira.

AN interesting application of the dilatometric method to the study of the polymorphism of the alkali nitrates is described by Prof. Bellati and Dr. Tinazzi in the *Atti del Reale Istituto Veneto*. It is shown that ammonium nitrate undergoes an abrupt expansion at 35°, a contraction at 86°, and a second expansion at 125°, corresponding with the three transition-points of the four modifications of the nitrate. Potassium nitrate undergoes an abrupt expansion at 127°, rubidium nitrate at 161°, cæsium nitrate at 148°, and thallium nitrate at 73° and 142° C.

IN reference to Dr. Baker's remarks on the Theory of Numbers at the Sheffield meeting of the British Association (NATURE, October 20, p. 514), Dr. Vacca, of Genoa, sends us the following quotation from Euler (Nov. Comm. Petr., vol. xvii., 1772, p. 25):—

"Non dubito fore plerosque, qui mirabuntur, me in huiusmodi questionibus evolvendis, quas nunc quidem summi geometrae aversari videntur, operam consumere; verum equidem fateri cogor, me ex huiusmodi investigationibus tantumdem fere voluptatis capere, quam ex profundissimis geometriae sublimioris speculationibus. Ac si plurimum studii et laboris impendi in quaestionibus gravioribus evolvendis, huiusmodi variatio argumenti quamdam mihi haud ingratam delectationem affere solet."

WE learn from the *Engineer* for November 11 that the Metropolitan Water Board intend to instal a battery of Humphrey gas pumps for the reservoir which is being constructed in the Lea Valley, near Chingford. A total pumping capacity of not fewer than 180 millions of gallons in twenty-four hours is required, made up of one unit of 20 and four units each of 40 million of gallons. It is understood that the Pump and Power Company, Ltd., offered to supply and erect on foundations provided by the Board five pumps of these capacities, together with a Dowson producer gas plant and all accessories, including two electrically driven compressors for starting purposes, for the sum of 19,388*l*. The guaranteed fuel consumption is not to exceed 1·1 lb. of anthracite coal fed into the producers per actual horse-power hour when working at the normal full load during an official trial of six hours' duration. The head to be pumped against is 29 to 30 feet, including friction. Thus a power of about 250 pump horse-power is required in each of the larger units. The conditions are ideal for the Humphrey gas pump, but as the power is larger than anything yet attempted by Mr. Humphrey, the results of the experiment will be awaited with considerable interest. At any rate, the Water Board cannot be accused of being behind the times.

AN article in the *Builder* for November 12 deals with a novel type of timber construction evolved by Mr. Otto Hetzer, of Weinar. In this new method the cross-sections of timber beams are adapted to actual stresses as in the case of riveted iron structures, and this is carried out by means of a composite beam with variable cross-sections in each given portion. A special glue being required, capable of forming an inseparable whole out of a number of composite parts, Mr. Hetzer seems to have succeeded, after many years of work, in producing one which possesses the required rapidity of binding, resistance against atmospheric influences, and the property of increasing hardening. The Hetzer compound beams are composed of three longitudinal layers, the uppermost of which is a wood characterised by a particularly high compressive strength (such as red beech), and the lowermost of a wood of great tractive strength (such as pine); the central portion need not be of any specially resisting material. An upward parabolic curvature is imparted to the central wood, so that in the central cross-section, submitted to the highest stresses, the whole of the deflection thrust is dealt with by this parabolic core and the lowermost layer. Satisfactory tests of these beams have been made at the Institute of Charlotten-

burg. Photographs of a bridge and several large roofs constructed under Hetzer's system are included in the article.

ONE of the chapters in the latest volume of "The Cambridge Modern History" (to be published on December 8), dealing with "The Scientific Age," is written by Mr. W. C. D. Whetham, F.R.S., who has undertaken the important and difficult task of surveying the trend of modern science in all its various departments. In this chapter will be found considerations of the Darwinian hypothesis, of evolution and religion, of electrical invention, of bacteriological treatment of disease, and other phases of modern scientific progress.

THE October issue of *The Central*, the organ of the Old Students' Association of the City and Guilds of London Central Technical College, maintains the high standard previously reached by this periodical. The number is well illustrated, the frontispiece being an excellently reproduced portrait of Prof. W. J. Pope, F.R.S. Among articles contained in this issue may be mentioned those by Mr. H. Clifford Armstrong on steel making; Messrs. W. Gore and D. Halton Thomson on rainfall, steam-flow, evaporation, and reservoir capacity; Mr. Howard Mayes on boiler management; and Mr. A. G. T. Glaisby on birds and photography.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A COMET.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by Dr. Cerulli on November 9. Its position at 8h. 20·8m. (Rome M.T.) was R.A.=3h. 38m. 36s., dec.=8° 43′ 20″ N., and its daily motion amounted to −8s., −19′. The magnitude is given as 10·2, and the comet's position lays about half-way between, but slightly below the line joining, ζ and λ Tauri.

METCALF'S COMET (1910*b*).—Dr. Ebell publishes a continuation of his ephemeris for comet 1910*b* in No. 4452 of the *Astronomische Nachrichten*. This ephemeris covers the period November 13 to January 4, and shows that the comet is now moving slowly, in a north-easterly direction, through Serpens towards Corona; on December 8 it will be about ½° north of δ Coronæ, and of the twelfth magnitude.

RECENT FIREBALLS.—A large number of fireballs have been observed during the last few weeks. The records of their appearance are not, however, sufficiently full and accurate to enable their real paths to be computed except in the cases where the objects were seen by capable observers.

The majority of the brilliant meteors have evidently belonged to a shower of Taurids, which is often very active in the first half of November, and is notable for the magnitude and conspicuous aspect of its members.

At 10h. 24m., November 9, one of the most interesting of the fine meteors recently seen was not a Taurid, but directed from a radiant at 312°+11° in the western sky. It passed from over a point east of Yeovil to west of Horsham at heights of 62 to 32 miles. The motion was unusually slow, viz. about 12 miles per second. The meteor sailed through the air in an apparently serpentine course, its sluggish, wriggling flight being specially noticed by observers at Bristol and other places, who mention it as quite an exceptional feature. There is no known shower at 312°+11° in November, but on November 2, 1891, Mr. Denning recorded a brilliant meteor close to its radiant, estimated at 311°+11°.

SOLAR ACTIVITY AND TERRESTRIAL TEMPERATURES.—An important paper on the effect of solar changes on terrestrial temperatures is published by Mr. W. J. Humphreys in No. 2, vol. xxxii., of the *Astrophysical Journal*.

Mr. Humphreys accepts the interrelation of magnetic, and auroral, disturbances and sun-spot changes as established, and points out that terrestrial temperatures and rainfall are observed with sufficient accuracy to justify an examination of their relation to solar activity. Further, he considers rainfall dependent upon temperature, which is more accurately measurable, and so considers only the latter.

Taking Abbot and Fowle's conclusion that sun-spot maxima are accompanied by terrestrial temperature minima, and *vice versa*, the average range being 1° C., he points out the practical importance of a fuller knowledge of the nexus between these phenomena.

His conclusions, stated briefly, are that at spot maxima the solar atmosphere is more fully charged with "dust" (*i.e.* any particles capable of reflecting and scattering light), and therefore, owing to selective absorption, the proportion of ultra-violet radiations finally escaping will be diminished. Ultra-violet radiations acting on cold, dry oxygen, such as exists in the earth's upper atmosphere, produce ozone, therefore at spot maxima the amount of ozone will be less.

Further, it has been shown that ozone absorbs a much greater proportion of the earth-reflected radiations than of the incident solar radiations. Thus at spot maxima, with less ozone, more heat will escape, and a lower temperature ensue; the converse explains the observed rise of temperature at spot minima.

This process is complicated by many factors, such as the increase of ozone-producing auroræ at spot maxima, but Mr. Humphreys suggests that the observed change in terrestrial temperatures may depend largely, if not wholly, upon the selective absorption of the direct solar and the terrestrially reflected thermal radiations by the changeable amount of ozone in our upper atmosphere.

STARS HAVING PECULIAR SPECTRA, AND NEW VARIABLE STARS.—Circulars 158 and 159 of the Harvard College Observatory contains lists of newly discovered variable stars and stars having peculiar spectra. In No. 158 thirty-eight new variables, chiefly discovered by Mrs. Fleming, are tabulated, and there is also a list giving the positions, magnitudes, &c., of nineteen stars of which the spectra exhibit various peculiarities. Ten of these are of type vi., three are of type v. with bright lines, four are gaseous nebulæ, and in the remaining two Hβ is bright. In the spectrum of the ninth-magnitude star DM.−14° 5265 the bright line appears to be of slightly greater wave-length than Hβ, but is not the 5007 nebula line, and on a later photograph there is a trace of a bright line on the less refrangible edge of the dark Hβ; it is suggested that in this spectrum the bright line may be variable.

No. 159 contains a list of fifteen new variables discovered on Nos. 7, 10, 16, and 19 of the Harvard Map, and the usual analytical table shows that 0·41 of the probable variables on map 19 yet remain to be discovered. It is also stated that the very red star +46° 1817 apparently varies very irregularly.

THE DISCOVERY OF NEPTUNE.—No. 1954 of *La Nature* contains the complete text of the letter in which Leverrier sent to Dr. Galle the results which led to the visual discovery of Neptune. It is stated that the first time the whole of this historic document has been published is in a recent article by Dr. See in *Popular Astronomy*, and it is suggested that the proper place for the original would be in the museum of the Paris Observatory.

VARIABLE STARS IN THE ORION NEBULA.—No. 4451 of the *Astronomische Nachrichten* contains a list of eleven more stars, in the nebula of Orion, which are apparently variable. The number of known variables in this nebula now amounts to 156.

THE BANQUET TO JUBILEE PAST-PRESIDENTS OF THE CHEMICAL SOCIETY.

THE council and fellows of the Chemical Society honoured five of their past-presidents who had completed their jubilee as fellows by entertaining them at a banquet at the Savoy Hotel on Friday, November 11. A large gathering numbering 250, including the Duke of Northumberland, the Postmaster-General, the presidents of the French and German Chemical Societies, and no fewer than eleven past-presidents, was presided over by Prof. Harold B. Dixon, F.R.S., the president.

The names of the past-presidents who were being honoured were :—

	Elected	President
Prof. William Odling, F.R.S. ...	1848	1873–5
The Rt. Hon. Sir Henry E. Roscoe, F.R.S.	1855	1880–2
Sir William Crookes, O.M., F.R.S.	1857	1887–9
Dr. Hugo Müller, F.R.S. ...	1859	1885–7
Dr. A. G. Vernon Harcourt, F.R.S.	1859	1895–7

Unfortunately, Sir Henry Roscoe was absent through illness.

After the loyal toasts had been duly honoured, the president gave that of the "Past-presidents who have completed their Jubilee of Fellowship." He referred to the personalities of the jubilee past-presidents, and to the particular work in which each was more especially distinguished: Sir Henry Roscoe, for his research on vanadium and as a pioneer educationist; Sir William Crookes, for his discovery of thallium, his researches on the rare earths, the genesis of matter and diamonds, and his brilliant discoveries in physics; Dr. Hugo Müller, for his researches on cellulose and discoveries in connection with printing; Dr. Vernon Harcourt, for his researches on the rate of chemical change and his work as an enthusiastic teacher; and Prof. William Odling, the doyen of chemistry, to whom all chemists will find it difficult to fathom their debt of gratitude.

In replying to the toast, Sir Henry Roscoe, whose speech was read by the president, drew on his reminiscences of the thirty-one past-presidents of the society, all of whom with the exception of two he had known, and of his association with the society.

Sir William Crookes sketched the steps by which he was led to the discovery of radio-activity. He stated that no law is more certain than the law of change. Radium has shaken our belief in the conservation of substance, the stability of the chemical elements, the undulatory theory of light, and the nature of electricity; it has revived the dreams of alchemists, and has cast doubt upon the very existence of matter itself. Physicists are beginning to say that there is no such thing as matter; that when we have caught and tamed the elusive atom and have split it into 700 little bits these residual particles will turn out to be nothing more than superimposed layers of positive and negative electricity. Speaking of the War Office Committee of which he was a member, he stated that what our country now most urgently requires is "brain-craft," the master of "hand-craft," and researchers who will cultivate chemistry for its own sake.

Dr. Müller commented on his association with the Chemical Society, on its rapid growth and increasing activity.

Dr. Harcourt referred to the influence of the growth of chemistry upon the teaching of the science as a part of general education, and to the importance in education of a knowledge of the general results of scientific inquiry and of some insight into the methods by which such knowledge has been gained. He mentioned the difficulty which the teacher of chemistry finds in keeping himself abreast of his subject, and the danger of teaching the latest hypotheses to students who are only studying science as a part of education and chemistry as a part of science, if it mislead them into believing that, because they have gained the latest lights, they have a thorough grasp of the science.

Prof. Odling referred to his connection with the four past-presidents who, with him, were being entertained, and with many of the older chemists, and of the association of Oxford University with the society.

Sir Edward Thorpe proposed the toast of the honorary and foreign members, which was replied to by Prof. Haller, president of the French Chemical Society, and Prof. Wallach, president of the German Chemical Society. At the conclusion of his speech Prof. Haller presented, on behalf of his society, a silver medal of Lavoisier to each of the jubilee presidents in honour of the occasion.

The last toast of the evening, that of "The Guests," was proposed by Sir William Tilden and acknowledged by the Duke of Northumberland, president of the Royal Institution of Great Britain, Mr. H. L. Samuel, the Postmaster-General, and Herr Generaldirektor S. Eyde, of Christiania.

THE INTERNATIONAL AGROGEOLOGICAL CONGRESS AT STOCKHOLM.

A FEW months ago (August 4) we reviewed the proceedings of the first International Agrogeological Congress, held at Budapest in 1909. The second was held this year simultaneously with the International Geological Congress at Stockholm, as an experiment. It was well organised by the local committee and well attended, the membership numbering about 160. The sessions were arranged to allow the frequent attendance of members at the geological meetings in which they were likely to be interested. But it seems to have been recognised by most that the bonds of association between the two congresses were not so close as to render it necessary, or even desirable, that they should be held at the same place and time; and it was decided by the council that the next meeting should take place independently at St. Petersburg four years hence.

A prominent feature in connection with the congress was the very interesting exhibition of specimens, maps and instruments illustrating the science of the soil, which was brought together in the rooms of the Technical School, 44 Mästersamuelsgatan. The Swedish exhibits, which naturally formed the greater part of this collection, included sample-sections of the typical soils and subsoils down to the underlying strata from which they were derived. The sections of peat-mosses which showed changing conditions of accumulation were particularly noteworthy. Excursions were made, both during and after the congress, through selected districts and to the chief agricultural stations, thus enabling the visitors to appreciate the local methods of practical research, as well as to gain personal knowledge of Swedish agricultural conditions.

The papers read at the meetings were grouped together by their subject-matter, so that each session was devoted to the discussion of a separate problem. As was to be expected from the earnestness which has been thrown into the study of soils in Germany, most of the papers were given in German. Indeed, hardly any other language was used at the sessions. At the opening meeting on the morning of August 17, Prof. Gunnar Andersson delivered his instructive presidential address on "The Swedish soil-types and their distribution," in which the geological bearings of the soil-study were allowed a prominence which they rarely attained in the subsequent discussions. At the afternoon session the 'leit-motif' was "The mechanical analysis of soils," with illustrative papers by Dr. A. Atterberg (Sweden), Prof. P. Vinassa de Regny (Italy), and Dr. W. Beam (Egypt).

At the subsequent sessions, on August 18, 19, 20, 22, and 24, the following were the principal subjects of discussion :—"Colloids of the soil," introduced by papers by Prof. E. Ramann (Germany) and Dr. D. J. Hissink (Holland); "Preparation of extracts of soils for chemical analyses," after papers by Prof. A. de Sigmond (Hungary), Prof. A. Vesterberg (Sweden), and Prof. A. Rindell (Finland); "Nomenclature and classification of soils," with papers by Prof. E. W. Hilgard and Prof. R. H. Loughbridge (California), Prof. P. Kossowitsch (Russia), M. Béla de Inkey (Hungary), and Dr. B. Frosterus (Finland); "Systematic soil-surveying," with papers by Dr. K. O. Björlykke (Norway), Prof. K. Gorjanovič-Kramberger (Croatia), and Prof. F. Sandor (Croatia); "The analyses of peat soils," with papers by Dr. E. Haglund (Sweden) and Dr. H. von Feilitzen (Sweden). There were a few other papers, chiefly on the chemical side of the subject, which did not fall under the above headings, among them being an interesting general account of the soils of Egypt, by Dr. W. Fraser Hume.

As a merely personal impression of the proceedings from a geologist's point of view, it may be remarked that, with the rapid advance of specialisation in the study of soils, the connection of the subject with geology seems to have become more remote. It was only in the papers dealing with the mapping of soils that geological considerations were brought into prominence, and even then only as a basis for specialised classification. For the rest, it was toward physics, chemistry and plant-physiology that the new methods of research approximated. The major part of the papers dealt with the laboratory treatment of soils, mechanically and chemically, and with the

resultants of the varied treatments. In the process of dismemberment it must often happen that the true individuality of a soil is lost, so that schemes of laboratory classification sometimes arbitrarily separate agricultural similars and unite agricultural discordants. This was recognised in several of the discussions, and the students of the soil are now fully alive to the complexity of the problems needing investigation. In the opportunity afforded for comparing and criticising the diverse methods of research the congress was eminently successful; and on the social side it was wholly pleasurable.

EDUCATION AT THE BRITISH ASSOCIATION.

THE presidential address this year was devoted to the topic of university education. Readers of NATURE have already had an opportunity of reading Principal Miers's suggestive discussion of the relations of teachers and pupils at school, and of the change of method which should differentiate university from school education. Incidentally, the address raised the very practical question of the present overlapping of the two, and led to the appointment of a research committee, with the president as chairman, to investigate the subject and to report at Portsmouth next year.

The presentation of the reports of the Section L research committee on mental and physical factors involved in education, and of the committee of Section H on the establishment of a system of measuring mental characters, was made the occasion for a joint session of the two sections for the discussion of research in education. In the report of the committee of Section L the gradual integration of a science of education, drawing its data, as Prof. Schuyten wrote, from hygiene, anthropology, physiology, normal and abnormal psychology, pedagogy, and sociology, and yet with a common centre of reference and an inner coherence which set it apart from each of these related sciences, was indicated. The work in psychopedagogy now carried on in this country was briefly reviewed, and it was shown that, in spite of the lack of funds which was everywhere reported, researches were on foot in at least ten university centres. Prof. Green in his introductory remarks showed how poorly off we are in this respect in comparison with such countries as Belgium, France, Germany, the United States, and even with Russia, where the War Office, in discharging its responsibility for the education of the children of officers, maintains a professor and a laboratory for research work alone. He also urged the importance of training for researchers in this as in all other branches of specialised research, a point which was subsequently taken up by Dr. C. S. Myers and other speakers. Prof. Findlay explained how the university departments were in this matter sent from pillar to post, Treasury grants being refused on the ground that the Board of Education always looked well after their own, while the Board, on the other hand, in set terms disavowed all responsibility for research work. The position, as the president said, is "disgraceful."

A typical illustration of more purely pedagogical research was contributed by Dr. T. P. Nunn in his sketch of the methods of algebra teaching worked out in the demonstration schools attached to the London Day Training College. The old theory of algebra, associated with the name of Euler, in which the symbols are regarded merely as numbers—"a large number of numbers"—has given place to the view of Chrystal and others, to whom algebra is a systematic science capable of development from its own axioms. The difficulty of adopting this view for school purposes is precisely the difficulty which faces the new school of geography teachers, namely, that the rationalising motive, the desire to build up a system for its own sake, does not develop in the English schoolboy much before his sixteenth or seventeenth year. Dr. Nunn has therefore based his method on the utilitarian motive, and aims at every stage to exhibit the value of the results for application. At the same time he seeks to comply with the schoolmaster's demand that the subject shall have "training value." Thus algebra for school purposes becomes an instrument the capabilities of which are throughout explored, and so extended, a kind of linguistic for the expression of thought operations. A large audience followed with keen interest Dr. Nunn's application of the theory in such crucial instances as the factorisation of a^2-b^2, and the explanation of the product of two negatives. The processes under his hand revealed the behaviour of realities, and no longer, as of old, came out of the void.

As an illustration of research upon mental processes Dr. Spearman gave an account of an inquiry into individual variations of memory among some 400 subjects. His results showed that the correlation coefficient between different ways of memorising was always positive, or, in other words, that the powers of memory showed some tendency to correspond, however the material upon which they were exercised might vary, while the more like two performances were the greater was the degree of correspondence. The common view that people of quick memory forget more rapidly than those to whom memorising is a slow process was shown to be erroneous, the correlation coefficient between the two remaining the same after a lapse of time. It was also shown that the difference between the two types could be largely traced to the method of recall, the quick memory being predominantly auditory and motor, the retentive memory visual and ideal. Finally, a high correlation was established between memory and teachers' estimates of general intelligence, in spite of the fact that the data upon which the latter were based were often obscure and variable.

The remainder of the sitting was occupied by a series of papers and discussions on the measurement of intelligence, in which accounts were given of practically all the researches on this subject hitherto conducted in this country. Dr. Otto Lipmann discussed the methods of Binet and Simon (*Année Psychologique*, 1908, xiv., pp. 1–94) and of Bobertag (*Zeitschrift für angewandte Psychologie*, iv.). His paper has been printed in full in *The School World* (October), so that here it will suffice to say that in his opinion their methods do not promise any certain test of a high degree of intelligence. We associate intelligence of this character with depth and power of self-criticism; but these things must be neglected in experimental tests, for results which would demonstrate the absence of these may be due to bodily condition or temporary inattention. On the other hand, the tests of Binet and Simon will establish with certainty whether a child is of sufficiently normal intelligence to be equal to the public-school course. The importance of this achievement will be seen when it is remembered that under English law a school medical officer may at any moment find it necessary to satisfy a bench of magistrates that a particular child ought to be sent to a special school for mentally defective children.

Mr. Cyril Burt described a series of experiments performed with a group of elementary-school children at Oxford, the result of which was to cast doubt upon the view that there is an intimate correspondence between power of sensory discrimination and general intelligence. A series of experiments with girls of secondary-school age at Liverpool tended to show that, by comparison with simple sensory and motor tests, tasks involving higher and more complex processes are less liable to be vitiated by absence of special training in the experimenter, and also have a more intimate relation with intelligence. Mr. William Brown discussed the mathematical technique of the evaluation of the results of intelligence tests, and maintained that the method of multiple correlation should always be employed.

Mr. J. G. Gray asserted the value of perseveration as an index of the quality of intelligence, explaining perseveration as dependent upon an elemental brain property which determines the persistence of mental impressions. He described a modification of Wiersma's colour disc devised by himself in order that the luminosity of the two colours the fusion of which at a certain rotation speed gives the index of perseveration might be regulated by the experimenter.

Mr. H. S. Lawson described a series of tests, based upon Binet's, to which the candidates for scholarships at a Midland secondary school were submitted. The order thus established was correlated with the official scholarship order in two successive years, the coefficients being 0·217 and 0·485. The tests had also been used to check the official order of merit obtained from a term's marks

in certain forms. In every case the correlation coefficient was high.

Miss Katharine L. Johnson read an interesting paper on the results of the application of Binet's tests to 200 school-girls in Sheffield. In her experience one of the chief difficulties was the personal equation of the experimenter. It is impossible to maintain the same tone and expression throughout, and children are very susceptible to suggestion. It is also difficult, sometimes, to estimate the results. She had found cases in which girls failed in the tests for their own age or for the age preceding, and yet satisfied the tests for a superior age.

Dr. E. Neumann's paper was summarised by Dr. Lucy Hoesch Ernst. He cast a doubt upon the possibility of determining a normal standard of intelligence for each year of school life which would be of general validity because of the difficulty of excluding acquired knowledge.

Dr. C. S. Myers entered a caveat against the collection of masses of psychological data by untrained observers. He was of opinion that the personal equation of the observer could not be got rid of, and that therefore comparison of results was only possible within very narrow limits. Racial differences in correlation are bound to vitiate the results of the examination of a sample of a heterogeneous people. But the main source of error lies in the neglect of the introspective element. A test of mental fatigue may in different subjects involve the play of such complicating factors as boredom, duty, ambition. It is only by individual introspection that we can determine exactly what factors an experiment involves. The result derived from the wholesale collections made by untrained observers can be nothing but a blur in the psychological aspect, though a sort of standard of productiveness may be obtained from them whereby we can measure the individual.

Dr. W. H. R. Rivers summed up the long discussion. In his opinion the work done was well worth doing, and marked a great advance regarded from the point of view of the scientific psychologist. But an enormous amount would still have to be done before the results could be applied practically in education. The work, so far, had been work with mass results, whereas the teacher wanted to test the individual. In spite of what had been said of the need for training in the investigators, it was all to the good that teachers were beginning to take up psycho-pedagogy.

On the third day of the meeting there was a series of papers on practical work in schools. The Board of Education's recent Memorandum on Manual Instruction came in for a good deal of praise. Sir Philip Magnus, as an old fighter in the cause of handicraft, urged that we should not fold our hands until the Board's four principles were everywhere observed, that handwork should be taught to all intending teachers, and that there should be a continuous course of it in every school taken by the ordinary teachers of the school. The president of the association spoke of the value of handwork as fostering self-help and initiative. Mr. J. G. Legge suggested the establishment of a type of school for boys from twelve to fourteen in which half the curriculum should be given to constructive work, and half the day should be spent in the workshop. Such a school would lead directly to technical training as the next stage in the education of the pupils. Mr. James Tipping described the vacation courses of the Educational Handwork Association, in which many teachers have acquired the manipulative skill, and at the same time the pedagogical knowledge, needed by teachers of handicraft; and Dr. G. H. Woollatt outlined a hundred-hour course for teachers in the making of scientific apparatus. Miss Cleghorn, in closing the discussion, warned the audience that enthusiasm in the teacher was a *sine qua non*, and hinted, at the same time, that it was difficult to be enthusiastic over the introduction of more subjects into the too short school life of the ordinary child.

Mr. Blair's paper on the relations of science with commerce and industry has already appeared in NATURE (September 15). The subject is usually treated on both sides in a spirit of vague vituperation which profits nothing. Mr. Blair's skilful marshalling of a mass of evidence from university graduates, professors, business men, and manufacturers all the world over will be of service to combatants on both sides who desire composition and not strife. In the short discussion which followed Principal E. H. Griffiths advocated bringing home to the lay mind the value of such work as Faraday's and Lister's. We should then hear less of the disinclination to believe in the application of science to business life and industry. He also advised scientific men to leave the language of the laboratory behind them when they came into the market-place, recalling Sir George Reid's words in the tests of intelligence discussion :—"It will be a grand thing when our men of science really do know everything they talk about, because when they do they will be able to tell us what it all means in plain English."

Dr. Beilby thought that things were improving; the great need was more cooperation between the two parties. The difficulty was to get the scientific man and the men of the markets together. In joint committees of professors and business men each side educated the other.

Sir William White also thought that there was no reason for alarm. We did not compare so badly with other countries. True, our rivals were better organised, but then organisation may paralyse effort. The young trained graduate of the technical college would not straightway apply his knowledge in industry; he had not the knowledge of practical business conditions. Such men should go through post-graduate courses, if possible, in works' laboratories. We must be content to train many mediocrities in order to catch the man of brilliant ability, and fortunately it takes all sorts to make the worlds of commerce and of industry.

Dr. Stead said that in the steel industry the value of research was recognised. The manufacturers had reached the point of wanting a little too much from research, and in too short a time.

Dr. H. E. Armstrong also advocated a two or three years' course in a work's laboratory for the technical-school graduate, and quoted the example of Sir Lothian Bell. Our organisation was at fault; when that defect was remedied the nation would soon regain its former commanding position in manufacture and commerce.

On the last day of the meeting an interesting series of papers was read on outdoor studies in schools of normal type. Prof. Mark R. Wright described the summer camp of the Durham Training College, Mr. G. G. Lewis showed what could be done by means of school journeys for London elementary-school children, and Mr. J. E. Feasey explained how much the interest and practicability of ordinary school work could be heightened by adapting it to the conditions of the open air.

In the afternoon there was a lively, though inconclusive, debate on voice production, in which Dr. Gray, Prof. Wesley Mills, Dr. Hulbert, Mr. W. H. Griffiths, Miss Ormay, Dr. Chichele Nourse, Prof. Silvanus Thompson, and others took part.

THE PRODUCTION AND USE OF ELECTRIC POWER.[1]

THERE are few subjects more important to the people of this country than the question of the rapid and ever-growing rate at which we are using up our coal supplies. Many writers have dealt with this subject, and have suggested various remedies.

It may be said that the rate at which we can use coal is a measure of our industrial activity and prosperity. This would be true, perhaps, if we were using our coal without waste, or at least with reasonable economy, but it is certainly not true of what we are at present doing.

Taking all the uses for coal into consideration, I believe that we are getting back an amount represented by useful work of one kind or another of much less than 10 per cent. of the energy in the coal. We can never, of course, hope to get anything like the full value of the energy in the coal, but, on the other hand, throwing away more than 90 per cent. of the value of our coal in the process of conversion is of the greatest possible concern to the country. Moreover, there is a further waste involved in our present methods of using coal which is only second in importance to the one I have spoken of. We now dissipate nearly the whole of the valuable by-products con-

[1] From the Inaugural Address delivered at the Institution of Electrical Engineers on November 10 by Mr. S. Z. de Ferranti.

tained in the coal, consisting principally of fixed nitrogen.

It is in the process of transformation of coal into work in the form of heat and power that the great loss occurs, as this is always a most difficult process, and requires the highest scientific and practical skill to carry out with even very moderate economy.

It has been proposed, with the view of accomplishing the above ends, to treat the coal at central stations and turn it into gas and distribute the energy in this form, but this process only goes a small way towards a solution of the problem, as under it combustion—which is such a difficult problem—would be taking place at numerous points over the whole country, all tending to inefficiency, and the conversion of the gas into power is by no means easy, involving running machinery of the reciprocating class, requiring special and skilled attendance.

It appears that with a problem such as we are discussing it is fundamental that the energy in the coal should be converted at as few centres as possible into a form in which it is most generally applicable to all purposes without exception, and in which it is most easily applied to all our wants, and is, at the same time, in a form in which it is most difficult to waste or use improperly.

We are therefore forced to the conclusion that the only complete and final solution of the question is to be obtained by the conversion of the whole of the coal which we use for heat and power into electricity, and the recovery of its by-products at a comparatively small number of great electricity-producing stations. All our wants in the way of light, power, heat, and chemical action would then be met by a supply of electricity distributed all over the country.

It must, however, be remembered that the distribution of energy in the form of electricity instead of coal can only be effectively carried out when it can be done in such a way that it is available for all the purposes for which coal is now used, and this can only be the case when the conversion is effected at such an efficiency as will cause the electric energy delivered to represent a high percentage of the energy in the coal. Failing this, no scheme for conversion at the pit's mouth and delivery of energy in the form of electricity is sound. There is also another controlling factor which must be satisfied in order to make this scheme possible. Both the conversion of the coal into electricity and the distribution of the current must be effected at a low capital cost, so as not to overburden the undertaking with capital charges.

Considering the various processes of conversion which are now available, or may be invented, and their possible and probable efficiency, we first come to electric generators driven by reciprocating steam engines. Their economy, expressed in the form of energy in the coal to electric energy, may be taken as a maximum of 10 to 12 per cent. This is, of course, far too low an efficiency to make any scheme such as I have already indicated possible, besides which the capital expenditure and the complication involved are far too great and the size of the units too small to be thought of for the purpose in view.

We next come to large steam turbines such as have been constructed up to the present, and see that their maximum efficiency may be put down at about 17 to 18 per cent.

Next in the list, in order of economy, comes the big gas engine fed from gas producers, with an efficiency of coal energy to electric energy of possibly 25 per cent.

In the future we have to look towards two other means of conversion—the gas-turbine-driven electric generator and the production of electricity in some more direct way from the coal; but these two means of conversion, although being capable of giving the most efficient results, are so much in the distance that they are quite beyond our present consideration.

After very careful thought on the subject I have come to the conclusion that, in order to supply electricity for all purposes, it would be necessary, amongst other things, to have a conversion efficiency of not less than 25 per cent.

For the purpose of looking into this question I have taken the figures of production and consumption given in the report of the Royal Commission on Coal, which clearly summarises the position as it stood a few years ago, and as the increase taking place is fairly regular these figures have been taken throughout. According to this report 167 million tons of coal were being used in the country in 1903. Of this amount 2 million tons went to coasting steamers and 15 million tons were used by the gas companies. In order to simplify matters and make the figures clear, I have left out of consideration the coal used on these two items, and taken the balance—viz. 150 million tons—as the annual coal consumption of the country. If now, instead of using this coal for doing work, as at present, we were to convert it into electricity, we should use, instead of 150 million tons, 60 million tons of coal a year. This coal, turned into electricity, would produce 131,400 million Board of Trade units, and the electricity so produced would, after allowing for losses of transmission and conversion into work of different kinds, be sufficient to supply the whole of our requirements now being satisfied by the use of the 150 million tons of coal which we now burn.

Summarising the whole position, it may safely be said that, wherever coal, gas, or power are now used, everything for which they are used will be better done when electricity is the medium of application.

Hardly less in importance in the all-electric scheme is the question of the by-products which become available by the proper use of our coal. These consist principally of fixed nitrogen, together with tar and oils.

Fixed nitrogen in the forms of sulphate of ammonia, nitrate of soda, and nitrate of lime are most valuable fertilisers, and enable land continually to produce the same crops with a greatly increased yield per acre. Much has been done in finding out how best to utilise these artificial fertilisers, but no doubt a great deal more will be done in this direction, and fertilisers will be prepared, with fixed nitrogen as their principal constituent, which best suit the particular soils and crops that it is desired to deal with.

According to last year's Board of Trade returns, we now grow about 23 per cent. of the total wheat that we use and import 77 per cent. Of the barley used we grow 59 per cent. and import 41 per cent., and of the oats used 78 per cent. is home grown and 22 per cent. imported. Last year we devoted 7¾ million acres to the cultivation of these crops.

Much is being done to improve the yield of corn crops, and it is probable that with scientific treatment in the production of the seed, in the sterilisation of the ground, and in the application of fertiliser, we may look at no distant date to an increased yield of 50 per cent. in these crops upon what is now being produced per acre. The most vital feature, however, in bringing this about, once we have acquired sufficient knowledge, is an ample supply of fixed nitrogen to use as fertiliser, and it is when considered from this point of view that a scheme which supplies this from our coal as the result of saving present waste is most important.

With the increased yields which we have mentioned we could produce corn crops sufficient to supply the whole of our requirements upon 11 million acres. This would represent 23½ per cent. of our present cultivated area, and would only be an addition of 3½ million acres to the land now used for the purpose of growing these same crops. The value of these additional crops would be about 58 millions sterling, based upon the prices which we paid last year, and to this would have to be added the value of the straw and the other wheat by-products, which would go a long way towards providing the food for growing the additional meat which we require to supply our demand at home.

In order to fertilise the land we should have available, under the all-electric scheme, 3 million tons, or its nitrogen equivalent, of sulphate of ammonia. This, if used over the whole of the 46¾ million acres now under cultivation, would give 143 lb. per acre; but, of course, the fertiliser would be distributed according to the nature of the land and the crops being grown. It is probable that in these circumstances the increased yield of the land now cultivated would not only give us all the grain that we should require for food, but also all the foodstuffs, partly as by-product from the grain and partly grown, that would be required for raising the cattle, sheep, and other animals necessary to supply the whole of our wants.

It is now beginning to be understood that intensive farming of the land also involves intensive cattle raising,

and that it is very advantageous greatly to reduce the amount of grass land and instead to grow crops intensively cultivated, as in this way a given amount of land can be made to produce a much larger yield.

Sulphate of ammonia is a particularly good fertiliser for the purpose of growing sugar beet, and here again it is probable that the availability of large quantities of this fertiliser at a very much lower price than at present prevails would enable us to produce the whole of our sugar at home, especially as the by-product, obtained in the form of crushings from the beet, is a very valuable food for cattle raising, and also as the crop is a very suitable one for growing alternately with wheat.

If it was found that a larger amount of fertiliser than the 3 million tons of sulphate of ammonia, which would be the principal by-product from 60 million tons of coal turned into electricity, could be advantageously used, this would be very economically produced from the electrical station by the oxidation of atmospheric nitrogen, giving a valuable fertiliser in the form of nitrate of lime. This could be made intermittently by means of current filling up the load curve, and would not necessitate the expenditure of any more money on plant for generation or transmission of the current. It would, however, require the burning of additional coal, and this in itself would add to the sulphate of ammonia available.

It is assumed by many people that the climate of this country is largely unsuitable for the purpose of growing food, and for this reason it is thought that we can never grow the food which we require. This is largely a misconception, as crops both large in quantity and of good quality can be produced in this country. Nevertheless, it would be a desirable thing if, instead of the dark weather that we now often experience owing to cloud obstruction, we could have continuous sunshine at certain times of the year. The amount of sunshine would, no doubt, be largely increased by the abolition of all smoke in the air, as not only does the smoke itself obscure the sun, but also it seems to have the effect of assisting the formation of cloud, which greatly diminishes the light and heat which we receive.

At present it is considered quite right and reasonable to canalise rivers and make great works for adding to the fertility of countries by means of irrigation, but I believe that in the future the time will come when it will be thought no more wonderful largely to control our weather than it is now thought wonderful to control the water after it has fallen on the land. I think that it will be possible to acquire knowledge which will enable us largely to control by electrical means the sunshine which reaches us, and, in a climate which usually has ample moisture in the atmosphere, to produce rainfall when and where we require it.

It seems to me that it may be possible, when we know a great deal more about electricity than we do to-day, to set up an electrical defence along our coasts by which we could cause the moisture in the clouds to fall in the form of rain, and so prevent these clouds drifting over the country between ourselves and the sun which they now blot out. It also seems to me that it will be possible, when more water on the country is required, to cause the falling of rain from the clouds passing over the highest part of the country, and so produce an abundance of water which, properly used, would greatly add to the fertility of the country.

Of course, it may seem that these are only mad visions of the future, but I think we can hardly consider these results more improbable than anyone would have considered wireless telegraphy or flight in heavier-than-air machines fifty years ago. My excuse for mentioning these matters here is that they might constitute another great use of electricity, and their useful consummation would certainly be facilitated by an abundant supply of electrical energy.

At present, although the using of our coal may mean commercial activity, it certainly means the desolation of the country in parts where it is largely used. Instead of this harm being done to the country by our coal, we should fertilise the lands by its means, and might even, as I have indicated, use it in the future to increase our sunshine.

Of course there are many things which at present stand in the way of realising such a scheme as I have outlined. There are many technical details which nothing but an immense amount of work can solve satisfactorily. There are also political and legislative difficulties standing in the way, but these, when the time arrived, would have to be got rid of rather than allow them to handicap the advance of the country. The more, however, that I have considered these ideas in detail, the more certain am I of the fundamental soundness underlying them, and that it is only a matter of time before such a scheme is carried out in its entirety.

What interests us most, perhaps, is the question of how long it is likely to be before the all-electric idea becomes possible. At present there is so much required to be done to make it workable in all its details that it seems as though its realisation would be long deferred. It must, however, be remembered that knowledge is continually being acquired which brings us nearer to its realisation, and that things engineering, and especially in electrical engineering, now move very rapidly. It may therefore come to pass that the all-electric idea, with its far-reaching changes and great benefits, will become an accomplished fact in the near future.

MATAVANU: A NEW VOLCANO IN SAVAII (GERMAN SAMOA).[1]

THOUGH not the seat of government, Savaii is the largest of the Samoan Islands in the Central Pacific Ocean. It has a backbone of volcanic mountains, some of which rise to a height of more than 4000 feet; most of them are extinct or dormant, but there have been several small eruptions within the last 200 years, and one as lately as 1902.

The volcano of Matavanu was formed in 1905 to the north of the main ridge, and near the centre of the island. The early part of the eruption was characterised by explosions, and the ejecta were mainly solid, but later on

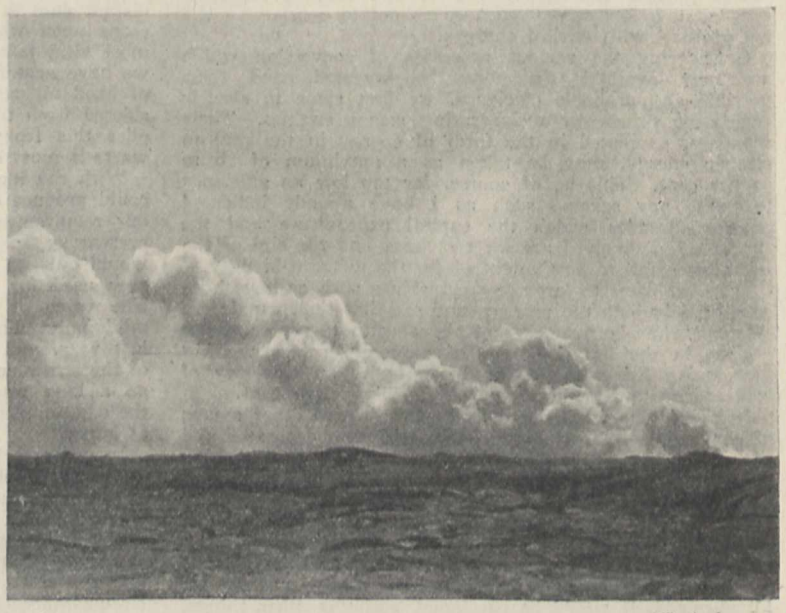

Photo.] [*T. Anderson.*

FIG. 1.—Steam Clouds from Lava falling into the Sea.

[1] Abstract of a Discourse delivered at the Royal Institution on Friday, April 29, by Dr. Tempest Anderson.

an enormous quantity of very fluid basic lava has been discharged. This has flowed by a sinuous course of about ten miles into the sea, devastated some of the most fertile land in the island, and covered it up with lava fields probably not less than twenty square miles in area.

The crater contains a lake, or rather river, of molten

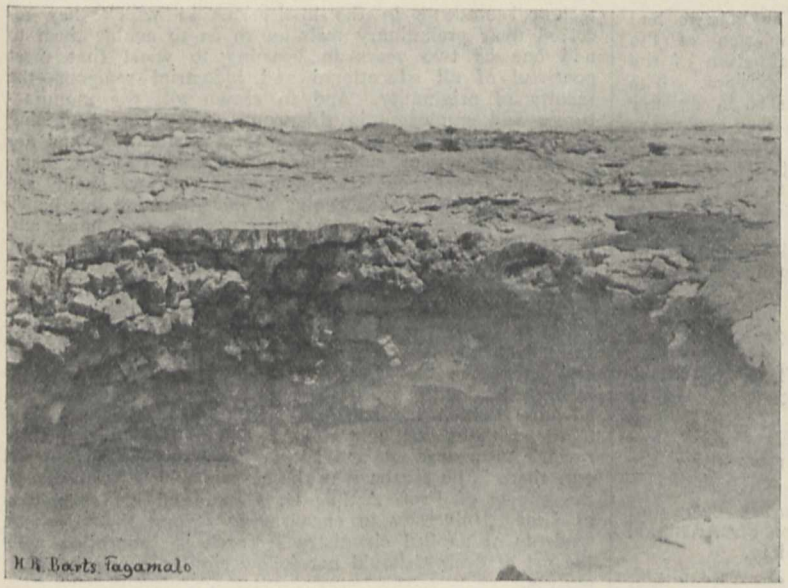

FIG. 2.—Pit Crater in Lava Field, on the line of the Lava Tunnel to the Sea.

lava so fluid that it rises in incandescent fountains, beats in waves on the walls, and rushes with great velocity down into a gulf or tunnel at one end of the crater. The lava, still liquid, runs in a passage, or perhaps system of passages, under the surface of the lava field, its course being traceable by a line of large fumaroles until, still

Photo.] [*T. Anderson.*

FIG. 3.—Lava in Lagoon corded above high water-mark: Pillow Lava below.

in a fluid condition, it reaches the sea, into which it flows with energetic explosions and the discharge of large volumes of steam, black sand, and fragments of lava. Where the action is less violent a structure resembling that of some varieties of pillow lava is produced.

The term pillow lava, originally applied to the results of a peculiar form of spheroidal weathering, is now extended to various smooth-surfaced lobular masses, which have been considered by Teall, Cole, and Gregory to be formed by lava flowing into water. This view has been combated by others; but Dr. Anderson watched the process actually going on, and photographed the results.

The formation of ordinary "corded lava" or "pahoehoe" takes place by a local quiet outflow of lava which forms a pool or lobe. The surface, being slowly cooled by the air, forms a more or less tenacious, treacly scum, which is pushed forward by the liquid mass underneath, and is puckered up into a cord or festoon. While this is taking place the new surface is becoming treacly, and in its turn is pushed forward into another fold, and so on until the whole surface is solidified, often with a very regular pattern.

Dr. Anderson said he had seen this taking place on Vesuvius, and had watched the same process going on at the sea-level at Matavanu. The surface of the lobes, however, being in that case exposed to the waves, was rapidly chilled, and solidified before it had time to be pushed forward to form "corded structure." A photograph of a recent flow into the lagoon showed corded structure above high-water mark, while lower down there was every transition into typical pillow lava.

The surface of the lava field shows several large pits along the line of the lava-conduit to the sea, out of which steam and vapours escape. They are larger than ordinary fumaroles, and appear to be formed by the remelting and falling in of the crust owing to the heat of the lava which flows beneath. The sections exposed in their walls show the lava field to consist of numerous very thin beds, partly surface flows, but probably in many cases intrusive sheets. This structure is very similar to that of the "pit craters" in Hawaii, the mode of formation of which is still unsettled. Possibly they may have been formed in the same way.

Other interesting points noticed were the formation of moulds by lava flowing round living tree trunks. The trees were, of course, killed, and when they decayed hollows were left corresponding to their former shapes. Occasionally, after the lava had solidified round a tree the remainder had flowed away; when the tree decayed a sort of hollow pillar was thus left, in which smaller plants sometimes grew.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Huxley lecture will be delivered on November 23 by Prof. Percy Gardner, professor of classical archæology in the University of Oxford. The subject of the address is "Rationalism and Science in Relation to Social Movements."

BRISTOL.—In connection with the faculty of engineering provided and maintained in the Merchant Venturers' Technical College, a course of five monthly lectures on "Aviation" has been arranged. The selected lecturers are Prof. W. Morgan, Mr. A. R. Low, Mr. E. S. Bruce, Mr. L. Blin Desbleds, and Mr. Joseph Clarkson.

A new wing erected for the chemical and physiological

departments of the University, at a cost of 50,000*l.*, was opened by Lord Winterstoke on November 15.

CAMBRIDGE.—On Saturday last, November 12, a large assembly of physicists from all parts of Great Britain, and many members of the University, came together in the Cavendish Laboratory on the occasion of the presentation to Sir J. J. Thomson of a volume entitled "A History of the Cavendish Laboratory, 1871–1910." The volume had been prepared to commemorate the completion of the twenty-fifth year of Sir Joseph Thomson's tenure of the Cavendish professorship of experimental physics. The presentation was made by Dr. R. T. Glazebrook, director of the National Physical Laboratory, who was for many years associated with the late and present Cavendish professors. The volume begins by recording the fact that perhaps no post in the world has held three men of such supreme and varied genius as James Clerk-Maxwell, Lord Rayleigh, and Joseph John Thomson. It contains a remarkable record of work, and concludes with a list of the memoirs which have been published in connection with the Cavendish Laboratory, which extends over forty-two pages, and a list of some two hundred men of science who have researched in the laboratory. We hope to publish a review of the volume in an early issue.

Mr. A. Hutchinson, of Pembroke College, has been appointed chairman of the examiners for the Natural Sciences Tripos, 1911.

Mr. J. S. Edkins, of Gonville and Caius College, has been approved by the general board of studies for the degree of Doctor in Science.

LIVERPOOL.—On November 14 the honorary degree of LL.D. was conferred by the University upon Sir Archibald Geikie, K.C.B., president of the Royal Society.

OXFORD.—The Herbert Spencer lecture on "Evolution, Darwinian and Spencerian," will be delivered by Prof. R. Meldola, F.R.S., on December 8 at 2.15 p.m.

IT is announced in *Science* that the State legislature of Arkansas has voted 70,000*l.* for the erection of four agricultural schools, and 100,000*l.* additional has been raised by the cities.

WE learn from the *Revue Scientifique* that the buildings of the medical faculty of the University of Toulouse were partially destroyed by fire on October 27. The library of more than 60,000 volumes was burnt entirely, and also the physiological lecture theatre and other rooms.

THE Department of Agriculture and Technical Instruction for Ireland has issued a programme of the Irish Training School of Domestic Economy for the session 1911–2. The school is situated at St. Kevin's Park, Kilmacud, Stillorgan, co. Dublin. The premises stand in grounds of about three acres, and the house provides ample accommodation for the staff and students, in addition to class and recreation rooms. A large fruit and vegetable garden is attached to the house. At the close of each school year, the Department, on consideration of the results of the examination held at the close of the course of household management, and the reports of their inspectors and of the teaching staff, selects for training as teachers of domestic economy a limited number of students who have shown themselves most capable of taking full advantage of the course of training provided. The course of training extends over at least two whole sessions, and involves a complete course of domestic economy suitable for teachers of this subject. It includes the principles of practical elementary science involved in domestic work; cookery; laundry; dressmaking and home sewing; housewifery (including household routine and the keeping of accounts); and practice in the teaching of these subjects. Practical instruction in home hygiene and sick nursing is afforded, and instruction is given in the theory and practice of education.

IN a letter to the *Yorkshire Observer* of November 11 Prof. R. Meldola, F.R.S., urges the need for the provision in this country of a larger number of scholarships for research. "Why, in the name of all that is sacred to the industrial welfare of this country, are not some of the vast sums now devoted to educational purposes available for research scholarships in existing institutions?" asks Prof. Meldola. Later in his letter he says, everything is ripe for the movement. There are competent teaching staffs; there is always a supply of promising students; there are funds from county councils and from public and private endowments; and there is the Treasury behind the Board of Education. There are scholarships given for all kinds of purposes other than for the continuation of the education of the most promising technical students in the institutions in which they received their preliminary training so as to enable them to add one or two years in learning to wield that most powerful of all educational and industrial weapons—the faculty of originality. And to crown all, the manufacturers and employers in this country are now beginning to take a more enlightened view of the situation, and are prepared to employ such men—when they can get them. It seems preposterous that year after year we should see ability, talent, and even genius slipping through our hands for want of means, when educators on one hand and employers on the other are both ready to play their part in promoting the industrial development of the country. We want, he concludes, a system of technical research scholarships which will be looked upon as a distinction to gain, for none but the most competent would be allowed to hold them. We want through such means to strengthen and encourage the work of the teachers by filling their laboratories with research students, and we want to advance British industry by handing over to the manufacturers the picked material from our educational institutions. As a leading article in our contemporary points out, there is no reason why the success which has attended the efforts of Prof. Arthur G. Green and his colleagues at Leeds University in encouraging among the advanced students of applied chemistry research in connection with the art of dyeing should not follow similar efforts in other centres.

IN Dr. Muir's report on education in Cape Colony in 1909, which has come to hand, he shows that in 1891 there were five colleges in the colony where students could pursue courses of study for a university degree, viz. the South African College, Cape Town, the Diocesan College, Rondebosch, the Victoria College, Stellenbosch, St. Andrew's College, Grahamstown, and the Gill College, Somerset East. A large proportion of the teaching power, however, in all these institutions was given to what was, properly speaking, school work, namely, the preparation of large classes for matriculation. Mathematics and chemistry, too, were the only sciences for the teaching of which provision was made. From its inauguration the policy pursued by the Education Department kept three aims in view. The first was the removal of the matriculation classes from the colleges, so that professors might have more time for advanced work, while the pupils of the junior classes might in the public schools be under a discipline more suitable to their years. The second was the institution of new professorships, more especially in the sciences, until then unrepresented; and the third was a reduction in the number of colleges—a number which seemed at the time excessive for the total number of students. Victoria College, Stellenbosch, was the first that agreed to part with its matriculation classes, the junior class in 1896 and the senior in 1899. In the latter year the South African College was induced to follow the example. At present practically all the colleges have ceased to retain matriculation classes. Since 1891 there have been instituted in connection with the colleges professorships of physics, applied mathematics, geology, botany, and zoology. In addition to the then existing courses in arts, law, and survey, there have been opened new courses in arts as well as professional courses in mining, civil and electrical engineering, medicine (preliminary), and forestry. On the literature side there has also been development, professorships in history and lectureships in Hebrew having been established in connection with the larger colleges. The movement towards greater concentration of effort in fewer colleges has been brought to a successful issue in the eastern province. The Gill College, Somerset East, has been closed, St. Andrew's College has restricted itself to school work, and in Grahamstown, by the happy union of all interests, the Rhodes University College has taken their places and become the centre of higher education for the eastern province.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 10.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir George **Darwin**: (1) The tidal observations of the British Antarctic Expedition, 1907; (2) a mistake in the instructions for a certain apparatus in tidal reductions.—F. **Soddy** and A. J. **Berry**: Conduction of heat through rarefied gases.—II. The thermal conductivities of argon, helium, and hydrogen at very low pressure have been examined in greater detail with new and improved apparatus. The hypothesis provisionally put forward (Roy. Soc. Proc., A, vol. lxxxiii., 1910, p. 254), that the interchange of energy on impact is imperfect in the lighter gases, has been tested and found not to account for the smallness of the ratio (K/Q) of the found to the calculated conductivities. The conductivity of hydrogen using a palladium hot wire is the same as that with a platinum wire. Change of temperature of the hot surface, that of the cold surface remaining constant at room temperature, does not exert so much influence on the value of K as was anticipated. The value of K/Q tended to diminish as the difference of temperature increased, especially at high temperatures. At low temperatures, attained by immersing the apparatus in liquid air and in solid carbon dioxide and ether, the ratio K/Q is *diminished*, whereas on the hypothesis of imperfect interchange of energy an increase was expected. Jacketing the apparatus with vapours up to 264° caused an increase in the value of K/Q. It appears that, most probably, increase in the difference of temperature between the surfaces tends to decrease the value of K/Q, whereas increase in the temperature of both surfaces increases it. Argon under some of the new conditions tried conforms to the theory hardly better than the other gases, and the agreement found previously was probably fortuitous. The general conclusion is that the conductivity at low pressures varies less with the nature of the gas and with the temperature of the experiment than is to be expected from kinetic considerations. The extreme values found for the conductivities of the three gases over a range of about 450° lay between 0·8 and 3·4, whereas the calculated values lie between 0·95 and 16·2 (X 10^{-5} calorie, per sq. cm. of hot surface, per 1° difference of temperature, per 0·01 mm. pressure of gas).—W. H. **Hatfield**: The chemical physics involved in the precipitation of free carbon from the alloys of the iron-carbon system. The intention of the author is to examine the conditions under which free carbon is produced in iron and steel. Whereas it has been an open question as to whether or not free carbon could be produced direct from the solid solution, the paper is intended to prove the truth of the theory that free carbon can only be produced by the dissociation of the free carbide. It is hoped to demonstrate that this theory holds good through the whole range of the alloys in which free carbon, whether as graphite or annealing carbon, is found. After the presentation of evidence in support of this view of the production of graphite in and near the freezing range, experiments, performed to determine the chemical physics underlying the liberation of annealing carbon in white cast iron, are described. By the electrolytic method of analysis the cementite carbide was obtained from such irons of varying composition, and it is shown how, by varying the percentage of silicon, manganese, or sulphur in the iron, the composition of the cementite is modied and its degree of stability at varying temperatures determined. It is also shown that the size and structure of the precipitated annealing carbon is largely due to the size and structure of the original cementite. Experiments performed to produce annealing carbon in blister steel during the cementation process are then described, after which an explanation of the phenomena of "black" steel is discussed; it is shown that the free carbon found in such steels may present one of two formations, each produced under different conditions. The author further endeavours to demonstrate that whilst the free cementite carbide is dissociated at high temperatures through the whole range of the alloys, the carbide remaining in solid solution does not dissociate until the resolution of the solid solution into the carbide and iron of the pearlite, at the carbon change point.—Dr. F. **Horton**: A spectroscopic investigation of the nature of the carriers of positive electricity from heated aluminium phosphate. The emission of positive ions from substances heated in a vacuum has been investigated by several experimenters, and it has been found that the ratio of the charge to the mass of the ions is the same for all the substances so far experimented on. Assuming that the charge is equal to that carried by the hydrogen ion in electrolysis, the mass of the carriers of positive electricity from heated substances must be about twenty-six times that of the hydrogen atom. The object of this research was to obtain the spectrum of these ions. Aluminium phosphate was chosen for investigation, because of the very large positive ionisation produced on heating this substance. A calculation showed that, with the apparatus used, it might be expected to collect a sufficient quantity of the carriers to obtain their spectrum in a small vacuum tube. The vessel used to collect the carriers was cooled in liquid air during the passage of the thermionic current from a strip of platinum covered with aluminium phosphate to a surrounding platinum cylinder. The material collected was then allowed to vaporise, and its spectrum was obtained by rendering it luminous with an electrodeless ring discharge. The spectrum of carbon monoxide was always obtained, although precautions had been taken to exclude this gas, or materials which might give rise to it, from the apparatus. It is concluded, therefore, that the positive ions consist of carbon monoxide, the molecular weight of which agrees fairly well with that required by the results of the e/m determinations. It is considered improbable that this gas is evolved on heating every substance which has been experimented on in the determinations of the specific charge, but from the nature of the apparatus used it must always have been present during these determinations. In the paper reasons are given for believing that molecules of carbon monoxide readily act as carriers of positive electricity, and this gas probably diffuses into the hot metal or other substance and is evolved in an ionised state.—N. **Bohr**: The determination of the tension of a recently formed water-surface. Arguments in further support of the author's previous conclusion, that the surface tension does not change sensibly with the time that has elapsed since the surface was formed.—Lord **Rayleigh**: Aërial plane waves of finite amplitude.—J. J. **Manley**: Observations on the anomalous behaviour of delicate balances, and an account of devices for increasing accuracy in weighings.—Prof. F. W. **Dyson**: The improbability of a random distribution of the stars in space.—G. I. **Taylor**: The conditions necessary for discontinuous motion in gases.—The Hon. R. J. **Strutt**: (1) The radium content of basalt; (2) measurements of the rate at which helium is produced in thorianite and pitchblende, with a minimum estimate of their antiquity.

Royal Microscopical Society, October 19.—Mr. E. J. Spitta, vice-president, in the chair.—J. J. **Simpson**: Hicksonella, a new gorgonellid genus. The genus is established to include three species, all collected off South Africa. One species was described by Prof. Hickson in 1904 under the name of *Juncella spiralis*, but the author believes that a reference to the genus Juncella is impossible. The clearing up of the position of this puzzling specimen was facilitated by recent work of the author in his revision of the family of the Juncellids. In addition to *Hicksonella spiralis*, g.n., he describes *H. flagellata*, sp.n., and *H. capensis*, sp.n.—E. **Heron-Allen** and A. **Earland**: Some varietal forms of *Massilina secans*. After referring to several varietal forms that had been previously described, the authors related the finding of numerous specimens of three of these varieties in narrow observation tanks where some gatherings of Foraminifera, made off Selsey Bill, had been placed, and where they multiplied. The conclusion arrived at was that these variations were caused by the want of sufficient shell-making material, the carbonate of lime in the tanks having been used up, the sea water never having been renewed.—E. M. **Nelson**: A micrometric difficulty. The author referred to the difficulty of counting correctly the number of ruled lines, or diatomic striæ, in a given space. The trouble does not arise when the interspaces are relatively wide compared with the breadth of the lines, but it does so when the breadth of the interspaces approaches that of the lines. It is the black and white dot image that is

responsible for the trouble. When the focus is at a white-dot image the white lines must be counted, and *vice versâ* when the focus gives a black-dot image.—E. M. **Nelson**: The resolution of new detail in a *Coscinodiscus asteromphalus*. This paper has reference to the resolution of further detail obtained by a new one-eighth objective by Zeiss, described in a previous communication. The new detail discovered is a fine sieve covering the so-called eye-spot in *C. asteromphalus*. As the size of the eye-spot is only 1/14,000th of an inch, it may be left to the imagination to estimate the size of the minute perforations forming the sieve.

Physical Society, October 28.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Prof. Ernest **Wilson** and W. H. **Wilson**: A new method for producing high tension discharges. According to this method energy is taken from an alternating or continuous current source and stored in a magnetic field by an inductance; it is then permitted to surge into a condenser which forms with the inductance a *low* frequency oscillating circuit. When the energy is stored in the condenser the latter is mechanically bridged across the primary winding of a spark-coil, with which it forms a *high* frequency oscillatory circuit. The energy is then transmitted by the secondary winding of the spark-coil to the work circuit in the well-known manner. Briefly the following are some of the advantages gained:—(1) For X-ray work the inverse electromotive force at "make" is eliminated, thereby leading to increased life of the tube and to a more sharply defined radiograph. (2) Only a small magnetising current is required as the inductance has a nearly closed magnetic circuit. This gives rise to a very small C^2R loss and consequently higher efficiency. (3) On account of the long periodic time of the system between the periods of "break" and "short-circuit," the voltage across the contact of the interrupter at "break" does not rise to a high value, or rises so slowly that the contacts are well separated before it is developed. Hence immunity from sparking. (4) The method lends itself to few secondary turns and this keeps down the time constant. It also makes the coil lighter, cheaper, and more compact. (5) The method lends itself to low secondary resistance—a point of great importance in connection with radio-telegraphy. (6) The iron of the spark-coil can be kept small in amount, and special attention can be paid to its lamination and insulation, as it may have to be operated at frequencies of three or four thousand per second. (7) The elimination of sparking increases efficiency, and on board ship where coal gas is not conveniently obtainable this is an advantage. (8) The apparatus can be worked from direct-current or alternating-current systems at usual voltages, or from a portable battery of a few storage-cells. (9) The oscillatory current at "break" does not pass through the battery, and hence does not assist in its discharge. (10) The iron in the magnetic circuit of the external inductance has only to operate at low frequency, and hence it has not to be finely laminated. (11) When used on alternating-current systems, rectification, if desired, is easily effected by employing two short-circuiting brushes, one for each half-period, and allowing the second brush to short-circuit at the moment when the condenser is fully charged after allowing a second complete surge of the energy between the condenser and the inductance of the spark-coil. (12) The apparatus is light, efficient, and cheap, and is suitable for radio-telegraphy, X-ray, medical, and other work in which high-tension electricity is employed.—F. **Rogers**: The behaviour of steel under combined static stress and shock. Attention is directed to the importance of the time rate of increase of stress, ds/dt, in the behaviour of materials under stress. The exact determination of this rate must usually present much difficulty, but the indirect experimental method adopted consisted in submitting specimens of steel to shock whilst under static loading. The conclusion that steel is substantially less resistant to shock whilst it is under static stress appears to be definitely established. In some cases the effect of a large static stress was to diminish the resistance to shock by as much as 30 per cent. The correction for the work done upon the sample in applying the static load is relatively small. Thus the energy absorbed in breaking a sample of steel is greater when entirely applied as shock than when applied partly as shock and partly statically. This difference is considered to be due chiefly to the difference in the rate of increase of stress at the higher stresses in the two cases. The actual values of the highest stresses are not necessarily identical, but probably the higher the rate of increase of stress the higher is the greatest stress reached before rupture occurs, whilst, simultaneously, deformation is diminished, and the intimate nature of the breakdown suffers a corresponding variation. At the higher static loads employed some portions of the test-pieces were stressed beyond their elastic limits, and this may also help to account for a part of the diminution in resistance to shock.

Linnean Society, November 3.—Dr. D. H. Scott, F.R.S., president, in the chair.—Prof. W. A. **Herdman**: A comparison of the summer plankton on the west coast of Scotland with that in the Irish Sea. This paper is the result of a series of vertical plankton hauls taken with the "Nansen" closing tow-net (made of No. 20 silk) from the S.Y. *Ladybird* in July of the last four years, from various deep hauls (eighteen of them being from more than 100 fathoms) at various localities off the west coast of Scotland. A comparison of the collection shows (1) that there is a constancy year after year in the nature of the plankton at certain localities; and (2) that some of the localities, not very far apart, differ considerably from one another in the nature of their plankton at the same time of year (July). Some of these deep hauls consist markedly of zoo-plankton and others of phyto-plankton, and the latter show a close resemblance to the phyto-plankton hauls typical of the vernal maximum of diatoms in the Irish Sea. The complete disappearance of the phyto-plankton, which is such a marked feature in the summer (July and August) gatherings from the Irish Sea, does not seem to take place in some localities off the west coast of Scotland, and these phyto-plankton hauls are obtained, not in the deep fiord-like lochs, but in the open sea, *e.g.* off Ardnamurchan and off the islands of Rum and Canna in the Sea of the Hebrides.—J. C. F. **Fryer**: The structure and formation of Aldabra and neighbouring islands, with notes on their flora and fauna. Aldabra, situate 250 miles north-west of Cape Amber, is a large atoll with an almost complete land-rim, a large shallow lagoon, and a narrow fringing reef. The land-rim is composed of coral-limestone, which gives definite evidence that Aldabra was formed by elevation and once stood at more than 40 feet above sea-level, though rain-water denudation has reduced this to its present level of 15 feet. A deposit of guano, by combination with the limestone, has produced phosphatic rocks, interesting in that they prove that the lagoon was once non-existant, and has since been formed by erosion and denudation. The atoll is still being washed away, but the loss is in part compensated by the piling up of sand by wind and wave. The fauna and flora, though peculiar, have been largely derived from Madagascar, the flora being interesting in showing four distinct types of jungle. Assumption, Cosmoledo, Astove, are also islands and atolls of elevated coral-rock, and form an interesting series showing the loss of rock-land by erosion and its replacement by sand and clays. Giant land-tortoises still exist on Aldabra, and fossil remains were found on the three other islands visited; in this connection it is noteworthy that none of these islands has ever been connected with continental land.—H. B. **Bigelow**: The Siphonophora of the *Research* Biscayan plankton. The memoir forms the thirteenth report on Biscayan plankton collected on board H.M.S. *Research* in 1900. The collection consisted exclusively of Calycophoridæ, with the exception of a single fragment from another group. In his report of the Siphonophora of the *National*, Prof. Chun noted a similar absence of Physophoridæ during the North Atlantic summer, and suggested that these latter forms must be at considerable depths at that season, yet the numerous hauls of the *Research* with closing nets down to really great depths failed altogether to find them. On the other hand, it is only during summer that these Physophoridæ are found on the eastern coasts of North America, at a time when the cold current alongshore is at its warmest; and further, they were not uncommon in July and August during cruises of the *Research* in the Færöe Channel, in the cooler water of

more northern origin. All these facts seem to point to rather narrow limits, outside of which the Physophoridæ perhaps die down to a large extent seasonally, except for a few specimens which will reproduce when the temperature optimum is again reached. The second point of interest to which the author directs attention is that all the ten species captured—except one new genus and species—were also taken in the eastern Pacific expedition of the *Albatross* under the late Prof. Alexander Agassiz. The collection included one new species of Diphyes and one new genus, Nectopyramis, apparently a monophyid. On the question of vertical distribution, which was a main object of the cruise, the author has arrived at some conclusions of interest. The Calycophoridæ were comparatively rare at the surface, but most plentiful somewhere below 25 and above 100 fathoms. The only species taken sufficiently often to allow of discussion was *Diphyes appendiculata*. The diphyid or polygastric generation was uncommon at the surface, seemed to reach its plurimum about 75–100 fathoms, and below that was very seldom met with. The eudoxid or sexual generation, on the other hand, presented a plurimum at the surface, was taken less often down to 100 fathoms, and only once below that depth, namely, between 400 and 500 fathoms. Another form captured, *Chuniphyes multidentata*, has so far been recorded only from considerable depths; the captures by the *Research* fix it as low as between 2000–1000 fathoms, that is, between nearly 3½ miles and 2 miles deep. The highest capture was in an open net hauled for an hour at 250 fathoms, and thence to the surface; but as it was taken in none of the ninety-five hauls above 250 fathoms, this is probably about its upper limit.

Mathematical Society, November 11.—Sir W. D. Niven, president, and subsequently Dr. H. F. Baker, newly elected president, in the chair.—Sir W. D. **Niven**: The relations of mathematics to experimental science (presidential address).—G. T. **Bennett**: The double-six of lines. Dr. W. H. **Young** and Mrs. **Young**: The existence of a differential coefficient.—Dr. W. H. **Young**: (1) Note on the property of being a differential coefficient; (2) conditions that a trigonometrical series may have the Fourier form.—F. **Tavani**: A class of integral functions which includes Riemann's Zeta-function.—T. W. **Chaundy**: The geometrical representation of non-real points in space of two and three dimensions.—J. E. **Littlewood**: The extension of Tauber's theorem.—F. B. **Pidduck**: The stability of rotating shafts.—J. E. **Campbell**: A class of orthogonal surfaces.—S. **Chapman**: Non-integral orders of summability of series and integrals.—Dr. A. R. **Forsyth**: Lineo-linear transformations, especially in two variables.—Dr. W. F. **Sheppard**: Notes on terminating hypergeometric series.—H. **Bateman**: The transformation of a particular type of electromagnetic field and its physical interpretation.—Dr. P. **Mahlo**: Uber die Dimensionentypen des Herrn Fréchet im Gebiete der linearen Mengen.

MANCHESTER.

Literary and Philosophical Society, October 18.—Mr. F. Jones, president, in the chair.—Prof. G. Elliot **Smith**: The convolutions of the brain. The cortex is mapped out into a great number of territories, differing in structure and function, and varying in size in different mammals, not only because the sense-organs themselves vary in size and acuteness in different creatures, but also because in different orders and families a sense organ of a given size will have a varying cortical representation. Thus, if one were to take a dog and a baboon with eyes of the same size, the monkey will be found to possess a much larger cortical visual area than the dog. It is these differences which determine the varied plans of cortical folding and the resulting varieties in the patterns of the convolutions in different mammals. Folding occurs most often along the boundary line between two areas of different structure and function. The difference in the rate of expansion of two such areas is no doubt the reason for this type of fissure-formation—limiting sulci. In the second place a rapidly growing cortical territory, meeting with obstruction to its expansion on all sides, may become buckled in, and so a furrow develops along its axis (*i.e.*, within its area), instead of at its edges. This second class of furrow is much less frequent than the first class, and may be distinguished as the group of axial sulci. There is a third variety, which may be called the operculated sulcus, in which one lip projects over a submerged area. Sulci of this type are produced by the submerging of a specialised fringing territory surrounding a main sensory area. In the fourth place various mechanical factors come into operation to modify the form of furrows formed in one of these three ways, or even to produce new sulci. By the application of these principles it is possible to interpret the meaning and the mode of formation of most of the furrows which subdivide the higher types of cortex into numerous convolutions.

November 1.—Mr. Francis Jones, president, in the chair.—Dr. A. N. **Meldrum**: The development of the atomic theory. (ii) The various accounts of the origin of Dalton's theory. (iii) Newton's theory and its influence in the eighteenth century. There are numerous accounts of the genesis of Dalton's theory, one of which comes from W. C. Henry, another from Thomas Thomson, a third from J. A. Ransome, and two come direct from Dalton. All the narratives come from Dalton originally, for Henry, Thomson, and Ransome based theirs on conversations they had with him. The discrepancies between these various accounts can be explained only on the supposition that Dalton was deficient in historical instinct, and never appreciated the difference between describing the genesis of his theory and expounding the theory itself. The main conclusions of the second paper are (1) that Newton's contribution to the development of the atomic theory was made under the influence of Descartes; (2) that Newton exerted an influence in the eighteenth century on Bryan Higgins, and through him on William Higgins. The atomic theory advanced by Bryan Higgins (1776) and amplified by William Higgins (1789) can be understood only when regarded as springing from Newton's theory under the conditions of the time. Those conditions were:—(*a*) the knowledge due to Priestley of different kinds of gases, and (*b*) the new light which Lavoisier threw on chemical composition, consequent on Priestley's discovery of oxygen.

PARIS.

Academy of Sciences, November 7.—M. Émile Picard in the chair.—M. **Bassot**: Halley's comet. Observations of this comet were made at the Observatory of Nice on November 2 and 3. It is visible in the morning a little before sunrise. The sky was covered on the nights of November 4 and 5, but in spite of the absence of a third observation there is no doubt of the identity of the comet.—A. **Müntz**: The struggle for water between the soil and the seed. For each specific kind of soil there is a definite percentage of moisture, below which the seed, instead of gaining moisture, actually loses it. For the seed to absorb sufficient water to be able to germinate, a higher percentage of moisture, fixed for each class of soil, is necessary. Thus in a sandy soil 0·5 per cent. of water is sufficient for germination; with loams the required percentage of water is from 2½ to 7·7 per cent., according as the proportion of clay increases; with a garden soil containing a large proportion of humus, nearly 19 per cent. of water must be present before germination can take place.—Charles **Nordmann**: A means of determining by colour photometry the parallaxes of a certain class of stars. First application to two stars. The method applied to Algol gives a distance of 59 years of light, or a parallax of 0·055″, a figure in good agreement with the 0·051″ given for this star by M. Bijourdan in his recent catalogue of stellar parallaxes. The same method applied to δ Libra gives a distance of 355 years of light and a parallax of 0·009″.—A. **Demoulin**: Certain couples of triple-orthogonal systems.—W. **Stekloff**: The development of an arbitrary function in series of fundamental functions.—L. **Favé** and L. **Driencourt**: Observations of the tides made at sea in the Channel and the North Sea. A self-recording instrument has been devised by the authors which, when placed on the sea floor, measures pressure variations directly, from which the changes of level due to the tides can be deduced. An automatic differential arrangement renders the sensibility very nearly independent of the depth. A diagram is given of observations taken at a point situated 52° 29′ N., 0° 47′ E., and the bearing of these data upon Whewell's work on the tides of the North Sea is discussed.—A. **Petot**: Unsymmetrical motors.—Eugène **Bloch**: The action of a magnetic field on the electric

discharge. The author has repeated and confirmed some experiments recently made by M. Gouy, and finds that there is a particular strength of the magnetic field which facilitates the maximum discharge. It is shown that this curious phenomenon is in general agreement with the modern theory of disruptive discharge.—J. **de Kowalski**: Progressive phosphorescence at low temperatures.—A. **Guntz** and M. **Galliot**: The preparation of crystallised strontium. A mixture of strontia and aluminium powder is placed in the lower half of a steel tube closed at one end. This is enclosed in a porcelain tube, a high vacuum being maintained in the latter. The temperature of the mixture is gradually raised to 1000° C.; after cooling, the inside of the cool portion of the tube is covered with a deposit of crystalline strontium. The yield is good, nearly 75 per cent. of the theoretical quantity, and the metal contains only 0·5 per cent. of impurities.—E. **Berger**: Tetranitromethane. This substance is obtained by the action of pure nitric acid upon acetic anhydride in acetic acid solution. The exact conditions necessary for a good yield (50 per cent. of the theory) are given in detail. The physical constants and the heat of combustion were determined.—E. **Kayser**: The influence of nitrates on alcoholic ferments. Alcoholic fermentation is more complete in presence of manganese nitrate, and for each strain of yeast there is an optimum amount of salt, the addition of which produces a maximum of diastatic activity.—G. **Malfitano** and Mlle. A. N. **Moschkoff**: The purification of starch. A 1 per cent. colloidal solution of starch is prepared, the turbid liquid frozen and allowed to melt. The clear liquid thus obtained holds in solution the greater part of the mineral impurities and very little starch; the bulk of the latter deposits in flocculent form, and can be separated by filtration or by centrifugation. After four or five repetitions of this treatment a starch is obtained which gives less than 0·02 per cent. of ash. The properties of starch thus purified are compared with those of ordinary starch.—M. **Marage**: Subjective noises in the ear. A classification of the various kinds of subjective noises in the ear in accordance with their pathological causes.—Henri **Labbé**: The distribution of nitrogen in the intestinal excreta. The dried excreta were extracted successively with various solvents, and the nitrogen determined in each extract.—S. **Lalou**: The variations in the quantity and composition of the pancreatic juice during secretions brought about by secretin. Repeated injections of secretin produce a regular secretion of pancreatic juice during a long period. The juice thus obtained is not of strictly constant composition; its alkalinity and diastatic activity diminish, this diminution being especially marked as regards the lipase.—P. **Chaussé**: Latent mesenteric tuberculosis produced experimentally in the dog. The injection of tuberculous products in the normal dog produced no visible lesions after six months. Latent mesenteric tuberculosis was, however, easily shown to exist in the majority of the dogs under experiment.—M. **Fabre-Domergue**: The food of the oyster and the mechanism of its contamination in impure water.—R. **Robinson**: Contribution to the study of the venous circulation in the lower limbs.—Paul **Marchal**: Contribution to the biological study of Chermes.—A. **Quidor**: The evolution and affinities of the Philichthydæ.—O. **Mengel**: Geology of the primary islet of La Guardia between Sègre and Noguera Pallaresa.—H. **Mansuy**: The stratigraphic succession in the neighbourhood of Luang-Prabang.—Maurice **Leriche**: The first fossil fishes met with in the Belgian Congo in the Lualaba strata.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 17.

ROYAL SOCIETY, at 4.30.—On the Effect of Gravity upon the Movements and Aggregation of *Euglena viridis*, Ehrb., and other Micro-organisms: Harold Wager, F.R.S.—The Proteolytic Enzyme of Drosera: Miss Jean White.—The Influence of Bacterial Endotoxins on Phagocytosis (including a new method for the Differentiation of Bacteria). (Second Report): L. S. Dudgeon, P. N. Panton, and H. A. F. Wilson.—On the State of Aggregation of Matter. Part I. On the Action of Salts in Heterogeneous Systems, and on the Nature of the Globulins. Part II. On the Action of Formaldehyde on Witte's Peptone. Part III. On the Solubility of Phenol and certain Crystalline Substances in Salt Solutions: Dr. S. B. Schryver.—A Method for Isolating and Growing the Leprosy Bacillus of Man: F. W. Twort.—The Oxidation of Phenol by certain Bacteria in Pure Culture: G. J. Fowler, E. Ardern, and W. T. Lockett.

LINNEAN SOCIETY, at 8.—(1) Theoretical Origin of *Plantago maritima* and *P. alpina*, from *P. coronopus*; (2) Supplementary Observations on the Theory of Monocotyledons being derived from Aquatic Dicotyledons: Rev. George Henslow.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Origin of the Present Geography of Northern Nigeria: Dr. J. D. Falconer.

FRIDAY, NOVEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Development of Road Locomotion in Recent Years: L. A. Legros.

MONDAY, NOVEMBER 21.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Duke of Abruzzi's Karakoram Expedition: Dr. Filippo de Filippi.

ROYAL SOCIETY OF ARTS, at 8.—Industrial Pyrometry: C. R. Darling.

TUESDAY, NOVEMBER 22.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—The Arrival of Man in Britain in the Pleistocene Age: Prof. W. Boyd Dawkins, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Portland Cement, and the Question of its Aeration: H. K. G. Bamber.

WEDNESDAY, NOVEMBER 23.

ROYAL SOCIETY OF ARTS, at 8.—Methods of Detecting Fire-damp in Mines: Sir Henry H. Cunynghame, K.C.B.

GEOLOGICAL SOCIETY, at 8.—The Effects of Secular Oscillations in Egypt during the Cretaceous and Eocene Periods: Dr. W. F. Hume.—The Origin of the British Trias: A. R. Horwood.

THURSDAY, NOVEMBER 24.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Colour-blindness and the Trichromatic Theory. Part II. Incomplete Red or Green Blindness: Sir W. de W. Abney, K.C.B., F.R.S.—On the Sequence of Chemical Forms in Stellar Spectra: Sir N. Lockyer, K.C.B., F.R.S.—The Influence of Viscosity on the Stability of the Flow of Fluids: A. Mallock, F.R.S.—An Electrostatic Voltmeter for Photographic Recording of the Atmospheric Potential: G. W. Walker.—Optical Dispersion, an Analysis of its Actual Dependence upon Physical Conditions: Dr. T. H. Havelock.—The Spectrum of Halley's Comet: C. P. Butler.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Street Lighting by Modern Electric Lamps: H. T. Harrison.

FRIDAY, NOVEMBER 25.

PHYSICAL SOCIETY, at 5.—The Electric Stress at which Ionisation begins in Air: Dr. A. Russell.—On the Measurement of a Flow of Water in a Closed Circuit by a method involving little or no Statical Friction: Dr. A. Griffiths.—Exhibition of a Surface Brightness Photometer: J. S. Dow.—The Approximate Solution of various Boundary Problems by Surface Integration combined with Freehand Graphs: L. F. Richardson.—The After-glow produced in Gases by Electric Discharge: Prof. R. J. Strutt, F.R.S.

CONTENTS.