THURSDAY, MAY 6, 1909.

VERTEBRATE DEVELOPMENT.

The Development of the Chick. An Introduction to Embryology. By F. R. Lillie. Pp. xi+472. (New York: H. Holt and Co.; London: G. Bell and Sons.) Price 16*s.* net.

THE first feeling of an embryologist on examining this beautiful volume is of disappointment and regret that it treats solely of the development of so familiar an animal as the chick. The like style of work, dealing with some less-known form, might have been a very valuable original monograph. The chick has, indeed, played a very large and undeserved part in the history of embryology from the time of Harvey, Caspar Friedrich Wolff, and earlier, through all the years during which Pander and Carl Ernst von Baer devoted themselves to its study, down to to-day. The incubator of the embryological laboratory is a silent witness of the importance often still attached to the development of the common fowl in the teaching of embryology. In addition to the employment of this animal in the laboratory, many embryologists have found the incubated egg of the hen useful, at times invaluable, in their researches. None the less, like the type-system of the zoological laboratory, the chick has seen better days in embryological work and teaching. Convenience has become the sole reason for its continued employment. For most, if not all, of the subjects of a course of embryology it is not difficult at all to find far more suitable material for instruction.

No embryologist would think of attempting to demonstrate the wonderful story of the germ-cells, the phenomena of the maturation of germ-cells, fertilisation, egg-cleavage, or even of the formation of the so-called germinal layers with material supplied by the development of the chick. In almost every field of embryological research, where fundamental questions have been solved or brought nearer solution, material from other animals has been employed. "The book is meant for beginners in embryology," we are told in the preface, and the long list of literature at its close is intended doubtless as a further guide to him. It embraces, however, only those memoirs in which the developmental features of the highly specialised bird find a place. The beginner, therefore, having worked through the book and some or all of the literature, will have gained a very erroneous idea of what modern embryology really is. Most of the important parts of its literature on all sorts of questions will not have been brought to his notice. For example, the classic memoirs of Boveri and F. Meves on oögenesis and spermatogenesis, those of Mark, Whitman, and E. B. Wilson on egg-cleavage, or of E. van Beneden, Hubrecht, and Duval on the trophoblast and placenta, can of necessity find no place or mention in a work designed as this has been. After a close study of the work, the student may not unnaturally put a question we have often heard, "What *is* trophoblast? Is it a name invented for something existing only in the imagination of some 'versatile' embryologist?" What a revelation would it not, then, be to him to read Hubrecht's classic monograph on the trophoblast and placentation of the hedgehog (1889), to be followed by the study of the works of Duval, E. van Beneden, and J. P. Hill!

Were one, indeed, to search for the cause of the existence and persistence of so much that is erroneous in embryology, the convenient chick would probably be found to be the chief culprit. Of what value is it to the student to learn that the thymus arises from the walls of the third and fourth branchial pouches, if at the same time he remain ignorant that such a restricted origin be not by any means universal, and that there be fishes in which each and every branchial pouch may furnish its thymus element? The nature of the thymus could never be solved from its development in the chick. The mode of development of important structures from well-defined placodes or plates of cells, each placode probably having a first origin in a single cell, cannot be demonstrated from the embryology of the chick.

This animal has always been, and it still is, the bulwark of the doctrine of epigenesis, and this because the true developmental phenomena are often here obscure. The placodes of piscine development lead us in the direction of the large single cells or *teloblasts* of the earthworm, and the two things have significant bearings on the question of the mode of the development, whether by epigenesis, as Wolff and most other embryologists have thought, or by evolution with pre-determination, *not pre-formation*, as some embryologists are beginning to suspect.

What the beginner requires, we imagine, is not so much facts as principles, those underlying the development. Unless it be the formation of the germinal layers, and concerning the truth of the germ-layer theory sceptics are not wanting, it is difficult to say what embryological principle can be illustrated from the developmental pictures presented by this animal. Direct development *or* alternation of generations, epigenesis *or* evolution, somatic origin of germ-cells *or* germinal continuity from generation to generation, these and many other fundamental questions receive no certain replies from the study of the development of the chick, and no discussion in the pages of the book before us. What is a larva and what an embryo? are natural questions for a beginner to ask, but he will find no answer in the work before us. He will not even read that, as many embryologists think, the larva becomes the embryo; still less as, wonderful to say, happened recently in a well-known work, the embryo in its turn could become a larva. From the account of the rudimentary pronephros of the chick he will be able to form no conception of what a functional pronephros, such as that of the frog or newt, really is. In short, it may be doubted whether from a study of the development of the chick the beginner can hope to obtain any real insight into the facts and tendencies of modern embryology.

The book is clearly written, and evidently much labour has been expended upon its production, while

the illustrations are excellent. Lillie's "Development of the Chick" is, indeed, one of the handsomest books available for embryological study, and it will be indispensable in every laboratory, though we should not care to regard it as a text-book of embryology for the student in quest of the scientific principles underlying animal development. B.

MODERN EXPLOSIVES.

The Manufacture of Explosives. Twenty Years' Progress. Four Cantor Lectures delivered at the Royal Society of Arts in November and December, 1908, by Oscar Guttmann. Pp. viii+84. (London: Whittaker and Co., 1909.) Price 3*s*. net.

IT is now fourteen years since Prof. V. B. Lewes gave a series of Cantor lectures at the Royal Society of Arts on "Modern Explosives." The period which has elapsed has been so fruitful in research and manufacturing improvements that the series of lectures delivered by Mr. Guttmann, which form the subject of the present volume, is very welcome.

Mr. Guttmann's treatise on "The Manufacture of Modern Explosives" was published in 1895, and the present small volume is a useful addendum to the larger work. As is pointed out in the preface, it is impossible in so small a compass to give more than a general outline of the many improvements and researches during the past twenty years, but this outline is certainly valuable, especially as the author gives full references to all important patents and papers.

In spite of all advances, it is of interest to note that black powder was employed in mines and quarries to the extent of 7000 tons in 1907. In addition, nearly 3500 tons of "safety" explosives were also used. The world's annual production of celluloid is put at the enormous total of 24,000 tons, whilst artificial silk reached the astonishing total of 5000 tons.

Nitro-cotton in some form or other is, without doubt, the most important explosive compound at present made, not only because it forms the basis of all smokeless propellant explosives, but also of celluloid and artificial silk. No possible pains must be spared to ensure stability of the nitro-cotton, and the causes which may give rise to instability or promote further decomposition are well treated by the author, but many will differ from him as to the extent of deterioration arising from the preliminary treatment of the cotton and the effect of alkaline stabilisers. It will be admitted that nitro-cotton has its defects, but such statements as "picric acid is a treacherous substance," "a more inconvenient material still is nitro-cotton," "we have an almost uncontrollable substance in nitro-cotton," are open to criticism. Later the author himself says that the stability of nitro-cotton below 20° C. is assured.

So far as our Navy is concerned, exception must be taken to the statement that "it was and still is the practice in men-of-war to arrange the ammunition stores and powder magazines in close proximity to boilers and engines, frequently without any ventilation." This has never been our practice; there have been unavoidable instances where such an arrangement has been forced upon designers by other considerations, but in such cases the magazines have been thoroughly heat-insulated. Moreover, magazines have always been specially ventilated independently of the general ventilation of the ship. It is fully recognised by those responsible for the designs that the lower the temperature the better preserved will be the powder, and for that reason refrigerating machinery has been introduced, but the author's fear as to possible breakdown at a critical moment has not been left unprovided for by men who can evolve such an engine of destruction as a modern battleship.

One turns hopefully to the question, "What will be the powder of the future?" only to find that "the future belongs to a stable nitro-compound of the aromatic series." Possibly; but is there even remote promise of the production of any such body which will meet the varied requirements of a smokeless propellant as distinct from a simple explosive substance? J. S. S. B.

CHEMICAL ANALYSIS FOR STEEL-WORKS' LABORATORIES.

Rapid Methods for the Chemical Analysis of Special Steels, Steel-making Alloys, and Graphite. By C. M. Johnson. Pp. vi+221. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 12*s*. 6*d*. net.

THE author of this book gives a detailed account of his methods for the determination of chromium, vanadium, copper, titanium, nickel, molybdenum, and tungsten in steel and steel-making alloys, besides those for the ordinarily occurring elements, viz. carbon, silicon, sulphur, phosphorus, and manganese. No reference is made to tantalum and uranium.

Most of the methods described are to be found in the standard English works on the subject, but there are several new features which deserve to procure a place for the book in all steel-works' laboratories. Of these features, the exact determination of phosphorus in ferro-vanadium, and the application of potassium ferricyanide to the separation of small amounts of copper and nickel from large amounts of iron are specially worthy of note.

Many of the methods described, however, are by no means "rapid," and much unnecessary time is spent in fusions, washing precipitates, &c. The analysis of tungsten powder is very tedious, although the author supplements his methods by a well-known rapid method of English origin, erroneously stated by him to give low results. Again, the author fuses impure tungstic oxide residues with about four times the necessary amount of sodium carbonate and for at least four times longer than necessary, whilst two hours are required for lead molybdate to settle, whereas it may be safely filtered off immediately after its formation. Many other similar points might be cited which are of little importance beyond the fact that the author aims, as the title-page suggests, at rapidity of execution.

The determination of carbon is dealt with very well indeed, and it is shown that the most trustworthy method is that of burning the drillings mixed with red lead in a stream of oxygen. This direct combustion process has been in constant use in most of the Sheffield works' laboratories for several years. Red lead is at present, however, being largely discarded in favour of pure manganese dioxide, which is in nearly every case quite as effective, and more than doubles the life of a porcelain boat.

The concluding chapters of the book include one on the examination of graphite and graphite crucibles, and one on the annealing of steel. In the former, the existence of silicon carbide in used plumbago crucibles is considered, and an account given of the determination of its amount. The chapter on the annealing of steel, to which attention is specially directed in the preface, contains the extraordinary statement that "rapid cooling of perfectly annealed steel has no effect whatever on its hardness." The author considers steel to be perfectly annealed when it has been kept at 700–720° C. for from ten to twelve hours, and states that it may then be cooled slowly or quickly—in fact, it may be plunged whilst at this temperature into cold water—without becoming hard. This statement cannot be accepted.

The book is very well printed, is singularly free from typographical errors, and is provided with an excellent index.

The author may be interested, by the way, to learn that the use of silver iodide indicators in the cyanide titration of copper solutions was suggested twelve years ago in the *Chemical News*. F. I.

HYPNOSIS AND SUGGESTION.

Die Hypnose und die Suggestion, ihre Wesen, ihre Wirkungsweise und ihre Bedeutung und Stellung unter den Heilmitteln. By Dr. W. Hilger. Pp. 185. (Jena: Gustav Fischer, 1909.)

THIS is a most interesting, scientific and readable book. After a somewhat detailed historical introduction, the author demonstrates in a clearer way than we have hitherto read, that there is at least a very close resemblance between normal and hypnotic sleep; indeed, one is left with the impression that there is practically no difference between them. *Inter alia* it is pointed out that there is an element of subconscious thought even in normal sleep, and that this is only partial (Teilschlaf); and, among other examples, the oft-cited mother is instanced who sleeps soundly through the noise of traffic or a thunderstorm, but wakes at the feeblest cry of her new-born child.

In discussing the nature of suggestion, Dr. Hilger directs attention to what he calls mental (seelische) reflexes, such as the flow of saliva at the thought of food, contraction of the pupils on thinking of a bright light, erection of the nipples and flow of milk when a lactating mother thinks of suckling her child, and so on. He also points out that memory-images are stronger in normal sleep than during waking hours, just as they are in hypnotic sleep. Some methods of hypnosis are described, and it is rightly said that a feeling of goodwill between the patient and the physician is essential to successful hypnotism.

In a chapter on suggestion and will, the author insists on the importance of the movement-idea in the performance of a voluntary action and on the cooperation of expectancy of and practice in the particular action. Instinct, motive, and interest are in turn duly considered.

The next chapter is devoted to a discussion of the influence of the will, suggestion, and similar psychical factors on disorders of perception; and many interesting cases bearing on the subject are reported, of which the following is a typical example. A man was afflicted with a tickling in his throat shortly after kissing his sweetheart, and he became convinced that it was due to a hair in his throat. His doctor examined the throat and found nothing more than a slight pharyngitis, which was treated in the usual way. Before the next visit, when the patient was no better and still convinced of the presence of the foreign body, the medical man had provided himself with a hair, which he surreptitiously introduced into but ostentatiously withdrew from the throat. The tickling was instantaneously and permanently cured.

In the last chapter, dealing with reflex disorders and their treatment, the author first points out that attention to a stimulus strengthens the reflex which it excites, and he makes special reference to Haab's cortical pupillary reflex. Many examples are then given of the cure by hypnotism, &c., of such reflex disorders as sea-sickness, the vomiting of pregnancy, hiccough, nervous diarrhœa, nocturnal enuresis, morbid blushing, palpitation, hay fever, nervous cough, asthma, &c. It will be a surprise to most people that the periods of menstruation may be modified by suggestion.

The volume concludes with an account of some cases of chorea and other functional disorders of the nervous system successfully treated by hypnotism. There is a good index, and we can cordially recommend the work to those interested in the subject.

THE STRUCTURE OF THE SCALLOP.

Pecten. By W. J. Dakin. Being No. 17 of the Memoirs issued by the Liverpool Marine Biology Committee. Pp. viii+136; 9 plates. (London: Williams and Norgate, 1909.) Price 4*s.* 6*d.*

THE scallop, clam or queen as it is called in different parts of our coasts is an animal of considerable interest. To the pilgrims of the Middle Ages who sought the famous shrine of St. James of Compostella, the shell was both a badge and a bowl, and from this old association it has become incorporated in many coats of arms, as, for instance, in that of the city of Reading. More utilitarian is the interest associated with the scallop as an article of food, and in this respect the rare delicacy of its flavour should bring "queens" into greater favour than they now enjoy. To the more curious inquirer the scallop offers many attractive features, both in its structure and habits. The gem-like green eyes that sparkle under the fringe of tentacles have

long been known to present a peculiar and highly-organised structure. Pecten is perhaps the most highly coloured of all molluscous animals. The strength and activity of the movements by which it evades its chief enemy, the starfish, form a remarkable contrast to the lethargy of most bivalves. It is therefore with particular pleasure that we welcome a monograph on the large British species, *Pecten maximus*.

To the considerable body of existing facts on this animal which have been drawn upon by the author, he has added confirmatory and in some cases new evidence from his own dissections and observations. The result is an admirable piece of work, which will be of great assistance to all who wish to gain acquaintance with this especially interesting and accessible type of shellfish.

The structure of Pecten is so largely modified in association with its active life that Mr. Dakin has been well advised in giving an introductory sketch of its habits and of their change during life. When the free-swimming larva first settles down, the only mode of progression is that of crawling by means of the mobile foot. A little later, the "byssus" spins its threads and forms an anchorage by the help of the foot. In some species this mode of attachment is permanent, but in most it is rarely employed when adult life is reached. By that time, or even before, the mantle, and shell secreted by it, have assumed the peculiar form that enables both forward and backward leaping movements to be executed.

Among the specially good features of this work may be mentioned the biochemistry of the digestive gland and the account of the eye structure. Mr. Dakin has the advantage of knowing the structure of other lamellibranchs, and his book gains much from the comparative method. He has studied Pecten at different places, and knows the variation which it exhibits. As a result we have a most careful, workmanlike, and fully illustrated account. The author and publisher are to be congratulated on the appearance of this valuable addition to biological literature. The only disappointing section is that on development, our knowledge of which is very deficient. We hope the author will be able to add to it in a subsequent paper.

A STUDY OF THE AUSTRIAN SEA-BOARD.

The Shores of the Adriatic. The Austrian Side. By F. Hamilton Jackson. Pp. xv+420; with numerous woodcuts, photographs, plans, and maps. (London: John Murray, 1908.) Price 21*s*. net.

THOSE who have had the pleasure of reading Mr. Jackson's previous volume on the Italian Adriatic towns will be very pleased to find that the author has extended his researches to the "other shore, you know, upon the other side." The tour outlined in this volume commences at Aquileia, somewhat west of Trieste, and extends down to the Bocche di Cattaro, thus covering Istria and Dalmatia. Geographically speaking, the two shores of the Adriatic differ widely, the Italian side being an almost unbroken flat coast-line, while here a nearly continuous chain of islands extends from Pola down to Ragusa, and a number of arms of the sea furnish excellent harbours well shut in by mountains. The vegetation of the district is described as distinctly Mediterranean, while the only fault of the climate appears to be the prevalence of a cold north wind.

The people of these districts are of a very different race from the Italians over the water, and a fair account is given of their history, customs, proverbs, and superstitions. At the present time the Croat majority is abolishing the use of Italian in schools, and the author advises those who wish to acquire a knowledge of Dalmatia without learning Croat to do so before Italian is forgotten. In this attempt to perpetuate multiplicity of languages, the Dalmatians are very like the British, and we noticed another resemblance of a small kind in one or two of their superstitions.

The descriptions lead us to believe that the interest of the tour is not so exclusively confined to rummaging over old churches, as on the Italian side, but that the architectural features, as well as the relics in the treasuries of the churches, are none the less worthy of attention, and a study of the reciprocal influences of the two shores, and of the extent to which the architectural similarity is due to Eastern influence, forms a suitable concluding chapter.

The fact that the author met no English on his second tour would have been considered remarkable thirty years ago, when middle-class English formed the main bulk of European travellers. At the present time the absence of English visitors is equally noticeable, even in many of the best-known tourist and health resorts. It is now no longer necessary to go to Dalmatia to get away from one's compatriots; on the other hand, there is perhaps less inducement for those who travel to keep to the beaten tracks, and they may evidently have a very enjoyable tour in these Adriatic provinces.

The illustrations are partly from photographs, but mainly from line drawings, which well show up the beautiful carving and ornamentation in the churches. A number of plans are also given, and if the author had not obtained a special permit from the Austrian Government his artistic and photographic studies would probably have got him into great trouble. We commented on the absence of a map in the Italian volume. Here there is a map, and it is most useful.

OUR BOOK SHELF.

Les Planètes et leur Origine. By Ch. André. Pp. 285. (Paris: Gauthier-Villars, 1909.) Price 8 francs.

LIKE Gaul, M. André's book is divided into three parts. The first part is devoted to planets, the second to satellites, and the third to the formation of the planetary system

The book is well written and well illustrated. It deals very thoroughly with an important branch of astronomy. It will serve the purpose both of a popular treatise and of a book of reference.

The comparison of orbital motion with theory seems to have been beyond the plan of the author. In other respects it is hardly possible to notice the omission of any matter relevant to the title of the book.

The author decides in favour of a rotation period for both Mercury and Venus approximating to that of the earth. He gives an excellent *résumé* of Prof. Poynting's investigations of temperature. He obtains for Mercury 193° C., for Venus 66° C., and for the earth, by the same method, 16° C. This last result inspires some confidence in the two former. M. André decides against the canals of Mars. It is one of the many evidences of the up-to-date character of the book that reference is made to the experiments by Mr. Maunder and Mr. Evans on this question with the help of the boys of the Royal Hospital School at Greenwich.

The chapter on minor planets is excellent. M. Mascart has, however, recently covered the same ground. The present volume contains a reference to 1906 TG. The chapters on Uranus and Neptune consist for the most part of what is now ancient history. The author considers that planets inside Mercury or outside Neptune would have been already discovered if they existed.

In the second part the author gives a historical account of various announcements of a satellite of Venus. His chapter on the satellites of Mars, and the first half of the following chapter, is necessarily somewhat hackneyed. The latter chapter concludes with Mr. Melotte's discovery of Jupiter's eighth satellite and Mr. Crommelin's announcement that the orbit was retrograde (*fait absolument inattendu*). Mr. Crommelin's original period of three years and a half, based on the supposition of a circular orbit, enables one to date the writing of this paragraph to within a month or two.

The interest of the next chapter centres on Phœbe and the still unconfirmed tenth satellite. The last chapter of the second part refers to the masses of the planets and their satellites.

The third part, on the formation of the planetary system, describes Laplace's nebular hypothesis and its subsequent extensions and modifications by Roche, Darwin, Faye, and Stratton. On p. 239, in four short paragraphs, we have a statement of the case against Laplace's hypothesis. In these paragraphs the retrograde motion of Jupiter's eighth satellite is again mentioned.

The Care of Natural Monuments, with Special Reference to Great Britain and Germany. By Prof. H. Conwentz. Pp. xi+185; illustrated. (Cambridge: University Press, 1909.) Price 2*s.* 6*d.* net.

THE title of this little work scarcely gives a sufficient clue to the nature of its contents, as there are comparatively few persons who would regard wild mammals or wild birds as "natural monuments." As he tells us in the introduction, the author has himself felt this difficulty, but has nevertheless used the term as a translation of the German "Naturdenkmal"; though we fear this rendering may result in checking the sale of an excellent and praiseworthy volume. Prof. Conwentz writes as one having authority, since he is the Prussian Government commissioner for the care of natural monuments. On this subject he delivered an address at the Leicester meeting of the British Association in 1907; and it is that lecture which forms the groundwork of the book now before us. The book is divided into two sections—"Nature Threatened" and "Nature Protected"—the former particularising the various natural objects and types of scenery which require protection, and the latter what has been and is being done in this direction in different countries, but more especially in the United Kingdom and Germany. On the whole, the author appears to consider that we are doing our duty as regards the protection of the indigenous fauna fairly well, and bestows unstinted commendation on the action of local authorities in establishing reservations in various parts of the country. He is, however, of opinion that more attention might be devoted to securing small areas as reserves of this nature; and as regards other "natural monuments" suggests that private landowners might be induced to do more in the way of conservation than is at present the case. It is also suggested that the central committee for the study and survey of British vegetation might include in its programme the protection of characteristic associations of plants, as well as of single rare species. By directing attention to what has been done and what remains to be done, the appearance of the volume will doubtless serve to awaken renewed interest in the subject. R. L.

The Mineral Kingdom. By Prof. R. Brauns. Translated, with additions, by L. J. Spencer. With 91 plates (73 of which are coloured). (Stuttgart: Fritz Lehmann; London: Williams and Norgate, 1908.) Parts i. to v., price 2*s.* net each.

WHILE popular introductions to botany and zoology are numerous and find a ready sale, little has been done to familiarise the general public with the appearance and characters of the commoner minerals. The chief obstacle has been found in the difficulty of depicting the colour and lustre of minerals so accurately that they may be recognised without the employment of the ordinary methods of determination.

To judge by the five parts which have already appeared an unusually successful attempt has been made in the present work to solve the problem of the representation of minerals by colour printing. The reproductions of topaz, tourmaline, and phosgenite are excellent, and even minerals with metallic lustre are in most cases very effectively rendered. The plates measure 9¼ inches by 6½ inches, and, as a rule, contain numerous coloured figures.

The book can be recommended to all who wish to take up the study of mineralogy, and have not the opportunity of referring to a collection containing as many examples as those illustrated in these plates.

The text is clear and readable, and comprises a simple introduction to the principles and methods of the science, as well as a detailed account of the different mineral species. J. W. E.

Man in the Light of Evolution. By Dr. J. M. Tyler. Pp. xiv+231. (London: Appleton and Co., 1909.) Price 6*s.* net.

THIS is the sort of book about which there is no need to say anything harsh. It is calculated to produce a vague edification in the mind of the unscientific reader. Prof. Tyler's attitude towards disputed problems of evolutionary science is so conciliatory and non-committal that one fails, for instance, to discover what view he holds about the inheritance of acquired characteristics, or whether he has any view of his own. He alludes in a distant way, but always politely, to Mr. Darwin, Mr. Haeckel, and so on. (But why is poor Mr. A. J. Balfour "Balfour"?) So far as he has any point to make, it would seem to be this, that the springs of progress lie not so much in the environment as in our own "higher powers," and that these "higher powers" consist especially in our moral and religious tendencies. All this may be quite true; but it cannot be said that our author helps in the slightest degree towards a clear understanding either of what those are or of how they have come about. A perfectly worthless bibliography is appended, in which the name of J. M. Tyler appears more than once, but that of E. B. Tylor not at all.

An Explanation of the Adjustment of Ships' Compasses. By Commander L. W. P. Chetwynd, R.N. Pp. 24. (London: J. D. Potter, 1909.) Price 2*s*.

THIS useful little book, the sections of which are accompanied by diagrams, is an endeavour on the part of the author to convey to the reader in as concise a manner as possible the various causes of deviation, and the methods of overcoming them, without the use of mathematical formulæ.

In most treatises dealing with this subject it is, unfortunately, the case that they are too theoretical and contain too many symbols to suit the average seaman; therefore great praise is due to Commander Chetwynd for the able manner in which he has brought out a practical book for practical people. H. C. L.

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.*]

An Inquiry concerning Scientific and Medical Journals.

CAN any of your readers kindly inform me where copies of the following journals can be found in England, if possible in London?

(*a*) *Lo Spallanzani.* This is a journal of the medical and natural sciences published at Modena in the 'seventies and 'eighties.

(*b*) *Mittheilungen d. Wiener embryol. Institut.* Published in the 'eighties, and perhaps still.

(*c*) *Gazette médicale d'Algérie.* Published at Algiers in the 'fifties.

(*d*) *Ann. Soc. méd. d'Émulation de la Flandre occid.* Roulers, 1849. There are other references to a *Soc. méd. d'Émulation*, without place or name. I should be very glad to have these *Soc. méd. d'Émulation* cleared up, as there must, I think, have been several such societies.

(*e*) *Baltimore Sun*, 1876. The stock of this journal was burnt. Is there a file of it anywhere in England?

(*f*) *Archiv de méd. nav.* Published at Paris in the 'seventies.

(*g*) *Archiv f. Psych. u. Nervenkrankheiten*, for the 'eighties.

(*h*) *Sociedad medica Argentina*, 1901.

(*i*) *International Med. Magazine.* Philadelphia, 1892.

(*j*) *Zeitschrift f. Tiermedicin*; 1897. (Sought at Royal Veterinary College.)

(*k*) *Soc. med. Württemberg*, 1905.

These have been sought for at the likely places, but it is possible that they exist and have been overlooked. It is a pity that some of the larger libraries in London duplicate certain of the *rarer* scientific and medical journals, whereas by a division of material they might provide a more comprehensive collection. Further, there ought to be at least one library in London with a complete set of university dissertations and degree theses. No library at present appears to make a speciality of such material. I have always found German university librarians most willing to lend copies, but the delay is vexatious, and a cursory examination of five minutes' duration would often have settled the point required. KARL PEARSON.

Biometric Laboratory, University College, London.

Radio-activity in Relation to Morozoff's Theory of the Constitution of Atoms.

THE fact that the α particles of radium, as shown lately by Prof. Rutherford and Geiger,[1] carry two elementary charges of positive electricity, $2\times4{\cdot}65\times10^{-10}$ E.S.U. per atom of helium, appears quite unexpected, and requires consideration. Since the atom of helium carries more than a single charge, which would present the simplest and most natural contingency, there arises the question, Why does it carry just two charges and not one or more? an answer to which has been proposed by N. L. Müller in the "Jahrbuch der Radioaktivität" (v., 702, 1908), but it seems to me that the following explanation, based upon the Morozoff theory of the constitution of atoms,[1] will not be devoid of interest.

According to Morozoff, all the chemical elements are formed by manifold combinations of three primordial elements, viz. archonium (nebulium) (Z), with a combining weight 4; protohelium (*x*), with a combining weight 2; and protohydrogen (*h*), with a combining weight 1. Of these, protohelium, as shown by the value of its combining weight, presents half an atom of ordinary helium, the re-combination of two of which yields again a helium atom.

Archonium (Z), with its eight affinities, plays the part of carbon in organic compounds, the archonium elements, more or less saturated with protohelium (*x*) and protohydrogen (*h*), building the main atomic chain. The chains of various chemical elements are built of one to eleven such links, which, combined after certain rules, allow us to reconstitute the whole periodic system of elements.

As in the notation of organic chemistry, the atom of radium is represented in Morozoff's system by the following symbol:—

$$x-\mathrm{Z}(x_2h)-[\mathrm{Z}(xh)_6]_9-(x_2h)\mathrm{Z}-x.$$

Radio-activity is due to closing of the chain, accompanied by splitting off of two helium half-atoms (*x*),

$$\mathrm{Z}(x_2h)-[\mathrm{Z}(xh)_6]_9-(x_2h)\mathrm{Z}+2x.$$

which yield the material carriers of electricity of the α particles.

Since both extreme helium half-atoms (*x*) are expelled under similar conditions, and since they carry electricity, each of them cannot carry less than one elementary charge of $4{\cdot}65\times10^{-10}$ E.S.U., hence a whole atom of helium must carry at least two elementary electric charges, or $9{\cdot}3\times10^{-10}$ E.S.U.

As not only radium, but also thorium and uranium, are represented by similar symbols, and their radio-activity is always accompanied by the expulsion of two helium half-atoms, it is evident that in all known radio-active changes an atom of expelled helium must carry at least two elementary charges. If we call, further, as has been done by Maxwell, an elementary charge an atom of electricity, we can consider the combination of two of them as a molecule of electricity, and state the following general law:—in all radio-active changes the smallest quantity of electricity associated with an atom of matter is not an atom ($4{\cdot}65\times10^{-10}$), but a molecule of electricity ($9{\cdot}3\times10^{-10}$). B. DE SZYSZKOWSKI.

Kieff, Zolotoworotska 6, Russia, April 16.

[1] Proc. Roy. Soc., lxxxi., 162 (1908), and *Physikalische Zeitschrift*, x., 42 (1909). Also NATURE, November 5, 1908.

The Gravitative Strain upon the Moon.

IN his discourse on "The Æther of Space" at the Royal Institution, February 21, 1908 (abstracted in NATURE, vol. lxxix., p. 323), Sir Oliver J. Lodge states that "the force with which the moon is held in its orbit would be great enough to tear asunder a steel rod four hundred miles thick, with a tenacity of thirty tons per square inch," and he further states that Maxwell calculated the gravitational stress near the earth to be 3000 times that which the strongest steel could stand, and near the sun it should be 2500 times as strong as that.

For convenience we may call the diameters of the earth and of the moon 8000 and 2160 miles respectively, and the moon's distance from the earth 240,000 miles. At the surface of the earth the moon would fall 16·1 feet, or 1/328 mile, in one second. The velocity necessary to counteract this fall is, therefore, equal to $\sqrt{8000\times1/328}$, or about five miles per second, at which velocity the centrifugal force of the moon, revolving at a distance of

[1] *Physical Review* (Russian), ix., 73, 121 (1908).

4000 miles from the earth's centre, would just balance the earth's attraction of gravity. So that, if this attraction were absent, and the two bodies were connected by a rod, or material bond, instead, there would be continual strain on such bond equal to the moon's weight at the earth's surface.

Now, the volume of the earth is $8000^3 \times 0.5236$ cubic miles, or about 4×10^{22} cubic feet, which, multiplied by $5\frac{1}{2}$ and $62\frac{1}{2}$, gives 1375×10^{22} lb., or 6875×10^{18} tons (the value given by Cavendish's experiment is 6.14×10^{21} tons, the difference being due to the larger value of the earth's diameter here used), the moon's weight at the earth's surface being, therefore, $6875 \div 80$, or 86×10^{18} tons, which would be the strain on the material bond connecting the two bodies as above in the absence of gravity. As this strain varies directly as the mass of the revolving body and the square of its velocity, and inversely as its distance or radius of revolution, then at the moon's actual distance of 240,000 miles, and velocity of 0.64 mile per second, the strain would be diminished by the factors $4000/240000 \times (0.64/5)^2$ or $1/3600$; that is, to $86 \times 10^{18}/3600$, or 24×10^{15} tons. Thus if some Titan should, like a stone in a sling, whirl the moon at its present velocity and distance around his finger, the strain upon the string would be 24×10^{15} tons, which, if the string be of the same thickness as the moon itself, gives about 1.6 tons per square inch, necessitating a steel rod about 400 miles in thickness of thirty tons per square inch tenacity, just as Sir O. Lodge states.

But have we not neglected a very important factor in this computation? As the moon moved away from the earth's surface to its present distance, we allowed for its change of velocity and distance as affecting its centrifugal force; but should we not also allow for the diminution of gravity at the increased distance? The tension of the stone in the sling upon its restraining cord would be less at the greater distance owing to the decreased velocity and to the effect of the increased distance upon the centrifugal force; but as the stone moved outwards it would also come into a weaker field of gravitative force, which would further reduce the strain inversely as the square of the distance (just as if its mass had been diminished), or by the factor $1/3600$, thus reducing the total strain of 24×10^{15} tons obtained above for the moon at its present distance and velocity to $24 \times 10^{15}/3600$, or $6\frac{2}{3} \times 10^{12}$ tons for its actual present value, requiring a steel rod only about $6\frac{1}{2}$ miles thick and of the same tenacity as before.

EVAN MCLENNAN.

Corvallis, Oregon, U.S.A.

The Inheritance of Acquired Character.

I HAVE received the following from my brother, Dr. A. W. Smyth, late superintendent of the United States Mint at New Orleans. He has experimented with bees and written papers on them, which have been published in several bee-journals throughout the world.

He says, The commonly accepted view, stated by Dr. Francis Darwin in his presidential address, that the queen bee is entirely isolated, so as to bar the ordinary course of inheritance, is not so. According to Dr. Smyth, some of the workers occasionally lay eggs, and these eggs always produce drones, which, coming to fertilise the queen, opens the path for the ordinary course of inheritance. Upon this principle he bases an explanation of the following facts. In Morocco the honey-bee has foes in the form of certain beetles. To guard their stores the bees have come to build pillars of wax at the entrance to the hive, which prevents the entrance of the beetle. This becomes a habit, and a habit that could only have arisen as an acquired character, and it could only have reached workers through the queen being fertilised by drone-offspring of the workers. When a Morocco queen is brought to this country, where these beetles do not exist, the progeny of the queen continue to build pillars of wax; in the course of time this acquired habit becomes attenuated. WM. WOODS SMYTH.

Maidstone, April 17.

THE IMPERIAL SIDE OF THE FUEL QUESTION.

THE returns issued by the Board of Trade on February 24, dealing with the output of coal in the United Kingdom during 1907, should go far to convince the most callous that our fuel supply is at the present moment every whit as important an Imperial question as keeping up our first line of defence to the two-Power standard or forming an efficient citizen army, and that unless due prominence and consideration is given to it, it is impossible for our Navy and Army, no matter how good, to save the nation for more than a limited period.

Our kingdom has but two capital assets, labour and coal, and without the latter labour would count for but little in face of competition with nations possessing the means of economic power production; so that the real measure of England's power and prosperity is to be found in her store of unwon coal and her ability to husband the resources with which nature has endowed her in order that she shall retain the same relative position towards other nations that she does at present.

Not only has America the largest store of coal in the world, but until lately the amount that has been mined has been comparatively small, and out of all proportion to the magnitude of her coalfields. The close of the last century, however, saw her an easy first as regards the output of coal, and she now raises at least a third more than the United Kingdom.

It is, however, with the position of nations nearer home in respect to this question that we are at the present time more deeply interested, and in order to gain an idea of the relative life of their fuel supplies as compared with our own, it is necessary to contrast their rate of output with the available quantities of coal still unused.

The Royal Commission on Coal Supplies, which sat from 1901 to 1905, collected all the evidence possible as to the amount of coal still existing in this country, which at the rate of output then obtaining would last something like six hundred years, but they also gave warning that "vast as are the available resources, it must be borne in mind that a large percentage of them are of inferior quality, or are contained in deeper and thinner seams which cannot be worked at the present cost"; whilst the rate of consumption is increasing so rapidly that the output of 236,000,000 tons of coal in 1905 had risen in 1907 to 267,831,000 tons.

Such factors as these mean an inevitable and increasing rise in the price of coal, and it must be clear that it will be the time when coal has risen to such a price as seriously to hamper our power of competing with other European countries that will govern the period of our commercial supremacy, and not the date of the complete exhaustion of our coalfields.

Taking such figures as are available for the coal resources of the more important coal-producing European countries and the returns of the coal raised in 1905 and 1907, we may tabulate them as follows:—

	Total existing coal, in millions of tons	Coal raised	
		1905	1907
United Kingdom ...	140,000	236,130,000	267,831,000
Germany	150,000	119,349,000	140,835,000
France	17,000	34,780,000	35,586,000
Belgium	16,000	21,500,000	23,324,000

So that for all practical purposes the quantity of coal still existing in Germany may be taken as being the same as ours, the extra 10,000 million tons which that nation possesses being made up for by the superior quality of our steam and gas coals.

When, however, we turn to the output we find that we are raising nearly double the quantity that is being brought to the surface in Germany, so that if the ratio between the two outputs remains fairly steady, it must follow that Germany will still be a flourishing and powerful nation at the time when the depletion of our coal supply has reduced us to the position of a second-rate Power.

In searching for the cause of the enormous demand for coal in this country as compared with Germany, where the climate is far colder, we find that our coal production amounts to 6 tons per head of population, as against 3½ tons in Belgium, 2¼ tons in Germany, and less than 1 ton in France, where wood is the chief fuel for domestic use; and it is clear that there must be something more than commercial activity to account for our consumption per head being more than double that of Germany.

The Royal Commission on Coal Supplies compiled statistics as to the proportion of the coal raised that was utilised for various purposes, which may be represented in percentages as follows:—

	Per cent.
Factories	22·97
Domestic	13·87
Iron and steel manufacture	12·17
Mines	7·80
Gas works	6·50
Railways	5·53
Potteries, brick works, glass works and chemical works	2·16
Metals and minerals	0·43
Coasting steamers	0·87
Steamers over seas	7·25
Exported	20·35

The first thing that strikes one is the high proportion of coal exported from this country, and further inquiry shows that this drain upon our coal supply is rapidly increasing, having more than doubled in the last thirty years, whilst the actual quantities exported in the last three years of which we have record were as follows:—

	Total quantity of coal exported from the United Kingdom
1905	47,477,000
1906	55,600,000
1907	63,601,000

Of this more than 14,000,000 tons went to Germany, an amount twice as large as was exported five years ago.

An instance of the amount of coal exported can be cited in the case of one colliery alone, the annual output of which is not less than a million tons per annum, but of this quantity not a single ton is retained in England, the whole amount being exported, and at a price at which it is able to compete with German coal even as far up the Rhine as Mayence. We must bear in mind, however, that of the 20 per cent. of exported coal a good deal is used for foreign coaling stations, and is there loaded into British ships, but this does not detract from the fact that steps should certainly be taken to prevent the depletion of our coal supplies for the benefit of our trade rivals.

As before stated, the estimated life of our coal supply is six hundred years, but at the rate at which it is being consumed it will not last, from a commercial aspect, for anything like this period, so that it is necessary for us to find out some means whereby economy in use can be secured. Isolated cases of fuel economy would have no effect on the consumption, but in the interests, not only of the country, but of each individual unit in our Empire, it behoves everyone to do his best to attain this result. It is possible, by slight alterations in the method of fuel consumption, to obtain the same manufacturing results as by the present system, with the added advantages of greatly reduced cost and reduction in the fouling of the atmosphere, a consummation which would soon tend to the benefit of the health and wealth of the community.

In England, conservatism to old ideas and methods has to a large extent checked the march of progress, but this does not obtain in other countries. In America and Germany, for instance, as soon as an improved method of working shows economy in manufacturing costs, the old machinery is regarded as obsolete and is ruthlessly scrapped; and although in certain directions we have begun to realise the logic of this practice, yet the majority of commercial firms are still pursuing the wasteful methods of their forefathers in the production of power and the generation of heat.

The Editor of NATURE having kindly afforded me an opportunity of perusing the foregoing article in proof, it appears to me worth while to add the following note:—

It is a popular superstition that some new source of energy will be discovered before our coal supplies become scanty. The recent "marvels of science" have been so striking that the average semi-scientific or unscientific man, if directly asked, will almost confidently reply that "electricity," or something else, will replace coal. Now, there are possible sources of energy other than coal:—(*a*) Water-power, derived from rivers and reservoirs. These are few in Great Britain, and of no great potentiality. If they were all utilised, little would be added to our store of energy. (*b*) Water-power, derived from the tides. While such power might be utilised in a few favoured spots, it is certain that any machinery erected on our coast would be liable to destruction at any moment. When we consider that heavy breakwaters are every now and then demolished by storms, it is vain to expect that machinery to utilise the energy of the tides would escape. Moreover, the capital cost of such machinery (apart from the heavy depreciation charges) would preclude its use as an economical source of energy. (*c*) Wind-power, used for driving wind-mills, is a possible source of energy. It has been shown here, too, that the cost of installation and repair is so great as to make it an uneconomical source. (*d*) It is certainly possible to bore a shaft eight or ten miles in depth, and so tap the internal heat of the earth. Apart from questions of the slow flow of heat into such a shaft, the cost is prohibitive; and the time required to drive the shaft enormous. (*e*) Lastly, a catalytic agent might be discovered to accelerate the loss of energy by certain forms of matter. But we do not know for certain that common forms of matter are losing energy; we have, on the contrary, every reason to believe that any change would be endo-, not exothermic. Substances of the nature of radium are few in number, and small in quantity. It would be fair to state that it is in the highest degree improbable that any important supply of energy whatever is to be derived from such sources. (*f*) Heat engines, driven by solar heat, however possible in warmer climates, are for us impracticable.

For these reasons, as well as for those given by the author of the above article, the conservation of our coal-supply is of the very highest importance to the nation, and indeed to the human race.

W. RAMSAY.

PLANT-LIFE IN KRAKATAU AND THE MEXICAN DESERT.[1]

ENGLISH readers owe a debt of gratitude to Prof. Seward and the Cambridge Press for an English edition of Prof. Ernst's account of the re-colonisation of Krakatau. It is five-and-twenty years since Krakatau and the neighbouring islands in the Sunda Strait between Java and Sumatra were transformed by the most violent volcanic outburst of historic times from forest-covered islands to deserts of pumice and volcanic ash. Long regarded as an extinct volcano, Krakatau, in the early summer of 1883, resumed activity, and towards the end of August the eruption culminated in an outbreak the effects of which were felt over almost the whole of the earth's surface. For a distance of twenty-two miles neighbouring land was covered with glowing stones and hot ashes, and it is estimated that the finer dust was spread over an area of some 234,000 square miles. As a result of this enormous loss of material, a large portion of the island fell in, and the Krakatau of to-day is less than half the size of the island of 1883, and has a quite different outline.

The islands therefore afforded an unprecedented opportunity for studying the development *ab initio* of the organic population of an oceanic island which rose several thousand feet above sea-level. The nearest land, the islands of Sebesi and Seboekoe, themselves half destroyed by the effects of the eruption, is twelve to fifteen and a half miles distant; the nearest points of Sumatra and Java are twenty-two to twenty-eight miles distant. Krakatau, the largest of the three islands affected, consists of the peak Rakata, 2700 feet high, which, on the north side, towards the disappeared portion of the island, forms an almost vertical wall, but on the south-east slopes steeply to a flat base in front of which is a small, level beach. In 1886, when Dr. Treub visited the island, its repopulation had already begun. Blue-green algæ, without doubt wind-borne, had formed a gelatinous layer on pumice and volcanic ash, and on the exposed rocks in the ravines on the mountain slopes; these formed a suitable nidus for the germination of wind-borne spores of mosses and ferns, as well as of seeds. Ferns preponderated at this early stage, being represented by eleven widely spread Indo-Malayan species; in the drift-zone of the beach were seedlings of nine phanerogams which had grown from sea-borne fruits or seeds; two of these were found in the interior and on the mountain slopes, with the addition of four species of Compositæ and two grasses, the fruits of which had obviously been brought by air-currents. Thus it was seen that the colonisation of an isolated high volcanic island does not proceed on the same lines as those of a coral island, where the elements of the strand-flora, brought by sea, are of the first importance. Here the wind-borne element played the principal part, and the flora of the interior had developed independently of the strand-flora, and with much greater rapidity.

It is to be regretted that more than ten years elapsed before the second exploration of the new Krakatau in March 1897. The number of species was then much increased, and amounted to fifty-three seed-plants and twelve vascular cryptogams; the ground was, in some cases, completely covered, and characteristic plant associations were forming; thus the *Ipomoea Pes-caprae* formation was a dominant feature on the beach. Further inland the vegetation constituted a kind of grass-steppe, the grass occasionally reaching a man's height and sometimes forming a thick jungle. On the hills and ridges were lower grasses with numerous ferns and a few seed-plants; ferns still predominated largely on the rock surfaces. Shrubs were few and trees rare. Of the fifty-three seed-plants it was estimated that thirty-two had come by sea, seventeen had been introduced by wind agency, and four by fruit-eating animals or by man. The results of a third expedition, in 1905, have not been published. In April 1906, was planned the short expedition of which the present is an account.

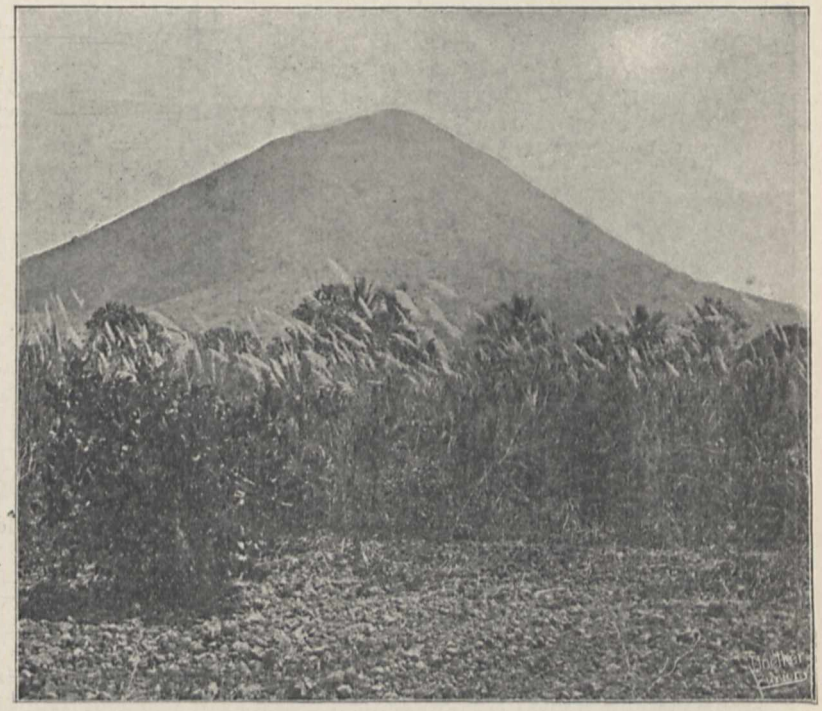

FIG. 1.—Clearing in the Strand-forest. To the left in the foreground *Scaevola Koenigii*; behind the grasses (*Saccharum spontaneum*) a group of coco-nut palms. South-east coast of Krakatau. From "The New Flora of the Volcanic Island of Krakatau."

The progress made by the vegetation since 1897 was remarkable; almost the whole south side of the island was seen to be covered with green. In the drift-zone on the beach was a great variety of fruit and seeds of land-plants, some quite fresh, some already germinated and rooted to the ground. They represent the widely distributed strand-plants which are the first colonists of recently formed coral reefs and islands, and owe their buoyancy to air spaces or light tissue in pericarp or seed-coat. Within the

[1] "The New Flora of the Volcanic Island of Krakatau." By Prof. A. Ernst. Translated by Prof. A. C. Seward, F.R.S. Pp. vi+74; with two sketch-maps and 13 photographs. (Cambridge: University Press, 1908.) Price 4s. net.

"Camp-fires on Desert and Lava." By W. T. Hornaday. Pp. xx+366; with 72 illustrations (8 in colour) and 2 maps. (London: T. Werner Laurie, n.d.) Price 16s. net.

drift-zone was the low growth of the familiar *Pes-caprae* formation—long, trailing, rooting shoots of *Ipomoea Pes-caprae*, with runners of Spinifex forming a network with which was associated some low-growing leguminous species, and here and there tall grasses, sedges, and other familiar strand-plants. Beyond this a young strand-forest of trees and shrubs recalled the similar formation on the Javan coast. Most conspicuous were tall Casuarinas (*C. equisetifolia*), 40 feet to 50 feet high, while slender climbing plants, such as Cassytha, Canavalia, *Vitis trifolia*, and others formed an almost continuous mass of foliage. Among the trees, *Calophyllum Inophyllum*, *Terminalia Catappa*, and the beautiful white-flowered *Barringtonia speciosa*, which has given a name to this type of strand-forest vegetation, were conspicuous. Coco-nut palms, clumps of screw-pine (Pandanus), and large-leaved figs were also seen. Beyond the strand-forest a monotonous steppe-like vegetation of tall grasses and reeds, sometimes associated with climbing plants to form dense jungle, extended into the ravines and on to the steep sides far up on the cone. A deep ravine, rich in trees and shrubs, extending half-way up the slopes of Rakata, promised a rich botanical harvest, but, unfortunately, the party was unable to make a way through the thicket with the equipment and time at its disposal, and much of the flora remains, therefore, still unexplored. Nevertheless, the results bring the total number of species collected up to 137; the ferns have not materially increased in number, but the seed-plants have risen to ninety-two species. Of the strand-flora, two-thirds are species which are cosmopolitan on tropical coasts, and the plants of the interior are also cosmopolitan, or represent the commonest species which are widely spread over the old-world tropics. Nitrogen-fixing bacteria were found in abundance in the soil. As regards the means by which the islands have been colonised, it is estimated that of the seed-plants 39 per cent. to 72 per cent. have been brought by sea-currents, 10 per cent. to 19 per cent. by birds, and 16 per cent. to 30 per cent. by air-currents; air-currents are also responsible for the presence of the ferns and lower cryptogams.

FIG. 2.—The Finest Organ-pipe Cactus. From "Camp Fires on Desert and Lava." Photograph by the author.

In "Camp-fires on Desert and Lava" the author gives a graphic account of the vegetation and animal life of the desert country in the extreme south-west of Arizona and the Mexican borderland. The book is a diary of a trip led by Dr. D. T. MacDougal, director of the recently formed Desert Botanical Laboratory at Tucson, Arizona. The ostensible object of the trip was the exploration of the unknown country round about Pinacate Peak, which lies between the international boundary and the Gulf of California. Mr. Godfrey Sykes, geographer to the expedition, supplies two new maps which show the route of the expedition and add considerably to geographical knowledge of the Pinacate district. But it is the naturalist and, above all, the botanist, who will find most of interest in the book.

Mr. Hornaday poses as Dr. MacDougal's pupil, but he has a keen eye for the plants, and has given as graphic an account as we have seen of the remarkable adaptations of plant-life to the almost waterless conditions of the sand-deserts or lava-strewn plains and mountains. The numerous excellent photographic illustrations are a great help towards realising the general ecological conditions of the district, as well as the habit of the components of its flora. The various Cacti, such as the giant cactus, or Saguaro (*Cereus giganteus*), the organ-pipe cactus (*Cereus Thurberi*) (Fig. 2), the Choya (Opuntia sp.), and the barrel cactus (Echinocactus), the Ocatilla (*Fouquiera splendens*)—"next to the giant cactus the most monumental and picturesque thing of plant growth found in two hundred miles of fertile deserts," when in full leaf resembling a bouquet of green wands held at the bottom by an invisible hand—the mesquite tree (*Prosopis velutina*)—the most persistent bush-tree of the deserts, the leaves and beans of which are eaten by horses and cattle when grass is not obtainable, while its wood is the general stand-by for fuel

and almost the only available for house-building in the deserts of the south-west—and the *palo verde* (*Parkinsonia microphylla*), which, according to soil and water supply, varies from 3 feet to 15 feet in height—these and the many other characteristic xerophytes become very real to us from Mr. Hornaday's quite non-technical descriptions and the photographs taken by one or other of the party.

The author is also a sportsman, and the text has many interludes which will interest the sportsman rather than the botanist; and it would be unfair not to mention the numerous observations on animal-life, especially the valuable chapter on the mountain sheep of Mexico and the range of the species. A. B. R.

THE MOUNTAINS OF THE MOON.[1]

EASTERN equatorial Africa has three mountain groups capped by perpetual snow—Kilimanjaro, Kenya, and Ruwenzori. Though the last is the lowest, and was the most recently discovered, it has aroused the widest popular interest; for its discoverer, Stanley, with characteristic insight, recognised it as "the Mountain of the Moon," the snows of which, according to the well-known passage in Ptolemy's "Geography," nourished the sources of the Nile. Ptolemy's general account of the Nile lakes is sufficiently accurate to show that he wrote from positive information. Otherwise, as Signor De Filippi remarks, he must have been gifted with prophetic insight. The statement about the Mountain of the Moon and its snows is, however, probably only an Arab interpolation; that view, so plausibly advanced by Cooley in 1854, is accepted as probable by Dr. Luigi Hugues in an appendix to this volume. Stanley's identification of Ruwenzori with Ptolemy's Mountain of the Moon has been, of course, called in question, but the alternative theories are as emphatically rejected in this work as in most of its predecessors.

Since the discovery of Ruwenzori by Stanley, the mountain has been repeatedly visited and partially explored. Stühlmann passed along its western side and took some fine photographs of the snow-capped peaks. Scott Elliot entered the range, saw some of its glaciers, and discovered that they were formerly more extensive. His observations and collections showed that instead of Ruwenzori having been volcanic, as had been suggested from analogy with Kilimanjaro and Kenya, it is a tilted block of Archean rocks left upstanding between the Victoria Nyanza basin and the rift valley of the Semliki. The later expeditions that visited the mountain found it usually shrouded in the clouds that had hidden it from Stanley's predecessor, Baker. The peaks could seldom be seen, but gallant attempts were made to reach them, as is duly recorded in Cav. De Filippi's narrative. Most of the expeditions added materially to our knowledge, and the repeated failures to achieve complete success tempted the Duke of the Abruzzi to undertake the exploration of Ruwenzori. He organised an expedition on a royal scale, judiciously selected the most favourable time of year, and the easy route by the Uganda Railway and steamer across the Victoria Nyanza. He left Entebbe, the capital of Uganda, on May 14, 1906, at the head of a caravan of 400 men, including a distinguished scientific staff, a company of Swiss guides and porters, and the great mountain photographer, Sella. Aided by the British officials, to whom warm thanks are expressed in the book, the Duke of the Abruzzi soon reached the eastern foot of the mountains, and established a light camp near the head of the valley, up which most of his predecessors had climbed to the Alpine regions of Ruwenzori. The expedition had been carefully equipped, and its resources were handled with the Duke's usual energy and courage. He overcame all obstacles, climbed all five of the ice-capped mountains, and most of the chief peaks; and his expedition returned with a series of mountain photographs unrivalled in African literature, a geological map of the main part of Ruwenzori, and detailed information as to its geography.

Mount Speke seen from the Senecio Forest at the foot of Scott Elliot's Col. From "Ruwenzori.

[1] "Ruwenzori: an Account of the Expedition of H.R.H. Prince Luigi Amedeo of Savoy, Duke of the Abruzzi." By F. de Filippi. Pp. xvi+408; illustrations, plates, 5 maps. With a preface by H.R.H. the Duke of the Abruzzi. (London: A. Constable and Co., Ltd., 1908.) Price 31*s.* 6*d.* net.

The history of the expedition has been compiled by Cav. De Filippi, and it is clear from his narrative that the expedition required great personal strength, courage, and endurance. The Prince and his two guides were badly smitten with snow blindness after the ascent of Mount Stanley, for they had to work all day in a glaring white fog, which was too dense to allow the use of goggles. The author mentions (p. 243) that the Prince spent seventeen days above the height of 13,000 feet, with a very light equipment, sleeping with the two guides in a Whymper tent, without a camp bed, and with clothes nearly always soaked with rain and snow. The climbing was in places very difficult, and the dangers were increased by the prevailing mists and bad weather. Some of the ascents taxed the skill of such expert climbers as the Prince and his two guides; but others were easy; thus the highest point of Mount Speke, 16,080 feet, though snow covered, did not require the use of the rope.

Commander Cagni, the surveyor of the expedition, has compiled a full sketch-map of Ruwenzori, including all its snow-covered peaks. The topographic data are stated in appendices. The mountains are illustrated by a series of magnificent photographic panoramas by Sella. The survey shows that the snow-capped peaks of Ruwenzori are arranged in a line curved like the letter G. Going from the upper point of the G to the tail, the peaks in succession are Mount Gessi, Mount Emin, Mount Speke, Mount Stanley—which includes the highest peaks of the ridge—Mount Baker, and at the end of the tail of the G is Mount Luigi de Savoia. The height of the highest point, Mount Margherita on Mount Stanley, is given as 16,815 feet.

The nomenclature is very carefully explained, and a table of synonyms (pp. 218-9) will be useful, as geographers are above rules of priority. Stühlmann's early names are quietly put aside, and the proposed native names are also rejected. There had been considerable confusion in the application of the early names, but this is perhaps hardly likely to be removed by some of the changes. For the worst alteration of names, the Prince, however, is not responsible, as he only yielded to the wish of the Geographical Society. It naturally desired that the Prince's name should be attached to one of five mountains, but unfortunately selected the one that had been named Mount Moebius by Stühlmann years earlier. The name Moebius has, therefore, been transferred to a minor peak in the central part of the range. The peaks called by Stühlmann Mount Semper are re-christened the Alexandra and Margherita peaks of Mount Stanley.

The full scientific results are being published in a supplementary volume which has not been translated, but some account of the results is included. The geological collections and geological sketch-map of the central part of Ruwenzori fully confirm the Archean age of its rocks, as to which doubt had been suggested by Mr. Wollaston's description of craters and crater-lakes; the author refers to some veins of basalt in the gneiss (p. 222) as the only formation on Ruwenzori of a volcanic nature, and such veins do not necessarily indicate volcanic action. The glaciers are proved to be ice-caps or calottes, with the glaciers extending as finger-shaped processes. The snow limit is at present at the height of from 14,700 to 14,800 feet, but it is now suggested that the glaciers extended even lower than was claimed by Scott Elliot. The evidence on which this low-level glaciation is based is, however, not given, and some doubt as to its value is raised by the remark that the exfoliation surfaces of granite, the characteristic weathering of granite in the tropics, are "somewhat similar to the rocks known as moutonnées in regions which have passed through a glacial period" (p. 91). However, as the rainfall in Ruwenzori is probably exceptionally heavy, it may well be that the glaciers there reached a lower level than on Mount Kenya. All students of African geography, and all interested in mountain exploration, will feel indebted to the Duke of the Abruzzi for the brilliant feat of travel by which he has wrested from the clouds of Ruwenzori the secrets they have concealed so long.

J. W. GREGORY.

SOME ASPECTS OF THE WHEAT PROBLEM.[1]

FEW agricultural problems appeal to a wider circle both among agriculturists and the general public than wheat production; the layman often considers it to be the farmer's chief business, and many farmers are still to be found who look back with regret on the days when it actually was so.

The area under wheat in the whole world exceeds 200 million acres, and something like 400 million quarters are raised. About 220 million quarters are grown in Europe, Russia being the chief producer, followed by France, Hungary, and Italy; 107 million quarters are grown on the American continent (more than 75 million in the United States, 20 million in the Argentine, and 10 million in Canada), and about 53 million quarters in Asia, three-fourths of which comes from India. It is noteworthy that the wheat area tends to decrease in old and highly farmed countries, but to expand in new countries or in old, backward countries just beginning to utilise their resources. To a certain extent, wheat is, therefore, a pioneer crop, and is relatively more important in the early stages of development of a country than later on when it simply takes its place in the rotation with other crops. It cannot remain so indefinitely, but there are still immense tracts to which it can spread. It requires warm, sunny summers, and not too much rain; indeed, it can do with astonishingly little rain if appropriate cultivation methods are adopted; where the summers are suitable, severe winters are no bar to the cultivation of wheat, though they may limit the yield.

The fact that wheat is one of the first crops grown in a new country renders necessary a thorough study of the effect of external conditions such as soil, climate, and manuring on its development. Much still remains to be done, especially with regard to the influence of water supply. There are also important breeding problems. No crop can be successfully grown on a large scale unless it is adapted to the local conditions, tolerably resistant to the local diseases, and commands an adequate price in the market. The first two conditions afford fairly straightforward problems. Wheats suitable to a given district are usually found by trying a number of varieties, and then improving on the most promising by the slow and mechanical process of selection—in other words, waiting for a "mutation" form to turn up. Resistance to rust, one of the worst diseases of wheat, has been shown by Biffen to be in all probability a Mendelian character; it should, therefore,

[1] A. E. Humphries: Journal of the Royal Society of Arts, No. 2934; A. Howard and G. L. C. Howard: Bulletin 14, Agricultural Research Institute, Pusa; A. E. V. Richardson: Journal of Agriculture of South Australia, vol. xii., No. 6; K. J. J. Mackenzie: Journal of the Board of Agriculture, vol. xv., No. 10.

only be a matter of time to obtain rust-resisting varieties. Saleability in the market is a somewhat artificial affair. At the present time millers require a "hard" wheat yielding a "strong" flour rather than a "weak" wheat, and, therefore, pay more for it. It is not claimed that strong wheat is more nutritious, but merely that it makes larger and more shapely loaves; there is the further advantage to the baker that a given quantity of strong flour makes a greater weight of bread because it takes up and retains more moisture than an equal weight of weak flour. No doubt an excellent case could be made out for "weak" flour, but that is not the business of the agriculturist; he has simply to provide what his customer wants. The scientific problem of discovering what constitutes strength is under investigation, and the fact that strength is inherited indicates the possibility of crossing it on to wheats possessing other desirable features.

The economic problems in wheat production have rarely been stated better than in Mr. Humphries's lecture before the Royal Society of Arts. For a number of years past British wheat has been sold at prices substantially lower than the best foreign wheat because it lacks strength. Probably few bakers would risk making bread from British wheat alone; they require foreign wheat to be mixed with it. Consequently, the mills are handicapped unless they are within easy access of a seaport. The Home-grown Wheat Association are trying to find whether strong wheat can be profitably produced in England; their experiments have already shown that strength is inherent in the variety, and is not the result of external conditions, though it is influenced by them; they have also demonstrated that the great Canadian wheat, Red Fife, keeps its strength when grown here. The Canadian farmer is satisfied with 20 bushels to the acre, but the British farmer, having heavier charges to meet, must get more than 30, and on occasions, in favourable districts, will even get 60 or more bushels of grain and good crops of straw. Unfortunately, Red Fife does not give these heavy crops, and is, therefore, not in much favour here. It it hoped, however, that crosses combining the strength of Red Fife with the cropping power of the standard English varieties will in time be available.

Other countries are also seeking to improve the strength of their wheats. Indian wheat, for instance, is at present no stronger than ours, but Mr. and Mrs. Howard have grown wheats at Pusa which were very favourably reported on by the English milling expert who examined them. One especially was praised, a wheat (Pusa 6) selected in 1906 and grown from a single plant. It has the further advantage that it is resistant to rust, and matures well even on second-class wheat soils. Canadian wheats are under constant investigation at Ottawa. The Agricultural Department of South Australia also conducts experiments, the results of which appear from time to time in its journal.

The introduction of strong wheats into English agriculture would unquestionably alter the conditions of wheat-growing here, and whilst strong varieties are being raised it is desirable to ascertain the precise cost of wheat production by modern methods and using modern labour-saving appliances. There is a great deal of work to be done in this direction. Mr. Mackenzie's paper in the Journal of the Board of Agriculture provides data for ascertaining the cost of harvesting; similar records for other operations are badly needed.

E. J. RUSSELL.

THE LONDON INSTITUTION.

AT the annual meeting of the proprietors of the London Institution, held on April 28, it was announced that, in view of the appointment of the Royal Commission on University Education in London, which had officially informed the Institution that they regarded it as coming under their purview, the scheme for amalgamation with the Royal Society of Arts must remain in abeyance. The solicitor of the institution had advised that Parliament would not pass a Bill altering the status of an institution the position of which was already under the consideration of a Royal Commission, and, assuming that opinion to be sound, as it probably is, it would certainly be inexpedient immediately to proceed with the Royal Society of Arts scheme, or any other that involved an Act of Parliament. A considerable opposition to the ratification of the scheme had been worked up, and an attempt was to be made to alter the constitution of the board, but upon the announcement that the scheme was not to be proceeded with at present, the opposition to the existing board was withdrawn. Whether the scheme which has now been shelved, at any rate for the present session, will be revived after the Royal Commission on University Education in London has reported is very doubtful.

From the outset the Royal Society of Arts has been unwilling to be a party to the scheme unless there was something like practical unanimity on the part of members of the London Institution. If the management of that institution had been in stronger hands it is probable that little would have been heard of opposition. Very similar opposition to the proposal to dispose of the Zoological Society's freehold premises in Hanover Square, and to expend the proceeds in providing suitable accommodation for the Society's offices and library at the Zoological Gardens, was summarily dealt with on April 29. But there seems to have been no strong hand at the helm at the London Institution, and the final result will probably be that a scheme which would have been of considerable benefit to two important institutions will fall through. The idea seems to be to make the London Institution a sort of school of economics, an excellent thing in itself, but not wanted, seeing that there is already existing an institution amply able to meet the requirements of the public in this direction.

At the meeting last week Lord Aldenham stated that the managers had received a letter from the Corporation asking whether they were open to receive proposals, and they answered in the affirmative, but no definite suggestion has been received from that source. Probably the best thing to do with the institution, if the scheme of amalgamation with the Royal Society of Arts is to fall through, would be to sell its land, and whatever else it has to sell, and divide the proceeds, so far as other claims permit, amongst certain educational institutions in the City.

NOTES.

THE first of the two annual soirees of the Royal Society will be held on Wednesday next, May 12.

WE announce with regret the death of Dr. F. G. Yeo, F.R.S., emeritus professor of physiology, King's College, London, at sixty-four years of age.

WE regret to see the announcement of the death, at seventy-five years of age, of Dr. J. Marshall Lang, Chancellor and Principal of Aberdeen University since 1900.

A REUTER message from Ottawa states that the Government has established a geodetic survey department for Canada under Dr. W. F. King, chief astronomer of the Dominion.

AT a meeting of the Aëronautical Society of Great Britain held on Monday, the gold medal of the society was presented to Messrs. Wilbur and Orville Wright in recognition of their distinguished services to aëronautical science.

AT a special general meeting of the Zoological Society on April 29 it was decided to dispose of the site of the society's freehold premises in Hanover Square, and to expend the proceeds upon the erection of new offices, library, and meeting-room at the Zoological Gardens in Regent's Park, and on the general improvement of the gardens.

A DESPATCH to the *New York Evening Post* from a correspondent in the West reports the discovery, near Esperanza, Mexico, of a stone inscription believed to have been carved by the Mayas of Yucatan, and to be more than a thousand years old. Some pottery of the Mayas was found at the same time. There had previously been no evidence of their having come so far north. The discoveries have been made by Major F. R. Burnham, D.S.O., and Mr. C. F. Holder, of Pasadena.

THE Royal Society of London invites applications for two Mackinnon studentships, each of the annual value of 150*l*. These studentships, which are restricted to British subjects, are awarded for the purpose of conducting researches, one in the group of the physical sciences, including astronomy, chemistry, geology, mineralogy, and physics, the other in the group of the biological sciences, including anatomy, botany, palæontology, pathology, physiology, and zoology. The present holder of the studentship in biology offers himself for re-election. Applications must be sent in to the Royal Society not later than June 1 on forms which can be obtained from the assistant secretary of the Royal Society, Burlington House, W.

STATEMENTS have been made in the medical and general Press that the electric waves used in wireless telegraphy are injurious to the operators and produce various diseases, such as conjunctivitis, corneal ulceration, and leukoma. Mr. Marconi writes to the *Times* to deny these suggestions, for which, he says, there is no evidence whatever. He adds:—"During the twelve years or so of our operations we have had to deal with no single case of compensation for any injury of this origin, nor, so far as I can ascertain, has any such injury been suffered. Speaking for myself, I may remark that my own good health has never been better than during the often extended periods when I have been exposed for many hours daily to the conditions now challenged, and in the constant neighbourhood of electrical discharges at our Transatlantic stations, which I believe are the most powerful in the world."

THE annual meeting of the Naples Table Association for Promoting Scientific Research by Women was held on April 24 at the American Museum of Natural History. Miss Caroline McGill, of the University of Missouri, was appointed a scholar of the association at the Naples station. We are informed that the award of the prize of one thousand dollars offered every second year for the best thesis written by a woman on a scientific subject, embodying new observations and new conclusions based on an independent laboratory research in biological, chemical, or physical science, was made to Miss Florence Buchanan, D.Sc., of London University, fellow of University College, London, for a thesis entitled "The Time Taken in the Transmission of Reflex Impulses in the Spinal Cord of the Frog." Miss Buchanan has been engaged in research work at the University Museum, Oxford, since 1896, and has published sixteen papers. It is worthy of remark that, of the eleven theses presented in competition, five were sent from England and one from Canada. The subjects of four were morphological, of two bacteriological, of two zoological, one physiological, one was in the domain of physical chemistry, and one in parasitology. The general average of these investigations was very high, distinctly above those of the three previous competitions. A fifth prize will be offered in 1911.

THE year 1911 will be the centenary of the publication of Avogadro's celebrated memoir on the molecular constitution of gases. In that memoir he arrived at the generalisation that equal volumes of gases at the same temperature and pressure contain the same number of molecules—a law which has borne rich fruit both in chemistry and physics. To commemorate the discovery of Avogadro's law, a committee has been formed by the Royal Academy of Sciences of Turin to obtain subscriptions for the publication of the most important of Avogadro's works in one volume, and the erection of a monument to him at Turin, where he was born in 1776, and died, while still professor of physics there, in 1856. An appeal is made to chemists and physicists for contributions to the fund being raised. The committee is international in its constitution, and includes the names of many men of distinguished eminence in the world of physical science. Subscriptions should be sent to the treasurer, Royal Academy of Sciences, Via Maria Vittoria 3, Turin.

THE seventy-seventh annual meeting of the British Medical Association will be held in Belfast on July 23–31. The president-elect is Sir William Whitla, professor of materia medica and therapeutics, Queen's College, Belfast. The address in medicine will be delivered by Dr. R. W. Philip, that in surgery by Prof. A. E. J. Barker, and that in obstetrics by Sir John W. Byers. The popular lecture will be delivered by Dr. J. A. Macdonald. The scientific business of the meeting will be conducted in fifteen sections, which will meet on Wednesday, July 28, Thursday, July 29, and Friday, July 30. The presidents of the sections are as follows:—Anatomy and physiology, Prof. C. S. Sherrington, F.R.S.; dermatology and electrotherapeutics, Dr. W. Calwell; diseases of children, Mr. H. J. Stiles; hæmatology and vaccine therapy, Sir Almroth Wright, F.R.S.; hygiene and public health, Dr. L. C. Parkes; laryngology, otology, and rhinology, Dr. St. Clair Thomson; medicine, Prof. J. A. Lindsay; navy, army, and ambulance, Fleet-Surgeon J. Lloyd Thomas, R.N.; obstetrics and gynæcology, Dr. J. Campbell; ophthalmology, Dr. J. W. Browne; pathology, Prof. Wm. St. Clair Symmers; pharmacology and therapeutics, Prof. R. Stockman; psychological medicine, Dr. T. Outterson Wood; surgery, Prof. T. Sinclair; tropical medicine, Mr. C. W. Daniels.

THE Liverpool Marine Biological Station at Port Erin, in the Isle of Man, has been utilised, in all its departments, to the fullest possible extent during the past Easter vacation. A class of senior students from the University of Liverpool occupied the large upper laboratory, and went through a course of practical marine biology under

the direction of Dr. Pearson and Mr. D. Laurie. The ground-floor laboratories have been occupied during the last six weeks by about ten or twelve investigators, including Dr. H. E. Roaf, working on the digestive ferments of various Invertebrata; Mr. W. J. Dakin, working on the nervous system of Pecten, and also making hydrographic observations on samples of sea-water; Mr. W. Riddell, assisting Prof. Herdman in his plankton investigations at sea; and several others. In the fish hatchery Mr. Chadwick has this year increased the output of young plaice; between nine and ten millions of eggs have been dealt with in the hatchery boxes during March and April, and Prof. Herdman has set free between seven and eight millions of young fry of the plaice from the S.Y. *Ladybird* at distances of from five to thirteen miles off land, in directions ranging from south-west to north of Port Erin, so that some millions have been carried by the south-going tide around the Chicken Rock to the eastern side of the Isle of Man, while others have been carried by the northern tidal system up the west and round the northern end of the island. In each year, recently, some fry produced in the fish hatchery have been retained in the spawning ponds until they underwent their metamorphosis and appeared on the bottom as healthy young flat-fish. These specimens reared in captivity were found on investigation to be feeding on diatoms, and at the present time, in the Irish Sea, the vernal increase in diatoms seems to be at about its greatest height.

WE have received a communication from Dr. J. B. Charcot, leader of the French Antarctic Expedition, from Deception Island, South Shetlands, dated December 24, 1908. The *Pourquoi-pas?* left Puntas Arenas on December 16, and arrived at Deception Island on December 22 in company with a Norwegian whaler that was met with off Smith Island. At Deception Island Dr. Charcot met two other Norwegian and one Chilian whaler, and thirty tons of coal were taken on board from the whaling station set up in Pendulum Cove by La Sociedad Ballinera Magellanes. So far, Dr. Charcot has naturally little news of interest, since the voyage has only begun. In fact, the chief interest is that now, for the first time for nearly a century, an exploring ship has met with sealers and whalers south of the latitude of Cape Horn. That an exploring ship can obtain its last supply of coal in 63° S. instead of 53° S. is of the utmost importance. Ships are able to cross the heavy seas of Drake Strait in better time, and have 600 miles extra start towards the south. The fact of this whaling station, with 200 men, two large steamers of more than 3000 tons, and eight small ones, existing at Deception Island is an eloquent testimony of commercial success following up scientific investigations. There was no word of such an industry being opened up before the departure of the Scottish and Swedish expeditions in 1901–4. When Dr. Charcot left Deception Island on December 25 general physical and biological investigations had begun, including actinometric observations during the eclipse of the sun on December 21, and pendulum records at the same point as Foster made them in 1829. He intended to steer for Port Lockroy and Port Charcot, and thereafter to the south and west along the west coast of Graham Land. During the three years the whaling station has existed, this region has never been so free of ice, which augurs well for the success of the French expedition.

APRIL was a record month for bright sunshine over the southern and eastern portions of England, and the duration of sunshine was in excess of the average in most parts of the kingdom. At Dover the sun was shining for 273 hours, and at several places in the south and east of England the duration exceeded 250 hours. At the London reporting station of the Meteorological Office, in Westminster, the bright sunshine amounted to 220 hours, whilst the previous brightest April occurred in 1906, with 207 hours. At Greenwich the duration of bright sunshine was 250 hours, which is 103 hours more than the normal, and there was only one day without sunshine. The mean temperature at Greenwich was 2·3° in excess of the average, and rain fell on thirteen days, yielding a total of 1·71 inches, which is 0·14 inch more than the average. The summary of the weather issued by the Meteorological Office shows an excess of sunshine since the beginning of the year over the whole of England and Ireland, but a slight deficiency in Scotland. In the south-east of England the excess of sunshine for the past four months amounts to 101 hours, and in the north-west of England to ninety-four hours.

IN No. 1665 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 191–6) Dr. O. P. Hay describes specimens of two fossil chelonians, one of which forms a new species.

IN the Journal of the Royal Microscopical Society (1908, pp. 529–43) Messrs. E. Heron-Allen and A. Earland describe, under the name Cycloloculina, a new genus of Foraminifera collected from the shore-sand of Selsey Bill between Bracklesham Bay and Chichester Harbour. The specimens on which the genus is founded are fossils, and were found in company with many other Foraminifera washed out of Secondary and Tertiary strata. They resemble Planorbulina in their general appearance, but when mounted in balsam are seen to have quite a different mode of growth. Two species are described as *C. annulata* and *C. polygyra*.

IN commemoration of Mr. Roosevelt's projected hunting trip in East Africa, the *National Geographic Magazine* devotes its March number to papers on Africa. Sir H. Johnston gives a delightful account, illustrated by admirable photographs, of the region which the ex-President hopes to explore. The Nandi forests he believes to be vestiges of the ancient forest-belt that stretched from the Indian to the Atlantic Oceans, and he points out that its *fauna* is more closely allied to that of East India and Malaysia than to West India or East Africa. The discovery of the okapi encourages the hope that if he explores this region in a systematic way, Mr. Roosevelt may discover other beasts and birds unknown to science. He may obtain specimens of the giant pig first discovered in Stanley's Ituri forest by Mr. N. E. Copeland, and he is anxious to secure the white or square-lipped rhinoceros, long supposed to be confined to Africa south of the Zambezi, where it is nearly, if not quite, extinct; it is now reported to exist in the north-western parts of British East Africa. He may also encounter the wonderful earthworm as large as a snake and coloured a brilliant verditer-blue. At any rate, he will find forests rivalled in luxuriance only by those of the Congo Free State and the Kameruns, the finest conifers in Africa, the largest continuous area of marsh, the largest lake, and the highest point in the continent. As for the people, he will meet pygmies, fanatical Mohammedans, enthusiastic Christians, and specimens of nearly all the most marked and interesting types of African man.

SOME years ago Sir Lauder Brunton suggested that it might be possible to relieve certain forms of heart disease by a surgical operation on the valves of the heart. Dr.

Bernheim records, in the Bulletin of the Johns Hopkins Hospital for April (xx., No. 217), some experiments performed on dogs in this connection; the results are encouraging, and suggest that the procedure offers no greater technical difficulties than numbers of others which are in daily practice.

IN a report by Mr. E. H. Ross on the prevention of fever on the Suez Canal (Cairo: National Printing Department, 1909), mosquito destruction at Port Said and its results are reviewed. After three years' work a great reduction in the number of mosquitoes has been effected, and in consequence malaria has much diminished, also continued fever and dengue. Although the population is increasing steadily, the death-rate for 1908 is 150 below the average for the previous five years. It is not possible completely to exterminate mosquitoes, and the campaign has to be continued. In an appendix certain interesting features in the biology of mosquitoes (*Culex fatigans* and *Stegomyia fasciata*) are detailed. It is found that male mosquitoes do not live more than a few days, and are much more numerous than females. The females apparently desire to suck blood only after fertilisation.

IN a third report on research work, Dr. Houston, director of water examinations, Metropolitan Water Board, discusses the value of the storage of raw river water antecedent to filtration as a means of purification. The medical advisers of the Local Government Board have long held the view that "time" is to be regarded as an important element among conditions that in nature combine to annul the vital activities of particulate matter which is the cause of disease, and in no direction perhaps is this "time factor" of more importance than in the storage of impure river water. The results of a large amount of experimental work, chemical and bacteriological, undertaken to investigate this question are given in this report. They show that the total number of micro-organisms and of *B. coli* are very considerably reduced by storage. The stored waters also contained less ammoniacal nitrogen and less oxidised nitrogen, and absorbed less oxygen from permanganate; as regards albuminoid ammonia, however, only Chelsea water showed a reduction; Lee water was unaltered, and Staines and Lambeth suffered an apparent increase. The engineers reported that the use of stored water prolongs the life of the filter-beds. It is concluded that an adequately stored water is to be regarded as a "safe" water, and its use would render any accidental breakdown in the filtering arrangements much less serious than otherwise might be the case. Although it would be preferable to regard thirty days as a minimum period of storage, this would entail the construction of huge reservoirs, and it is suggested that thirty days' storage might be considered a maximum, adopting in addition, during times of stress and storm, an intermediate system of purification (*e.g.* by mechanical filters or by precipitation tanks) between storage and sand filtration.

A SECOND part of the illustrated studies in the genus Opuntia, by Mr. D. Griffiths, has been received, being an advance publication from the twentieth annual report of the Missouri Botanical Garden. It consists chiefly of descriptions of new species from the States of Mexico, Texas, and Arizona, with illustrations to indicate the general habit, fruits, and seeds.

AN article by Mr. E. Maigre on geotropism and the statolith theory appears in the *Revue générale des Sciences* (March 15). Discussing the much-debated question as to the exact position at which the root is sensitive to geotropic stimulus, the author lays stress on Picard's experiment, in which the root was rotated round an axis oblique to the longitudinal axis of the root. The root was placed in different experiments so that the axis of rotation cut it at different points between the tip and region of growth, and thereby the stimulus produced by centrifugal force acted oppositely on the two regions. The author defends the statolith theory mainly on the strength of Buder's recent researches, which consisted in turning the root sharply through an angle of 180° at stated intervals, when it was found that the curvatures produced were in conformity with the theory.

MR. E. D. MERRILL contributes three articles to the botanical number of the *Philippine Journal of Science* (vol. iii., No. 6) published in December, 1908. A revision of native species of Garcinia shows seventeen species, of which twelve are endemic and five are new to science. The indigenous Ericaceæ are collated under the genera Vaccinium, with nineteen species, Gaultheria, Diplycosia, and Rhododendron, with sixteen species; all are plants growing at medium or high altitudes, and according to existing records, out of thirty-nine species as many as thirty-six are endemic. The third contribution relates to collections of plants from the Batanes and Babuyanes islands, which furnish evidence of a strong affinity with the flora of the other Philippine islands and a very slight affinity with the flora of Formosa. There is also a noteworthy communication to the journal by Dr. E. B. Copeland regarding new genera and species of Bornean ferns. The new genera are Macroglossum, a marattiaceous fern, and Phanerosorus, the latter being, however, a new title for *Matonia sarmentosa*.

THE reports on the botanic station, agricultural instruction, and experiment plots at Grenada are to hand. The chief industries of the island are cacao and nutmeg cultivation, but it is suggested that fodder crops and ground provisions might with advantage be more extensively grown. Interest is being taken in rubber planting; *Hevea brasiliensis* appears to be more promising than *Castilloa elastica*. It has been demonstrated that Sea Island cotton can be produced on land near the coast. The importance of improved methods of cultivation and treatment in cacao orchards has been continuously urged upon growers, and both large and small owners are adopting such methods. Prize-holdings competitions have been introduced among the peasantry, and have been found to encourage better methods of working.

MYCOLOGISTS will be interested in the regulations drawn up by the Board of Agriculture of British Guiana, and recorded in the *Agricultural News* for March 20, dealing with the importation of sugar-canes, and having for their object the exclusion of plant diseases so far as is possible. Canes from stated places must not be imported in any description of earth or soil. They are to be inspected on arrival by the Government botanist, and if infected with any pest or disease not commonly known in the colony they are to be destroyed; if infected with any common pest or disease they are to be treated as the botanist directs. Those passed by the botanist are to be planted in a nursery apart from the general cultivation, and subject to inspection for twelve months; if during that time any pest or disease appears, they are to be destroyed if the pest is new, or treated as the botanist directs should it already occur in the colony. The regulations are very stringent, but the introduction of new pests and diseases is a very serious matter to agriculturists, and entails a great amount of trouble besides considerable financial loss.

THREE parts of the "Palæontologia Indica," just received from the Geological Survey of India, contain important memoirs on the Lower Mesozoic invertebrate faunas of the Indian region. A collection of fossils, chiefly bivalved shells, obtained by Messrs. T. D. La Touche and P. N. Datta from the Napeng beds of the Northern Shan States of Burma, is described by Miss Maud Healey, who shows the fauna to be remarkably similar to that from the Rhætic formation of Europe. Even the characteristic *Avicula contorta* occurs. The fossils, however, are much distorted, and preserved only as imperfect casts, so that their exact determination is almost impossible. Miss Healey remarks that very similar bivalves have also been found in rocks on the west coast of Sumatra which are not Eocene, as hitherto supposed, but really of Rhætic age. New collections, chiefly of Cephalopoda, from the Trias of Spiti, in the Himalayas, are described by Prof. Carl Diener, who makes an interesting contribution to our knowledge of this much-discussed formation. He treats especially of the Upper Muschelkalk, and compares in detail the several zones with those recognised in Europe. A remarkable collection of fossils from scattered blocks of Upper Triassic and Liassic age, found in the frontier district between Hundes and Malla Johar, is also described by Prof. Diener. Basing his studies chiefly on ammonites, he concludes that "the difference between the Liassic faunæ of Würtemberg or England and the Alps is more conspicuous than that between the Mediterranean and Tibetan faunæ of the Lower Lias."

MR. B. GOMME recently issued the "Index of Archæological Papers published in 1907," which forms the seventeenth annual number of this publication, originally started by his father, Mr. G. L. Gomme. It contains references to the proceedings of fifty-two learned societies in Great Britain and Ireland, and is likely to be useful to all who are interested in archæology. Many societies are subscribers to this index, which they issue with their annual Proceedings, a course which may be safely recommended for general adoption. This publication would be of much more practical value if, in addition to the bare titles of communications, a short abstract of the contents or a summary of the views advocated by the author were appended.

IN the April number of *Man* Mrs. M. E. Cunningham directs attention to a remarkable feature in the entrenchment known as Knap Hill Camp, in Wiltshire. Along the exposed side of the camp the entrenchment is pierced by no fewer than six openings or gaps, which were formerly supposed to be cattle-tracks or made for agricultural purposes. Excavations, however, show that none of them is the result of wear or accident, and that they represent gangways intentionally left in the circumvallation. Something of the same kind was remarked by General Pitt-Rivers at Winkelbury Camp, and he supposed that they were gangways adapted to allow in an emergency a considerable number of cattle to enter the camp. In this case, Mrs. Cunningham urges that it would have been simpler to make one or two wide entrances. From the fact that these causeways lie askew to the gaps in the rampart she suggests that they may have been purposely left as positions from which the defenders could enfilade the ditch, the distance from one causeway to another being not greater than could be covered by hand-thrown missiles. It is to be hoped that the fuller exploration of the site which the writer promises will throw further light on the interesting problems connected with prehistoric fortresses which are raised in this communication.

THE report of the Danish Meteorological Institute on the state of the ice in the Arctic seas during 1908 shows that the general distribution of the Polar ice was almost the opposite of that observed in the preceding year. During 1907 greater masses of ice than usual drifted from the Arctic Ocean towards Franz Joseph Land and Spitsbergen and along the east coast of Greenland, whereas during 1908 those regions were more approachable and free from ice than is normally the case. The supposition that the change was due to the ice having found an outlet elsewhere is supported by the fact that the ice conditions were reported as specially unfavourable in the Bering and Beaufort Seas.

THE meteorological and magnetical report of the Royal Cornwall Polytechnic Society, containing the observations made at Falmouth during 1908, has been received. This important observatory receives an annual grant of 250*l*. from the Meteorological Committee for the supply of hourly meteorological observations, and is at present subsidised by the Royal Society and British Association for the maintenance of magnetic observations. At the request of the International Conference on Terrestrial Magnetism it supplies a table of the daily magnetic records to the Royal Netherlands Institute for publication with similar data from other observatories; the magnetic results are also published by the National Physical Laboratory. A comparison of the air- and sea-temperature observations for 1908 shows that the mean of the latter (52·9°) was 1·3° above that of the air; from May to July inclusive the mean sea temperature was lower than that of the air. The rainfall amounted to 37·6 inches, being 4·4 inches below the average. A chart is added to the report showing the annual rainfall for thirty-seven years, 1872–1908, registered by the self-recording rain-gauge; the wettest year was 1872, rainfall exceeding 64 inches, and the driest 1887, rainfall less than 30 inches. The mean magnetic declination for the year was 17° 54′ W.

MR. S. S. BUCKMAN has sent us a copy of a paper (Oxford: Parker and Son) in which he advocates a scale of notation with radix 8 instead of 10. His proposals are more revolutionary than this change necessarily implies, for he would write the numerals upside down, and completely alter his weights, measures, and coinage down to a charge of 7½*d*. for telegrams. Apart from the object-lesson that in Austria even the change from *kreuzer* to *heller* took years to accomplish (and kreuzer are probably not dead yet), we note that the advantages of "octonary numeration" were clearly and plainly set forward, without the introduction of unnecessary complications, by Prof. Woolsey Johnson in October, 1891 (Bulletin New York Mathematical Society, i., 1).

THE importance of the discovery made by Prof. Townsend last year, that when a gas is ionised by Röntgen rays positive ions are produced having double the electric charge previously regarded as the ionic charge, has led Drs. J. Franck and W. Westphal, of the University of Berlin, to investigate the properties of these doubly charged ions in some detail, and their results were communicated to the German Physical Society on March 5. They find that the mobility of the ions in an electric field, as measured by a modification of Zeleny's method, is identical with that of the singly charged ions, while their rate of diffusion, as measured by a method identical in principle with that first used by Townsend, is only half that of the singly charged ions. The double charge is thus accompanied by double mass, and the number of double ions produced by Röntgen rays is, the authors find, only about 9 per cent. of the total number of positive ions.

DR. W. W. COBLENTZ, of the United States Bureau of Standards, recently completed an investigation of the radiation constants of metals with a view to account for the high efficiency of the new metallic filament incandescent electric lamps, and his results are published in part iii. of vol. v. of the Bulletin. The radiation from the filament of an incandescent lamp provided with a fluorite window, after passing through a fluorite prism, was measured by the bolometer while the temperature of the filament was kept constant. From the curve of distribution of energy throughout the range of wave-lengths examined, the radiation constant α of the formula $dE = C\lambda^{-\alpha}e^{-c/\lambda t}d\lambda$ is found for the material of the filament at various temperatures. Its value for a "cavity" black body is known to be 4, while for platinum it is 6. Dr. Coblentz finds it to be about 6 for "flashed" and for untreated carbon, to be between 7 and 8 for silica-coated carbon, between 6 and 8 for platinum and tungsten, between 6 and 7 for tantalum, and to be about 6·8 at all temperatures for osmium. As the temperature at which the lamp is run increases, the radiation constant decreases in the case of the metallic filaments with the exception of osmium. At the normal voltage the constants have the following values:—metallised carbon, 6·1; tantalum, 6·3; tungsten, 6·6; osmium, 6·9. The high value of α explains the superiority of the osmium lamp.

THE Proceedings of the American Academy for March contain two papers from the Harvard Laboratory on the atomic weight of chromium. Since the early determination of Berzelius in 1818 (Cr=55·95), thirty-three values have been placed on record, the earliest being those of Peligot (1844) and the latest those of Meineke (1890). Rejecting one high and one low value, the eleven figures given by Meineke ranged from 52·03 to 52·27, mean 52·12, in good agreement with the earlier values of Siewert (1861), 52·07; Baubigny (1884), 52·13; and Rawson (1889), 52·09. The methods now adopted by Baxter and his colleagues consisted in converting silver chromate and dichromate into the chloride and bromide, and thus deducing the percentage of silver in the chromium compounds. Conversion of chromate into chloride gave Ag=65·0345 per cent., and into bromide Ag=65·0321 per cent., mean 65·0333 per cent., whence if Ag=107·88, Cr=52·008; conversion of dichromate into bromide gave Ag=49·9692 per cent., whence Cr=52·013. It is noteworthy that the final value, Cr=52·01, differs from the whole number by only one-hundredth of a unit, whereas the figure adopted by the International Committee for the present and previous years, Cr=52·1, differed by a tenth of a unit. It will be remembered that the recent revision of the atomic weight of nitrogen also resulted in bringing the value within 0·01 of the integer.

MR. J. H. SHAXBY asks us to state that, by an unfortunate mistake, he wrote "Faraday" instead of "Tyndall" in his letter upon the fluorescence of *Lignum Nephriticum*, published last week (p. 249).

OUR ASTRONOMICAL COLUMN.

DEVELOPMENT OF MARTIAN CANALS.—Through the agency of the Kiel Centralstelle (Circular No. 107) we have received a message from Prof. Lowell saying that the development of the Martian canals corroborates the prediction that they would be seen leaving the south polar cap of the planet.

COLOURS AND MAGNITUDES OF STARS.—In a note appearing in these columns on February 4 (p. 410, No. 2049, vol. lxxix.) we directed attention to Mr. Franks's conclusions regarding the relation of star colours to star magnitudes in galactic and non-galactic regions.

A note by Miss Bell, appearing in No. 5, vol. lxix., of the Monthly Notices, confirms Mr. Franks's in showing that there appears to be a slightly more intense relation between luminosity and colour in the galactic regions. This result was obtained by the statistical method of contingency, and a further calculation shows that, as a chance coincidence, the chances are 500 to 1 against there being a group of stars so divergent from stars as a whole as are the galaxy stars, whilst they are 2500 to 1 against any random sample showing the divergency from the whole that the non-galactic stars display.

A GROUP OF RED STARS IN SAGITTARIUS.—Whilst examining the Draper memorial photographs of stellar spectra, Mrs. Fleming has found that a plate covering the area R.A. 18h. 48m. to 19h. 29m., dec. 13·0° S. to 23·1° S. (1900), shows an abnormal number of red stars having peculiar spectra. The positions and spectral types of these stars are given in Circular No. 149 of the Harvard College Observatory. The area includes the n.f. portion of the constellation Sagittarius, and is in the southern border of the Milky Way. Besides twenty-one stars having spectra of the third type, there are six of the same type with the addition of bright hydrogen lines (class Md) and one of the sixth type (class R).

In contradistinction to the above, Mrs. Fleming found that a similar plate of a neighbouring region (R.A. 17h. 24m. to 18h. 11m., dec. 27° 8′ S. to 38° 0′ S.) shows a deficiency of red stars, but contains several stars having peculiar spectra. These include stars of the third type, a variable of the fourth type, two of the fifth type with bright lines, and two gaseous nebulæ.

THE CALCULATION OF COMETARY ORBITS.—It frequently occurs that the definitive calculation of a comet's orbit is carried out by two or more calculators working independently, and without the whole of the available observational data. This leads to varying results and confusion, which Prof. Kobold is trying to obviate. For this purpose he publishes in No. 4319 of the *Astronomische Nachrichten* a list of comets since 1757, with the names of the workers by whom the definitive orbits have been, or are being, worked out. The present list accounts for forty-six comets, and Prof. Kobold will welcome any additions thereto.

PHOTOMETRIC OBSERVATIONS AT CATANIA.—A paper by Signor A. Bemporad, in which he describes and discusses the photometric observations made at Catania during the three years 1904–6, appears as an abstract from vol. xxxvii. of the *Memorie della Società degli Spettroscopisti Italiani*.

The programme of work included (1) the determination of the wedge constant; (2) the study of the extinction curve for Catania and then for the Etna Observatory; (3) the determination of the atmospheric absorption at both places; and (4) the observations of variable stars. The results obtained under each heading are fully discussed in the memoir, and the light-changes of a number of variables are compared with previously published ephemerides.

RECENT SOLAR RESEARCH.—As a reprint from vol. xxxvii. of the *Memorie della Società degli Spettroscopisti Italiani* we have received an interesting paper, in which Prof. Ricco discusses the recent work done in the field of solar research. Most of the subjects have already been discussed in these columns, *e.g.* Hale's vortices, Deslandres's filaments, Belopolsky's anomalous forms of the K line in 1906–7, &c., but readers of Italian will find Prof. Ricco's review to be a useful *résumé* of all these researches.

OCCULTATIONS OF PLANETS.—In a brief note appearing in No. 5, vol. lxix., of the Monthly Notices (p. 431), Dr. Downing gives the data for two occultations of planets by the moon, during the present year, observable at British observatories. Times and position-angles of immersion and emersion are given for occultations of Mars and Venus visible at Ottawa and Sydney respectively, the former on September 1, the latter on November 17.

SS AURIGÆ (31.1907) AN IRREGULAR VARIABLE.—A note from Prof. Hartwig, appearing in No. 4319 of the *Astronomische Nachrichten*, announces that the Bamberg observations show the star SS Aurigæ to be an irregular variable of the SS Cygni type.

THE ERUPTION OF VESUVIUS OF APRIL, 1906.[1]

FOR thirty years Dr. Johnston-Lavis has devoted much of his life to the investigation and elucidation of volcanic phenomena as illustrated by the classical type-volcano Vesuvius. To him we owe the great geological map of Vesuvius and Somma, and a detailed memoir in which he worked out the geology of that very complex Neapolitan volcano, as well as numerous papers upon several eruptions.

FIG. 1.—The aspect of the great cone of Vesuvius on May 4, 1906, as seen from the Punta del Nasone on M. Somma looking due south. The dotted line is that of the outline of Vesuvius in October, 1903, taken with the same camera and lens, and represents, except for a faint variation at the extreme summit, the actual outline of the cone before it was truncated by the late eruption.

In a monograph lately issued by the Royal Dublin Society we have a careful vulcanological study of the great paroxysm of 1906, and an attempt to read from the recorded phenomena and the ejected materials the physics of such an eruption.

A quarter of a century ago, and in frequent communications since, Dr. Johnston-Lavis has pointed out that in the ejecta, and especially in the fragmentary materials, we have a key for interpreting the physical causes and phases of an eruption.

He holds that the aqueous and other vapours of an igneous magma are derived from materials acquired and dissolved by the igneous paste on its way towards the surface. There is evidence that the H_2O and other volatile elements really exist in the form of a solution of gases in a liquid, and that variations in the phases of an eruption are due to the separation of such volatile materials from solution and the expansion to the gaseous state on the relief of pressure or the increase of the amount and resulting tension of them. He maintains that the same physical laws that govern the solution of CO_2 in water under varying pressure and temperature are identical with those which govern the solution of H_2O, volatile chlorides and sulphates in a mixture of fused silicates.

This is the thesis that the author follows in the description of the last great outburst of Vesuvius, and still further claims his old favourite as the type-volcano of the world.

In the first chapter is a review of the changes that have occurred at Vesuvius since 1872, the date of the last important eruption. Next follows a diary of the daily and hourly changes at the volcano during its great paroxysm, partly from Dr. Johnston-Lavis's own observations and partly from those of other observers. The observations are then analysed in a chapter on general considerations and a scheme of grades and varieties of the activity of volcanoes is given, in which the eruption of April is classed under the *paroxysmal vesuvian* type, as distinguished from ordinary Vesuvian type. A protest is made against the application of the terms *vulcanian* and *pelean* to this outburst, the term being considered to be more applicable to acid volcanoes, in which the higher viscosity of an acid magma gives rise to a very different series of phenomena, namely, (*a*) amount of lava above the lateral outlet; (*b*) the secular output of lava; (*c*) the rise of magma due to its expansion from increased vesiculation after the relief of pressure from the fluid column above it has drained or blown away. The different phases of the eruption are studied, and the varying output of lava examined from these points of view.

The lava in this eruption was of the usual *aa* type of Vesuvian rapid outflows, and differs from the *pahoehoe* type of slow dribblings such as built up the great lava cones of 1891 and 1895. A comparison of microscopic characters shows that the felspars are more developed in the slow outflows, whilst the leucites dominate in the rapid floods of lava. A series of excellent photographs taken by the author exhibit many striking phenomena of lava flows on the open slopes, along narrow ravines, and amidst streets, houses, railroads, bridges, &c.

The so-called bombs which are frequent on the surface of lava streams were shown by the author some years ago to be due to the fragments of solid materials caught in the lava stream and floated to the surface by the vesiculation on their surface, which latter acts in a catalytic manner. They have condensed on their surface a crust derived from the fluid rock which gives them their bomb-like appearance. A photograph is given in which the nucleus is composed of a piece of wall, thus indicating their true origin. The author aptly compares them to a dumpling, and proposes in future to call them by that name to distinguish them from other so-called bombs.

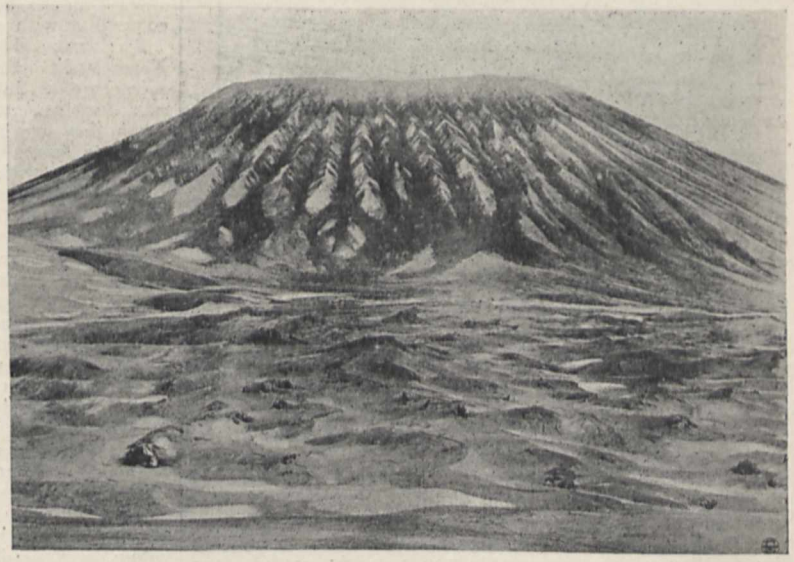

FIG. 2.—The great cone of Vesuvius as seen from the west at the foot of the Colle Umberto, looking due east across the Atrio on May 3, 1906, to show the truncation of its top and the remarkable barrancos formed on its sides by the slipping of loose fragmentary ejecta.

Several reasons are given for the slight variations in the composition of the lavas, scorias, and dusts, such as the effect of aërial sorting, loss of chloride and sulphates, or the acid radicles of such salts leaving the bases behind, fumarolic exhaustion, &c., which are each reviewed in turn.

[1] Scientific Transactions of the Royal Dublin Society, vol. ix. (Series ii.), part 8. (Dublin: University Press.)

Two plates are devoted to a series of detailed sections of the fragmentary materials as distributed around the volcano, and the conditions that influenced the distribution of such materials are discussed.

The essential ejecta are shown to be represented by two strata of brown and black scoria that form the base of the great sheet of lapilli which covered the north-east sector of the volcano, and were so destructive to Ottajano, S. Giuseppe, and other towns. These were followed by the still more important and larger volume of the accessory ejecta derived from the fragmentation and ejection of the upper part of the great cone. One-third of that great cone has gone, as can be seen by the photographs in some of the plates, and a tremendous crater half a mile in diameter and of unknown depth afforded these materials.

The remarkable photographs of the great cone showing this truncation, compared with its original outline and that of the new crater at different dates, make impressive pictures. Plate V. of the memoir, here reproduced in Fig. 2, will remain as a classical view of the general shape of the cone with its scored sides, and Plate VI. of the details of those remarkable barrancos that are like the pleats in a half-opened umbrella. This scoring of the slopes of volcanoes was formerly supposed to be due to aqueous erosion, but is shown in this eruption to be caused by the slipping down of avalanches of loose

FIG. 3.—Lava that invaded the court of the villa of M. and T. Borosio at Boscotrecase.

fragmentary materials piled on the steep slopes of the cone towards the end of the eruption, when the ballistic energy was unable to throw them farther afield.

Some remarkable "hollow dykes," first described in the 1885 eruption, are given on p. 185, and the mechanism of their formation explained. The author believes they were possibly the canals by which issued the lavas of the Colle Margherita and the Colle Umberto.

The microscopic and other characters of the essential ejecta are illustrated by some plates of photomicrographs. The size of the vesicles, the relative amount of glass, microliths, and state of the magnetite are shown to indicate the position of the magma in the volcanic conduit, the amount of volatile constituents it acquired or lost at different depths, and their relationship to the different phases of the eruption.

The minerals and other eruptive products of the eruption are described in so far as they bear on the interpretation of the eruptive phenomena, but the author avoids petrographical and mineralogical details that he considers have no special bearing on the study of this outburst.

In addition to a large number of reproductions from photographs taken by the author, there are plans, figures, and maps. The last plate is a plan, on the scale of 1/10,000, of the modifications wrought in the cone and crater, printed specially for this memoir by the Istituto Geografico Militare of Italy.

TANTALUM AND ITS INDUSTRIAL APPLICATIONS.[1]

WHEN the announcement was made in the year 1878 that "the division of the electric light had been successfully accomplished," many people believed that the days of lighting by gas had come to an end, and acted accordingly, much to their own disadvantage, for the competition of the glow-lamp served only to stimulate its rival to new life. Burners of improved construction, regenerative burners, and finally gas mantles, helped to restore to gas the ground it had lost, and until a short time ago even threatened to check the spreading of electric lighting.

Not only this growing competition of gas, but the universal necessity of cheapening the production of commodities that are for general use, forced electrical engineers to study in all its aspects the question of improving the efficiency of electric lighting. As a guide in their researches they had the well-known principle that the illuminating power of a solid body increases at a much greater ratio than its temperature, or, in other words, that with the increase of temperature a greater percentage of the energy expended for heating the body is converted into light. There is plenty of room for improvement, for even the most economical source of light, the electric arc lamp, converts only about 1 per cent. of the energy of the electric current flowing through it into light, the rest appearing as heat, so that in reality all methods of lighting devised by men are to a much greater extent methods of heating.

The first successful incandescent lamp consisted of a carbon filament, and for a long time carbon appeared to be the only suitable substance, although the temperature to which such a filament can be raised is limited to about 1600° C., as above this point the carbon begins to disintegrate rapidly. At this temperature the lamp consumes from three to three and a half watts per candle-power, while any attempt to produce light more economically by raising the temperature of the filament results only in shortening its life and destroying, thereby, its power of competing with gas lighting.

An improvement on this result was introduced by Prof. Nernst, of Göttingen, who suggested as the source of light refractory earths, similar in character to those used for gas mantles, which, however, conduct electricity only when they are hot. Lamps constructed on Prof. Nernst's principle have, therefore, to be fitted with contrivances for heating their filaments when starting, which complicate the construction of the lamp.

Another step forward was made by the invention of the osmium lamp, which is produced in a somewhat similar manner to the carbon lamp, by squirting a plastic mixture of metallic oxide and a reducing agent into the shape of a filament, which is gradually heated in a glass bulb by the passage of an electric current, while the bulb is being exhausted by an air-pump or an equivalent device. So far as utilisation of energy goes, these lamps are a great improvement on carbon lamps, but their filaments are very brittle, and the total production of osmium per year is only about 8 kg. for the whole world, of which 5 kg. are required for medical purposes.

In January, 1905, Dr. W. von Bolton, the head of the chemical laboratory of the firm of Siemens and Halske, announced in a lecture to the Elektrotechnische Verein of Berlin that he had succeeded in producing pure tantalum, and his discourse was followed by Dr. O. Feuerlein describing how tantalum had been utilised for filaments in the lamp works of the firm. These discourses presented the result of long years of research work based on the general principle already alluded to, that that filament would give the best economical results which could be maintained for the longest time at the highest temperature.

The number of substances capable of conducting electricity and of sustaining such high temperatures is very limited, and platinum, the most refractory of the well-known metals, had been tried and found wanting. It became, therefore, necessary to start the research by

[1] Discourse delivered at the Royal Institution on Friday, April 23, by Alex. Siemens.

devising methods for producing the rare metals in a commercially possible manner, and then to try one after the other as filaments of incandescent lamps.

While working on these lines Dr. von Bolton succeeded, in the first instance, in producing a vanadium filament by heating a mixture of vanadium pentoxide and paraffin to 1700° C., and thereby producing sticks of vanadium trioxide, which in their turn were heated by electric currents in a glass bulb exhausted by an air-pump, and so converted into metallic filaments. As it was found that vanadium melts at about 1680° C., such filaments were no improvement on carbon filaments, and the next substance to be investigated was niobium, which belongs to the same group of elements, but has nearly double the atomic weight. Treated in a similar manner, the niobium filament gave somewhat better results, but still its melting point, estimated at 1950° C., was too low for practical purposes.

In this connection it should not be forgotten that at a temperature considerably below their melting points all these metals begin either to soften or to disintegrate, so that their "working" temperature is not identical with their melting temperature.

Turning his attention to tantalum, which has an atomic weight of 181, Dr. von Bolton experimented with the black metallic powder produced by the method of Berzelius and Rose, and found that it could be rolled into a fairly coherent mass in the form of ribbons. Alternative experiments, conducted on the lines by which vanadium and niobium had been obtained, resulted in the production of pure tantalum in the form of a metallic button, which was found to be tough and malleable like steel.

These and other qualities convinced Dr. von Bolton that nobody before him had handled pure tantalum, although Berzelius had first obtained the metal by a chemical process in 1824, and later Moissan succeeded, in 1902, in producing it in his electric furnace. The latter describes tantalum as a hard, brittle metal of the specific gravity of 12·8, and a non-conductor of electricity, but he adds that the substance obtained by him contained about half a per cent. of carbon.

Considering the high atomic weight of tantalum, this admixture of carbon evidently exercises a great influence on the physical qualities of tantalum, and explains the differences between the observations of Dr. von Bolton and those of his predecessors. In nature, ores containing tantalum are found in many places, principally in Scandinavia, North America, South-west Africa, and Western Australia. Columbite from South Dakota contains from 10 per cent. to 40 per cent. of tantalum pentoxide (Ta_2O_5), and a good deal of niobium, combined with iron and manganese in various proportions.

As the separation of tantalum and niobium is somewhat troublesome, it is preferable to utilise the tantalite, which consists almost entirely of iron and manganese combined with tantalum pentoxide. From these ores tantalum is separated in the form of a fluoride in combination with potassium (K_2TaFl_7), and subsequently reduced by metallic potassium to the black powder already mentioned, which, however, still contains some oxide and some hydrogen.

In order further to purify the product, the powder is pressed into the form of small cylinders, which are melted in a vacuum, by an electric current under certain precautions, into small buttons of pure tantalum such as are exhibited.

Since the production of tantalum has been carried out on a commercial scale it has been possible to improve many details of the process, so that the tantalum produced by it at the present time is even purer than that shown in 1905 at the discourse of Dr. von Bolton and Dr. Feuerlein.

Some specimens of this latest tantalum have been submitted to Sir James Dewar, who has very kindly made experiments with reference to its specific heat and to its thermal conductivity. He ascertained the specific heat by plunging small spheres of tantalum, which had been heated to the temperature of boiling water, into water of 14° C., then transferring them to melting carbonic acid (−78° C.), and finally to liquid air (−183° C.), and as an average of several experiments the specific heat was found to be between 100° C. and 14° C.=0·033, 14° C. and −78° C.=0·032, −78° C. and −183° C.=0·028, while Dr. von Bolton in 1905 gave the specific heat as 0·0363. Multiplying these results by the atomic weight (181), it will be seen that Dr. von Bolton's value (6·57) is slightly higher and Sir James Dewar's value (5·97) lower than 6·4, which, according to Dulong and Petit, is the atomic specific heat.

The result of Sir James Dewar's experiments proves tantalum to have about three-quarters the conductivity of iron and about one-eighth the conductivity of copper. At ordinary temperatures, say below 300° C., pure tantalum resists the action of all acids except fluoric acid, of all alkalies, and of moisture, so that it is an ideal material for chemical apparatus which do not require high temperatures, and for any implements which, when made of steel, are liable to rust.

It has already been stated that pure tantalum is tough and malleable, so that it can be hammered out into thin sheets or drawn into fine wire, the diameter of the filament wire being 0·03 mm., or about one eight-hundredth of an inch; all the same, it is elastic and as hard as soft steel, and has a tensile strength of 93 kg. per square mm., which is equal to 57 tons per square inch. This means that the filament wire is capable of supporting about 80 grams, or 2·8 ozs., as can be shown by actual experiment.

Tantalum sheet can be stamped into various shapes, and out of bars of tantalum springs can be bent. Another use made of tantalum is as material for writing pens, manufactured in the usual way. When it was first offered for this purpose it was found that the material could not pass the test prescribed for pens made of steel. These are pressed by a weight of 180 grams on writing paper which is moving at the same speed as ordinary writing, and while 10 km. (6¼ miles) of paper are passing the loss by abrasion must not exceed 0·7 mg. (0·01 grain).

At first the tantalum pens lost more than double the permitted weight, but it was found that slightly oxidising the surface of the pens hardens them so much that they only lose 0·8 mg. by the 10 km. test. By weight this is still more than is permitted for steel pens, but having regard to the specific weights of the two substances the actual volumetric abrasion of the tantalum pen is the lesser of the two.

Although only the surface of the pens had been oxidised, it was found that the rate of abrasion remained the same for the whole length of 10 km., when it was expected that this rate would increase materially after the skin of oxide had been ground off.

Advantage was taken of this circumstance when an inquiry was received from India as to whether it would be possible to manufacture cataract knives for oculists out of tantalum. The qualities demanded of such a knife are that its blade should be (1) intensely hard, so as to be able to acquire a very sharp edge of great smoothness, and to retain this fine edge for a long time; (2) very tough, without any tendency to bend; (3) chemically and mechanically stable, so that it can be easily sterilised and that it is not liable to rust; (4) capable of acquiring a high polish. Manufacturing such a blade out of pure tantalum, and slightly oxidising it before polishing it, appears to fulfil these stringent conditions, but as the knife, which is on the table, has not yet been actually tried for an operation, it can only serve to demonstrate the similarity of tantalum to steel for such purposes.

Another field for the application of tantalum may be found in the supply of dental instruments, owing to its immunity from chemical changes, but beyond showing two cases of such appliances there is no necessity to go further into details. While possessing all these qualities of a true metal, tantalum has some others which rather limit its usefulness. When heated to a dull red heat it absorbs gases greedily, especially hydrogen and nitrogen, and by combining with them it loses its tensile strength and becomes brittle.

Here are three pieces of tantalum wire taken from the same coil; one of them has been heated in an atmosphere of nitrogen, the other in hydrogen, and the third has not been interfered with. The consequence is that the latter has retained its strength, while the former have become brittle and useless. On heating tantalum in air, it shows

first a yellow and then a blue tint like steel, but when the heating is continued it burns to pentoxide. The black powder and thin wires can even be lighted by applying a match to them, as the experiment shows.

Its melting point *in vacuo* lies between 2250° C. and 2300° C., which makes it particularly suitable for electrodes in vacuum tubes, especially as it does not disintegrate. For example, it is extensively used in Röntgen tubes. Its specific weight is 16·6.

Turning now to the electrical qualities of tantalum, its specific resistance was stated by Dr. von Bolton in 1905 to be, on the average, 0·165, with a temperature coefficient of 3 per cent. between 0° and 100° Celsius.

Further experiments conducted by Dr. Pirani in the laboratory of Siemens and Halske revealed the fact that wires of various thicknesses varied in their specific resistance from 0·173 to 0·188, but after they had been heated to 1900° C. in a high vacuum for from 100 to 200 hours, they all possessed the same specific resistance, viz. 0·146, and their temperature coefficient between 0° and 100° C. had risen to 0·33 per cent.

As the temperature of a tantalum filament, when consuming 1·5 watt per candle-power, is about 1850° C., and its resistance about six times its resistance at 100° C., the temperature coefficient between 100° C. and 1850° C. may be taken, on the average, as 0·29 per cent.

No doubt the difference between these results is caused by alterations in the structure of the wires during their manufacture, and the heating *in vacuo* served a similar purpose to the annealing of steel, so that Dr. Pirani's results published in 1907 may be taken as standards.

At present the most important industrial application of tantalum is its use for filaments of incandescent lamps, which may be said to date from July, 1903, when Dr. Feuerlein succeeded in producing a tantalum wire one-twentieth of a millimetre in diameter. Of this wire he made a glow lamp with a filament 54 mm. long, using a current of 9 volts 0·58 ampere, and giving a light of 3·5 candles (Hefner), at the rate of 1·5 watts per candle-power.

A simple calculation shows that for a current of 110 volts 660 mm. of the same wire would be required, giving at the same rate of consumption of energy a light of 43 candles.

In carbon lamps, for 220 volts the length of filament is only 400 mm., and the filaments remain hard until they disintegrate. Tantalum filaments, like other metallic filaments, soften, however, to such a degree that they cannot be used in the same shape as carbon filaments.

After trying various methods of housing the long Ta filament in a glass bulb of approximately the same dimensions as the carbon glow lamps, the present form was arrived at during the year 1904. In this lamp, which was adopted as standard, the length of the filament was 650 mm., its diameter 0·05 mm., and its weight 0·022 gram, so that about 45,000 of these lamps contain 1 kg. of Ta.

Since then these dimensions have been modified to a certain extent; for instance, the diameter of the filament is now only 0·03 mm., but the external shape has not been altered.

It was soon found that after burning a short time the filament underwent certain structural changes and lost its great tensile strength. Examination under a microscope revealed the fact that in about 1000 hours the smooth, cylindrical filament shows signs of capillary contraction, as if the cylinder was going to break up into a series of drops, and the surface, from being dull, commences to glitter. This contraction of the filament after being heated is readily recognised by comparing a new lamp with an old one. On the stars of the new lamp the filament hangs loosely, while in the old lamp the filament is evidently in tension.

The characteristic difference between carbon filaments and tantalum filaments is shown by a diagram representing the influence of temperature on the electric resistance of the two filaments in proportion to each other.

In order to have the differences at once shown in per cents., the normal pressure and the normal resistance of both filaments, when giving the light of 1 candle for 1·5 watts, is marked as 100, and it is immediately seen that the resistance of Ta alters directly, and that of carbon inversely, as the temperature. Owing to this quality a Ta filament is better able to resist overheating than a carbon filament, as the following experiment shows, where two lamps, one Ta and one C, burning normally at 110 volts with 1·5 watts per candle-power, are gradually exposed to higher voltages. The C lamp breaks, while the Ta lamp stands up to 200 volts, the highest voltage available here. Of course, its useful life will be shorter than at its normal voltage.

As stated at the beginning of the discourse, the primary object of all the research was to find a filament more economical in the consumption of electrical energy than the C filament, and the following experiments will show that the Ta filament is in this respect a great improvement on the C filament. To begin with, a comparison can be made by burning a Ta and a C lamp under water, each being immersed in a vessel containing the same quantity of water. Owing to the C lamp requiring more energy to give the same light as the Ta lamp, the temperature of the water in the C vessel rises quicker than in the other vessel. Another way of showing the difference is by measuring the current taken by each of the two lamps when giving approximately the same light, or by sending the same current through both lamps in series and noting the difference in candle-power.

In conclusion, two interesting qualities of Ta should be noted. The first is that, when a Ta filament is heated in a high vacuum, it will expel any oxygen that has combined with it. It is possible to detect whether a filament contains any oxide by very gradually heating it up, when the parts containing oxide will appear brighter than those consisting of pure Ta, owing to the greater electrical resistance of the oxide.

These lamps have been purposely exposed to the air while they were being exhausted, and have become "spotty" in consequence, but if they are raised a little above their proper voltage and left burning for a few minutes their filaments become quite uniform by the expulsion of the oxygen.

The second quality is that Ta will act as a rectifier when used in an electrolyte, that is to say, it will allow the passage of the positive current only in one direction. In the apparatus shown the positive current passes through the lamp to a Ta anode, thence to a Pt kathode, but in a very short time the Ta anode covers itself with a film of oxide which stops the current. When the current is reversed the lamp lights again, and continues to burn. When an alternate current is connected to the lamp it will also continue to burn, but with diminished brilliancy.

All these experiments are intended to show the remarkable qualities of this material, and when they are fully appreciated and its limitations are properly understood there appears to be a great field open to tantalum and its industrial applications.

CONFERENCE ON ROADS.

A CONFERENCE arranged by the County Council Association, in conjunction with the Association of Municipal Corporations, the Urban and Rural District Councils' Association, the Association of Municipal and County Engineers, and the County Surveyors' Association was held in London last week, and lasted over three days. The meetings were divided into three sections, which met at the Institution of Civil Engineers, the Mechanical Engineers, and the Surveyors' Institution.

This conference was very largely attended by borough and county engineers, chairmen and members of the Roads and Bridges Committee of county councils, and others interested in automobiles.

Following on the International Road Congress held at Paris last year, this gathering together of those responsible for and interested in the management of the highways of this country shows the increasing importance of road traffic and of the interest taken in the condition of our highways.

Forty papers were contributed for reading and discussion, the subjects dealt with relating to the construction and maintenance of roads; motors and traction engines,

their weight and speed, and effect of wear and tear on the roads; nationalisation of the roads, and Exchequer grants towards their maintenance; the collection of statistics and standardisation of these.

There can be no doubt that a very considerable change has come about in the requirements of roads since the advent of the motor-car. After the introduction of railways the main roads became very much neglected, and little interest was taken in their condition, but now they are more used than even in the old coaching days. For the traction engine, the motor-car, or the steam trolley the old methods of management are unsuitable, and the new conditions require different treatment. The greater part of the roads in rural districts may be described as having grown or developed, and have been built up by the use of the metalling placed on the surface without any foundation. This accounts for their unsuitableness for the rapid and heavy traffic with which they have now to contend, and for the excessive cost of maintenance.

The old turnpike roads, which constitute the greater part of the main roads now under the control of the county or borough councils, have been, as a rule, well made, and are under the management of qualified engineers, and on these roads considerable attention has been paid in the endeavour to adapt them to the altered circumstances; but on the highways which are under the management of rural district councils the case is different. These rural councils, from a false idea of economy, make use of perishable materials for repairing the roads, such as limestone or gravel, because these can be procured in the neighbourhood, and can be obtained at less price than suitable road material brought from a distance. With the same false idea of keeping down the cost, unqualified men are employed as surveyors at small salaries. Sometimes the only qualification that the applicant for this office possesses is that he has been unsuccessful in his business as a farmer.

In a pamphlet on the repair and management of roads, issued by the Roads Improvement Association for the use of surveyors of highways, it is clearly shown that roads well maintained and kept in good order cost less than bad roads repaired with inferior material. An example is given of a turnpike road which had been much neglected, of which, owing to change of management and the use of granite in place of local stone, the cost was not only considerably reduced, but from the improved surface of the road one horse was able to draw as large a load as formerly required double the number. In the same district it was also shown that the parish roads, which cost the most to maintain, were without exception those that were kept in the worst condition, and that when these were placed under efficient supervision, while the roads improved, the cost of their maintenance diminished.

The use of self-propelled vehicles, owing to the way in which they affect the surface of the roads, more than ever emphasises the necessity for the use of skilled supervision. There was a unanimous expression of opinion at the conference that the cost of maintaining the roads had very considerably increased, and that in many cases, owing to the want of proper foundations or inadequate metalling, they are quite unsuited for the class of traffic that they have now to bear.

In one of the papers read at the congress it was shown that to cover such roads with a coating of suitable material of a thickness of 3 inches, in place of the flint or limestone at present in use, would cost 1100*l.* per mile, or five millions of pounds for the south-eastern division of England, where the motor traffic is the heaviest, and to which the paper more particularly referred.

The cost of maintaining the main roads has been very largely increased owing to the wear and tear of automobiles. During the last nine years the annual cost of the main roads, which extend over a length of 27,600 miles, has risen from 2,024,711*l.* to 2,766,903*l.*, or at the rate of 76·1*l.* to 100·2*l.* per mile. In one of the southern counties the cost has been doubled.

A matter that received considerable attention at the conference was the nuisance due to the dust which prevails in dry weather along the roads frequented by self-propelled vehicles moving at great speed. Motor-cars not only raise and distribute dust in a manner previously unknown, but also are responsible for its production. This is especially the case on the roads that are in the worst state of repair. On a loose surface the fine particles, which act as a binding material to the larger stones, are sucked up by the tyres of the wheels and distributed over the road, causing inequalities and providing material for dust. A great deal of damage is also done by the sucking out of the water from the puddles when the road is wet. A rubber-tyred wheel splashing into a puddle sends the water flying out of it with a speed and force greater than any other vehicle, and converts a small puddle into a larger one. This effect is greatest where the surface is repaired with soft material, or where the material used for binding is unsuitable. On roads under the management of unskilled surveyors any material is considered sufficient for binding the larger stones used for covering the surface of the road. The scrapings of the mud off the road in winter are often made use of for this purpose, and in one of the papers read at the conference it is stated that in one district even material was dug from the sides of the road, and the metalling bedded with this. Under such practices the result, of course, cannot be otherwise than a muddy surface in winter and dust in dry weather.

Various processes have been tried as a means for preventing the generation of dust, but the one most generally adopted in this country is to make the surface of the roads waterproof by the use of pitch or tar, either as a matrix for binding the stones together or as a surface dressing. Already 1500 miles have been treated in this way. The best results are obtained where there is a good foundation, and a surface covering of sufficient thickness of the hardest and toughest material, well consolidated by rolling, with just sufficient fine chippings of the same stone to fill the void spaces, the surface being rendered impervious to water or the action of frost by the use of tar or some bituminous material. Tar macadam, which consists either of the whole material used or only of the binding material being mixed with tar before being placed on the road, has been largely used. Opinions varied as to the use of this process. In some cases it has been a complete success, in others a failure. This is probably owing to the manner in which the material has been prepared and laid, and to the quality of the tar or pitch used. To be successful it requires that the material must be mixed with the tar when it is dry, and dry weather is required when it is put on the road. If improperly mixed it either breaks up in patches, which are difficult to repair, or becomes so soft in hot weather as to work into a very uneven surface.

For surface dressing on roads already made and in good condition, spraying with tar either by hand or by a machine made for the purpose is effective, and as it adds considerably to the life of the road it does not add much to the cost of maintenance.

No reference was made in any of the papers to the practice in use in the United States, and which now extends over many hundreds of miles in California and other States, of using petroleum or bituminous oil for spraying instead of tar, which is there found to be very effective. The oil is spread from a specially designed tank-car at a rate varying from one to two gallons to the square yard. Roads so treated are fit for traffic twenty-four hours after being sprayed; they are thus rendered impervious to rain-water, and the surface remains hard and firm in hot weather.

MAGNETIC SURVEYS.[1]

THE first volume referred to below may be regarded as the coping-stone of the work done for the Coast and Geodetic Survey by Dr. Bauer during his tenure of the office of chief of division of terrestrial magnetism. Dr. Bauer had actually transferred his services to the Carnegie Institution of Washington before the volume

[1] Department of Commerce and Labour, Coast and Geodetic Survey, United States Magnetic Tables and Magnetic Charts for 1905. By L. A. Bauer. Pp. 154. (Washington: Government Printing Office, 1908.)

Magnetic Survey of the Dutch East-Indies. 1903–7. By Dr. W. van Bemmelen. Pp. 69; with charts. (Batavia: Government Printing Office, 1900.)

Survey of India. Extracts from Narrative Reports, 1906–7. (Calcutta: Superintendent Government Printing, 1909.)

appeared, but the responsibility for the work seems entirely his. The volume represents a complete magnetic survey of the United States for the epoch January 1, 1905, based on observations at 4149 stations, including 3311 in the United States itself, 575 in Canada, 201 in Mexico, and 62 in the West Indies. The great majority of the stations were occupied by Coast and Geodetic observers, but acknowledgments are made to Señor Felipe Valle for results from some seventy of the Mexican stations, and to Dr. King and Prof. Stupart for a good many results from Canada. In the United States the density of the stations varied from one per ninety square miles in Maryland to one per 2924 square miles in Idaho, the average being one per 973 square miles. Details as to instruments, methods, and sites of stations are not given, having been dealt with in previous volumes of the Survey.

Table I., pp. 18–87, summarises all the observations. It gives the name, latitude, and longitude of the station, the date of observation to 0·1 of a year, the observed values of the three elements declination (D), inclination (I), and horizontal intensity (H), the values of the elements reduced to the epoch 1905·0, and, finally, the authority. D and I are given to 0′·1, and H to 0·0001 C.G.S. (or 10 γ). The results are grouped under the States of the Union. Table II., pp. 91–5, summarises results obtained at sea in the Atlantic and Pacific Oceans, and in the Gulf of Mexico, at 241 stations, between January 1, 1903, and midsummer, 1907. In this case results are given for total intensity as well as for D, I, and H. Table III., pp. 101–7, shows the secular change in D at eighty stations representing specified portions of different States of the Union. Values of D are given at ten-year intervals from 1750, when available, down to 1900. The values for 1905 and the estimated annual changes at that date are added. Table IV., pp. 114–9, gives secular-change data for D, I, and H for five-year intervals, from 1840 downwards, for forty-seven geographical positions; *e.g.* twelve have latitude 45°, their longitudes being respectively 65°, 70° . . . 110°, 115°, and 122°·5 W. Table V., pp. 123–150, contains values of D, I, H (along with its north and east components), as well as values of the vertical intensity (V) and total intensity (T), at the intersection of all degrees of latitude and longitude on the North American continent between 17° N. and 49° N. Values of D and I are given to 0°·1, values of H to 0·001 C.G.S. These data for D, I, and H are obtained by scaling from the charts, the process not claiming an accuracy exceeding 0°·05 in D and I, or 0·0005 in H. The other force elements were apparently computed from these, but they are given to four significant figures.

The first five charts, dealing respectively with D, I, H, V, and T, are each about 28 inches by 22 inches. As to the method of construction of the charts for the three first elements, we are told (p. 153) that "the reduced values for 1905·0 . . . were plotted on a base map of about four times the size of the charts. Next the lines (isogonals, isoclinals, isomagnetics) were drawn to conform as strictly as possible with the plotted results." The V and T charts are based on values calculated by combining values of H and of I scaled from the charts for these two elements. The aim is at least to indicate all local irregularities of any importance, and, as Dr. Bauer truly remarks, "one cannot fail to be impressed by the manifold irregularities shown by the lines." This remark is especially true of the isogonals, but the V and T isomagnetics are also exceedingly irregular in the regions bordering on the great lakes. In the charts, successive D and I lines differ by 1°, successive H, V, and T lines by 0·01 C.G.S. These lines are drawn in red, geographical details being in black. The D, I, and H charts also contain blue lines, drawn to pass through the places where the secular change of the element is the same. In 1905 the agonic line—along which the needle points to the true north—ran from a little to the west of Charleston, in South Carolina, in a north-westerly direction to the north-east corner of Lake Michigan. The line of no secular change ran, roughly, parallel to the agonic line, but about 250 miles to the west of it. To the east of the line of no secular change the needle is moving to the west, and to the west of this line it is moving to the east. The extreme annual change—met with on the Pacific coast—is only about 4′. The phenomena, in a general way, are such as would ensue from a southerly movement of the north magnetic pole, and this is in general harmony with the secular changes in the other elements. H is falling and I increasing over nearly the whole United States, except in the extreme north-east, west, and north-west. There have, however, been remarkable changes in the set of the secular change of late years, showing that the real phenomenon is of a very complicated character, which renders any forecast for the future very uncertain.

The two last charts are of a different character from the others. No. 6 shows "magnetic meridians," defined as horizontal lines which have for their tangent at every point the direction of the compass needle. No. 7 gives secular-change curves of two types, one showing the change of absolute direction in space of the freely dipping needle, the other showing changes in the horizontal intensity.

The work is one which merits, and will doubtless receive, close attention from all who are engaged, or are likely to be soon engaged, in magnetic surveys. It is interesting to learn (p. 13) that corrections for diurnal inequality were applied only in the case of the declination. In the case of the inclination and horizontal intensity, Dr. Bauer's opinion seems to be that corrections for diurnal inequality "are, in general, of the order of the error of observation, and certainly much less than the 'station error' due to the irregular distribution of the earth's magnetism." He was presumably influenced, in part, by the consideration that secular change in H varies over the United States from +20 γ to −70 γ per annum, so that a knowledge of the annual change, even to the nearest 10 γ, must be difficult to acquire in the regions more remote from magnetic observatories. How disturbances are dealt with does not seem to be stated. If Dr. Bauer's views are correct, and they are based probably on a wider experience than that of any other man living, one cannot help thinking that extreme refinement in field instruments or observations may be largely thrown away in the case of a general survey of a large area. If we may borrow and extend a military metaphor, supreme importance attaches, not so much to the gun, or even to the man immediately behind it, as to the general.

In the second volume we have a survey for the epoch 1905·5 of the Dutch East Indies, made under the direction of Dr. W. van Bemmelen, of the Batavia Observatory. The area included extends from Sumatra in the west to the borders of Dutch and German New Guinea in the east (95° to 141° E.), and from Timor in the south to Mandanao (Philippines) in the north (11° S. to 8° N.). The area is thus very big, including much sea and many small islands, in addition to Sumatra, Java, Celebes, and parts of Borneo and New Guinea. There were 158 stations, a considerable number being on the smaller islands, but none at sea; they were occupied during 1903 to 1907. Owing, no doubt, in part to the relatively small number of his stations, Dr. van Bemmelen's practices are in many respects the antithesis of Dr. Bauer's. The former attaches comparatively little importance to the exact site of his stations. On the other hand, though having continuous records from only one observatory, he applies corrections to all the elements to eliminate the diurnal inequality and irregular variations, going to 0′·1 in declination and dip, and to 1 γ in horizontal force. The Dutch charts, again, unlike the American, take no account of local peculiarities, but resemble the world charts of the British Admiralty in the bold sweep of their lines. They are drawn on thick paper in the body of the volume, and, again unlike the American, present quite an artistic appearance.

Dr. van Bemmelen gives the values of the magnetic elements at intersections of degrees of latitude and longitude, going to 0°·01 in declination, 0°·1 in dip, and to 0·0001 C.G.S. in the total force and in its vertical, horizontal, southerly, and easterly components. He reproduces, with some corrections, the results of two previous surveys of the East Indies, one for the epoch 1848·0, by Captain C. M. Elliot, the other for 1876·5, by Dr. E. van Ryckevorsel, and makes use of these in discussing the secular change. Though representing a much smaller amount of field work than the American, the Dutch survey

presents—as one expects from Dr. van Bemmelen—many ingenious ideas, which, if not all equally valuable, are at least suggestive. Observers in tropical countries, for instance, will be interested to learn how he dealt with mosquito troubles, and how he rendered the beats of his chronometer audible during rain-storms. To those now engaged in the magnetic survey of India, the work must be one of especial interest.

The third volume describes the work done in 1906–7 by the Survey of India. Besides interesting details as to pendulum and tidal work, levelling and ordinary surveying, it gives an unusually full account of the progress of the magnetic survey under Captain Thomas, R.E. As in previous volumes, there is an account of elaborate instrumental investigations, but the most novel part is a discussion of formulæ got out by Mr. J. Eccles—acting, apparently, on a suggestion by Sir A. Rücker—for deducing the diurnal inequalities of declination and horizontal force at any intermediate place from those recorded at two magnetic observatories. There are comparisons of the inequalities observed at one magnetic observatory with those calculated for its latitude and longitude from the inequalities at two other observatories. The agreement is pronounced very satisfactory. The formulæ seem based on the assumptions that the diurnal inequality at a given latitude is a function only of the local time, and that for the area concerned the rate of variation with latitude of the departure at any local hour from the mean value for the day is constant both for the northerly and easterly components of force.

So limited a hypothesis seems hardly likely to prove very satisfactory unless confined to somewhat restricted areas, and when one looks into the observed and calculated values, especially those for the declination, one finds that, *relatively to the amplitude of the inequality*, the agreement is less satisfactory than one would have inferred from the comments made. The declination diurnal inequality, however, in India is so small that even large percentage departures from accuracy would be of minor consequence from a survey point of view.

Various prospective difficulties are referred to in connection with the distribution of magnetic storms, the difference between mean values from all and quiet days, and similar matters. The nature of the answer to several of the problems mentioned might perhaps be anticipated from what is already known from other sources; but one cannot avoid a suspicion that, unless India is singularly free from local magnetic disturbances, some of the difficulties referred to may prove to be of secondary importance. It will certainly require no small amount of knowledge and ingenuity to utilise to the full all the refinements which it is intended to introduce into the observational material.

C. CHREE.

BIRD NOTES.

FROM Dr. Thienemann, director of the Vogelwarte (ornithological station) at Rossitten, on the Baltic, we have received three papers relating to the recent work of that establishment. The first of these, which deals with marked storks and swallows, is an extract from Reichenow's *Ornithol. Monatsberichte* for October, 1908; the second, in which the migration of storks is discussed at some length, was originally published in *Land- und Forstwirkschaftliche Zeitung* for September; while the third, relating to marked storks in Africa, gives no clue as to its place of publication. A note on this third paper appeared in the *Times* of April 5. In connection with these, it may be mentioned that a very interesting article by Mr. A. L. Thomson on the work of the Rossitten station, and more especially the method of marking birds, is published in the April number of Witherby's *British Birds*.

As regards the capture of marked storks in Africa, reference in NATURE has been already made to the specimen recently killed in Natal. Dr. Thienemann now tells us of the capture, at Morija, Basutoland, of a Rossitten bird in February last. This is the most southerly point reached by a stork liberated in east Prussia, but the Natal bird, which was set free in Hungary, went further, although the distance from the point of liberation was less. Other records include a stork, one of a brood of three marked near Königsberg in June, 1906, the ring and foot of which were brought by natives to a French officer near Lake Tchad, the bird having been snared in October of the same year on the Fittri Lagoon. A stork from a brood of three, liberated near Koslin, Pomerania, in July, 1907, was taken the following winter near Fort Jameson, Rhodesia. It is now, therefore, certain that European storks habitually migrate to South Africa, and the next point to ascertain is whether they ever breed south of the equator.

According to the *Times* of April 26, the capture of a marked stork near Jerusalem has been reported to the Hungarian Central Bureau for Ornithology, Budapest. A flock of more than 2000 storks alighted to rest by one of the lakes near Jerusalem, and five were caught. The marked bird was hatched at Egri, in eastern Hungary, last season, and marked with the stork-ring No. 293 on July 8, 1908; it will be placed in the new Palestine Museum. The storks seen were on their homeward journey, probably from South Africa. This capture is considered important as showing that these birds do not pass over the Mediterranean Sea, but follow the longer route over the land.

That the South African honey-guides (Indicatoridæ) are parasitic in the matter of egg-laying has been long known, but it appears from a paper by the Rev. Noel Roberts in the April number of the Journal of the South African Ornithologists' Union that this habit is shared by certain members of the whydah-bird group (Ploceidæ). From a paper in vol. iii., No. 1, of the same journal, it seems that this parasitic habit has been demonstrated in the case of the pied whydah-bird (*Vidua principalis*), and in the issue now before us Mr. Noel gives reasons—although these are not quite so clear or convincing as they might be—that the same holds good in the case of the typical species of the genus Quelea. In the author's opinion, this bird deposits its eggs, at all events in some instances, in the nests of another member of the same family, namely, *Pyromelana oryx*. It may be hoped that further investigations will be undertaken for the purpose of confirming these interesting observations.

Naturen for April contains a paper, by O. J. Pettersen, on the habits and distribution of the redbreast.

In the course of his annual report on Norfolk ornithology, published in the April number of the *Zoologist*, Mr. J. H. Gurney comments on the scarcity of nightingales, spotted flycatchers, willow-wrens, and various kinds of warblers during the summer of 1908. This scarcity the author attributes to the great snowfall which took place on April 23 of that year. Three features in the autumn migration were noteworthy, namely, the number of redstarts on September 23, the great flights of rooks, crows, and starlings on October 18 and 19, and the abundance of woodcock.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An anonymous benefactor has expressed his willingness to contribute a sum of 500*l.*, if required, to supplement the 500*l.* which the Senate has already voted towards defraying the cost of the Darwin commemoration.

Prof. Woodhead has been re-appointed as the representative of the University of Cambridge on the council of the Lister Institute of Preventive Medicine.

At the Congregation on Thursday, May 13, the following Grace will be offered to the Senate:—That there be established in the University a professorship of astrophysics, and that such professorship be governed by the following rules:—(1) the professorship shall be called the professorship of astrophysics, and shall terminate with the tenure of office of the professor first elected; (2) it shall be the duty of the professor to promote by research and teaching the study of astrophysics; (3) the professor shall receive no stipend from the University; (4) the special board of studies to which the professor shall be assigned shall be the special board for physics and chemistry.

Major P. G. Craigie, C.B., will deliver the Gilbey

lectures for 1909, on the history and economics of agriculture, on May 10 and 11, at 5 p.m., in the University Chemical Laboratory, Pembroke Street. The lectures will deal largely with the sources of the cereal supply and with the agricultural history and economic position of the Russian Empire; of British India and its varying wheat exports; with the developing areas of the Argentine Republic, both as regards wheat and meat export; and will conclude with an examination of the resources and exporting prospects of the possessions of the British Crown in Australasia and in the Dominion of Canada.

LONDON.—Offices have now been definitely assigned to the Royal Commission on University Education in London, and all communications in reference thereto should in future be addressed to the joint secretaries, 12 Queen Anne's Gate, S.W.

A course of eight lectures on the "Structure and Functions of the Central Nervous System" will be given in the Physiological Institute (University College) by Dr. W. Page May on Tuesdays at 5 p.m., beginning on Tuesday, May 11. The lectures are open to all students of the University, also to qualified medical men on presentation of their cards.

OXFORD.—Much interest has been aroused by the publication of the Chancellor's letter on "Principles and Methods of University Reform." All parties seem agreed in appreciation of the fulness and lucidity of the memorandum, and of the statesmanlike qualities shown by its author. Many of Lord Curzon's proposals will be accepted in most quarters as practicable and salutary; as to others, opinions will differ. It is too soon as yet to attempt any detailed criticism of the proposed new measures, but it is satisfactory to see that Lord Curzon fully recognises the obligation that rests on the University to take its part in extending the boundaries of science. "Oxford," he says, "should train its scholars, not merely to acquire knowledge, but to increase it." The efforts of the University should be directed towards attracting, by encouragement and rewards, men who are capable of advanced and original work. Various means are suggested by which this might be done more effectually than at present, among the most important being the establishment of a system of coordination between the university and the colleges, having for its object the adoption of a general policy of research.

THE April number of the Journal of the Association of Teachers in Technical Institutions contains the programme of the Whitsuntide meeting of the association, to be held in Liverpool from May 29 to June 2. The arrangements include a visit to the R.M.S. *Mauretania*, and one to Eaton Hall. In addition to the accounts given of matters more particularly interesting to members of the society, there are useful short articles on methods of teaching in technical classes. Under the title "The Artisan's Claim to Technical Education," Mr. W. T. Emery advocates the establishment of trade schools in all our towns, believing that they would be efficient substitutes for the dying apprenticeship system. In time they would become much more, and he hoped for legislation to "limit employment under eighteen years of age to thirty hours a week, with thirty hours' technical instruction" (*cf.* Minority Report of the Poor Law Commission).

THE recently issued administrative report of the Missouri Botanical Garden, and an announcement of Washington University concerning the Henry Shaw School of Botany, indicate that the Shaw foundation is on the eve of entering on a much increased activity. Although Henry Shaw in 1885 endowed a school of botany in Washington University, to the head of which Prof. Trelease was called from the University of Wisconsin, the provision made was practically for only a chair of botany. Four years later, on the death of Mr. Shaw, his fortune, appraised at several million dollars, passed to the care of trustees for the maintenance of his long-established and well-known garden, and for the further development of an institution of research and instruction in botany and allied sciences, the head of the school of botany being selected as its director. It is now announced that a definite step toward the development contemplated by the founder and planned by the director has been taken in the establishment of the post of plant physiologist at the garden, and the creation of a professorship of plant physiology and applied botany in the Shaw School of Botany, with provision for two research fellowships in botany. Dr. George T. Moore has been appointed to the new professorship.

OUR esteemed contemporary, *Engineering*, in a leading article of April 23 dealing with "Engineering and Mathematics," takes exception to our recent remarks upon the advantage of theoretical training to the artisan. The writer of this article says that every foreman and works manager will asseverate with no little emphasis the opinion that the best handicraftsmen amongst his apprentices are not generally to be found amongst those most constant in their attendance at technical classes. We agree that this, unfortunately, is too often the case, but cannot accept the writer's explanation that this is generally owing to lack of interest in theoretical principles on the part of apprentices. Any teacher who has had extended experience of evening classes will easily give the correct explanation by referring to the huge annual bundle of reasons for absence—almost invariably overtime on the part of his best students. Overtime costs money in wages at a higher rate, and inferior apprentices are not wanted for overtime; consequently the best are selected by the foreman or manager, who, being too often himself without theoretical training, has little sympathy for his apprentices' progress in this direction. We suggest that our contemporary should refer to those cases in which the works' authorities give full facilities, without compulsion, for attendance at classes, when the opinion expressed will be probably modified.

WE have received the first volume of the report of the United States Commissioner of Education, dealing with the year ended June 30, 1908. The greater part of the work (nearly 400 pages) is occupied by statistics, accompanied by running commentary. Recent progress is reviewed, not only in the United States, Porto Rico, and the Philippines, but also in the United Kingdom, in Europe, and in Spanish-American countries. We learn that the Bureau of Education has re-organised its library so as to render this collection of 150,000 educational publications available for direct service to the institutions of the country. From the commissioner's introduction we gather that the marked features of the year were the State Educational Commissions now working in ten States, the rigour of voluntary organisations, and the general effort to "standardise" American education. This is described as "the pure-food movement in our spiritual world, necessary to the soundness of our educational freedom and experimentation." International congresses were remarkably numerous last year, and the commissioner regards as the main movement in England, France, and Germany the gradual integration of the educational system. As specially characteristic of British cities, he notes the completeness with which the entire child population is brought under control, and the provision made for promoting the physical well-being of the children. He notes the growing agencies for assisting children in their search for work when their school life is ended. He considers London to be far inferior to New York in the extent of its *public* provision for education beyond the elementary stage. Whereas in the States the disposition is to open higher education freely to all children, the effort in England is to discover and encourage special ability.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 10, 1908.—"Electrolytes and Colloids. The Physical State of Gluten." By Prof. T. B. **Wood** and W. B. **Hardy**, F.R.S.

Gluten is the chief protein of wheat flour. In presence of water and salts it forms a tenacious, stringy substance, which confers upon dough its characteristic physical properties. Like other colloids, the physical state of gluten is determined by the electrolytes which are present. If the salts be washed away with ordinary distilled

water, gluten gradually loses its coherence, and disperses as a cloudy, colloidal solution or hydrosol, which is precipitated by a trace of salt or alkali. The change is due, not to the water, but to the carbonic acid which is present. In the absence of salts cohesion is destroyed by traces of acid or alkali. With low salt content 0·0001 normal acid, for instance, disperses the protein almost instantaneously. Strong acids, however, disperse gluten only when their concentration is low. Above a certain critical value, *e.g.* 0·05 normal HCl, the acid restores and maintains cohesion. Alkalies act in the same way.

A hydrosol of gluten is precipitated by salt, and the gluten restored to its characteristic stringy state. There is, therefore, an antagonism between salts and acids or alkalies.

The relations between acids and salts were investigated by varying the concentration of acid and determining the concentration of salt necessary to maintain cohesion, *i.e.* to oppose completely the dispersive power of the acid. The results show that at first, as the concentration of acid increases, the concentration of salt must be increased also until a point is reached beyond which further addition of acid lessens the quantity of salt which is needed to preserve cohesion.

We may conclude from this that the dispersive action of acid increases with increasing concentration to a maximum beyond which it decreases to zero. A weak acid, such as lactic acid, will not maintain cohesion at any concentration.

Very dilute acid or alkali breaks up coherent gluten by forming round each protein particle a double electric layer. The protein may be looked upon as an amphoteric electrolyte similar to an amino-acid. It reacts with acids or alkalies to form salts of a peculiar nature, which, by ionisation, form double electric layers. Excess acid or alkali suppresses the feeble ionisation, and so restores cohesion.

The potential difference between protein and fluid was determined by measurements of the migration of the protein in unit field. It was found to increase with increase in the concentration of a strong acid up to a maximum, beyond which it diminishes. The curve expressing the relation of concentration of acid to the potential difference has the same form as that which expresses the effect of a salt upon the dispersive power of acid. Salts act by preventing the formation of electric double layers.

April 29.—Sir Archibald Geikie, K.C.B., president, in the chair.—Note on the results of cooling certain hydrated platin-cyanides in liquid air: J. Emerson **Reynolds.** Some months ago Sir James Dewar directed the writer's attention to the fact that a colourless crystalline material, which was supposed to be lithium platino-cyanide, became temporarily *red* when cooled in liquid air. On repeating the experiment with some of the material which Sir James Dewar had placed in the writer's hands for examination, he found that, after several repetitions of the treatment, a permanent yellow substance was also formed, which did not return to the usual colourless condition at ordinary temperatures. Chemical examination of the material led to the conclusion that it was a mixture of lithium chloride, cyanide, and sulphate, including merely a trace of platino-cyanide, but that rather less than 5 per cent. of *lithium platinicyanide* was present, and that the colour changes at low temperatures were due to the presence of the latter salt. Pure lithium platino-cyanide was freshly prepared for comparison, and when analysed was found to consist of $Li_2Pt(CN)_4,5H_2O$. The grass-green crystals of this salt did not become red when immersed in liquid air, but merely became paler in tint, therefore that salt could not be concerned in the production of the phenomena noted above. On the other hand, pure lithium platinicyanide, when fully hydrated, was shown by analysis to have the composition

$$Li_2Pt(CN)_5,3H_2O.$$

When the nearly colourless crystals of this compound were slowly cooled in liquid air they became of an intense *red* colour, and this change was found to coincide with the loss of one molecule of water of crystallisation, which was resumed when the temperature was allowed to rise, the colourless tri-hydrate being reproduced. Further, on *rapid* cooling of the tri-hydrate, a portion always passed beyond the red stage, and more or less of a *yellow* substance was formed. This turned out to be a yellow mono-hydrate. This hydrate also resumes water at ordinary temperatures, and affords the colourless tri-hydrate; but it was found that when certain neutral salts are present, as in the case of Sir J. Dewar's material, this re-hydration is inhibited, and the yellow mono-hydrate persists at higher temperature—hence all the phenomena noted at the outset were explained. Similar changes of colour and composition can be effected by heating the platinicyanide, but this appears to be the first case in which successive stages of dehydration of a crystallised salt have been traced on cooling the substance in liquid air.—A phenomenon connected with the discharge of electricity from pointed conductors; with a note by John Zeleny: H. T. **Barnes** and A. N. **Shaw.** In the study of point discharge made by Prof. John Zeleny, it was noticed that, when examined under the microscope, steel needle points, after discharging as anode, showed an irregular deposit, which extended outwards some little distance, and resembled ordinary rust. A much smaller deposit was noticed when the point was made the kathode. The authors have investigated, somewhat in detail, the character of this deposit, not only for steel points, but also for points of other metals. Using a microscope of high power, it was possible to distinguish characteristic forms of the deposit. These the authors classify as (1) a granular deposit; (2) a tubular deposit; (3) a smooth formation; and (4) a thin film formation. The four types are all probably connected with each other, but in appearance they are quite distinct. The tubular formation is perhaps the most interesting, and appears to be a tube of oxide growing up around a minute droplet of water, or, perhaps, hydrogen peroxide. These tubes were seen to elongate under the microscope when blown upon by moist air, and to swell up at the end as though water vapour were condensing through the thin film of oxide closing the tube. In some cases the swelling caused the oxide film to burst. In dry air the liquid appeared to recede in the tube, leaving a hard, horny structure of oxide extended. The granular deposit appeared to be broken down tubes, while the smooth formation appeared to be drops of liquid with oxide so hardened as to be incapable of extension. The thin film formation was produced only on metals less easily oxidised. The appearance of water drops on the point makes it seem probable that it is the water vapour in the discharge chamber which has condensed around the negative ions and been swept into the anode point. Discharging in absolutely dry air gave no sign of any deposit on even the most easily oxidised metals. The slightest trace of moisture in the chamber caused a growth of deposit as much as 50 per cent. of the total amount obtained when discharging in steam. The metals giving the greatest deposit were aluminium, zinc, steel, and cadmium, while gold was found to give no deposit at all. Prof. Zeleny points out that the presence of water droplets on the point indicates a much lower temperature there than the luminosity might lead us to expect. This he verifies by making a point out of the junction of two dissimilar metals.—The effect of temperature on ionisation: J. A. **Crowther.** The effect of temperature on the ionisation produced in a gas by Röntgen rays was first investigated by Perrin, who, using air, concluded that the total ionisation in a gas was independent of the temperature if the pressure were kept constant. McClung, however, who repeated these experiments later with air, carbon dioxide, and hydrogen, found that the ionisation in a gas was independent of the temperature if the density of the gas is kept constant, that is, if it is heated at constant volume. Although no source of error could be indicated in Perrin's work, there was little doubt that the later experiments of McClung were correct, and that between the limits of his experiments (15° C. to 272° C.) and for the gases used the ionisation produced by Röntgen rays was independent of the temperature when the gas was kept at constant density. It is well known that the ionisation produced by rays of given intensity in certain gases and vapours, for example, methyl iodide, ethyl bromide, or carbon tetrachloride, is much greater than that in air or carbon dioxide. The present investigation was made to discover

(i) if the effect of temperature on the ionisation produced in these gases and vapours were the same as for air; (ii) if cooling down air to a temperature near its condensation point produced any appreciable alteration in the ionisation produced in it by rays of given intensity. As it is almost impossible to clean out completely a vessel which has once contained organic vapours, the second experiment was performed first. The ionisation produced by Röntgen rays has been measured in air at the temperature of liquid air, and in ethyl bromide and methyl iodide, at various temperatures up to 184° C. It was found that in every case the amount of ionisation produced was independent of the temperature of the gas if the density of the gas remained constant.—The wave-making resistance of ships: a theoretical and practical analysis: T. H. **Havelock.** The usual estimates of the wave-making resistance of ships rest on a formula obtained for "two-dimensional" motion, that is, for motion confined to transverse waves of uniform height; if a is the amplitude of the waves and v their velocity, the wave-making resistance R is proportional to a^2 for deep water. Hence there arise formulæ which make R proportional to v^4, by supposing that a varies as v^2. Regarding, however, the ship as in this respect equivalent to a travelling band of pressure disturbance, a simple type of distribution leads to wave-ridges giving a formula for R in which the velocity enters in the form e^{-a/v^2}. This function is shown to have the general character of experimental curves of residuary resistance. From a consideration of the waves diverging from bow and stern, and the interference of these systems, a semi-empirical formula,

$$R = ae^{-2\cdot53/9c^4} + \beta\{1 - \gamma\cos(10\cdot2/c^2)\}e^{-2\cdot53/c^2},$$

is obtained. Here R is in lbs. per ton displacement of the ship, and c is the speed-length ratio, viz. (speed in knots)/$\sqrt{}$(length of ship in feet); α, β, γ are adjustable constants, which depend upon the form of the ship. Various experimental model curves are examined, and it is shown that these can be represented very well by a formula of the above type. It is found that the constant α is small relatively; and if the comparison is limited to values of c from about 0·9 upwards, the curves can also be fitted by an alternative formula of the type

$$R = \beta\{1 - \gamma\cos(10\cdot2/c^2)\}e^{-n/c^2}.$$

The effect of finite depth of water is considered, and a modification of the formula is obtained to express this effect as far as possible. Starting from an experimental curve for deep water, curves are drawn from the formula for the transverse wave-resistance of the same model with different depths; although certain simplifications have to be made, the curves show the character of the effect, and allow an estimate of the stage at which it becomes appreciable. Finally, the question of other types of pressure distribution is discussed, and one is given in illustration of the wave-making resistance of an entirely submerged vessel.—The ionisation of various gases by secondary γ rays: R. D. **Kleeman.** The ionisations of a number of gases relative to the ionisation of air by the secondary γ rays from substances exposed to the γ rays of radium were measured. Secondary radiators of lead, zinc, and carbon were used. It was found that the ionisations of gases the molecules of which consist of atoms of H, C, N, O, S, Cl, with the exception of H_2, are practically the same as those obtained with the primary γ rays; but the secondary rays produce a greater relative amount of ionisation than the primary in gases the molecules of which contain atoms of higher atomic weight than that of chlorine. The ionisation of H_2 is abnormal; it is smaller with the secondary rays than with the primary. The ionisations of the various gases, with the exception of H_2, obey approximately an additive law. The atomic ionisations, by means of which the ionisations in the gases can be calculated, increase more rapidly with the atomic weight with the secondary rays than with the primary.

Geological Society, April 7.—Prof. W. J. Sollas, F.R.S., president, and afterwards Mr. H. W. Monckton, vice-president, in the chair.—Overthrusts at Tintagel (north Cornwall): H. **Dewey.** In this paper the author deals with the geological structure of the Tintagel area. After brief reference to the stratigraphy north of Bodmin Moor, mention is made of the apparent difference in order of superposition of the beds near Tintagel. The several types into which the Upper Devonian rocks are divided are next described.—The Lahat "pipe": a description of a tin-ore deposit in Perak (Federated Malay States): J. B. **Scrivenor.** Large quantities of tin ore have been obtained during recent years in the Kinta district of Perak, principally from detrital deposits, but also in some cases from the limestone which forms the floor of the Kinta Valley. From 1903 until 1907 the Société des Étains de Kinta secured more than 1000 tons of dressed tin ore from a peculiar deposit which had the form of a pipe in the limestone, measuring only 7 feet by 2 feet at the surface, but widening when followed downwards. It was worked to a depth of 314 feet. The veinstone was a deep red mixture of calcite and iron oxide with some quartz, chalybite, and chalcopyrite, but no tourmaline was found in it. In this the cassiterite occurred in irregular pieces and broken fragments, some of which consisted of radiating needles. In Kinta the tin ores occur in the limestone in two different ways:—(1) As lodes or veins with fresh sulphides, but not iron oxides. The tin-oxide crystals have a definite arrangement. (2) As transformed masses, deposited in fissures. The cassiterite is in rounded grains, and quartz, tourmaline, and other materials, also well rounded, accompany it. The Lahat pipe is a lode deposit which has been converted into a detrital deposit *in situ*. —The sculptures of the Chalk Downs in Kent, Surrey, and Sussex: G. **Clinch.** The author classifies the various forms of sculpture of the Chalk Downs under three heads, namely, (1) dry valleys of simple form; (2) dry valleys of complex form; and (3) wet valleys. He directs attention to the relatively small catchment-areas of the dry valleys, and to the large number of tributary valleys found in some districts, two points which he considers have not received hitherto entirely satisfactory explanation. While accepting the view that frozen conditions in former times altered the drainage system of the Chalk, he argues that the most potent excavating force was the frost itself acting on Chalk saturated or highly charged with water. He propounds a theory to account for (1) the great size and breadth of the valleys in relation to their catchment-basins; (2) the ramifications of some of the valley systems; and (3) the remarkable fact that many dry valleys die out just before the crest of the Chalk Downs is reached.

Royal Anthropological Institute, April 20.—Prof. W. Ridgeway, president, in the chair.—The Blackfeet Indians of Montana: W. **MacClintock.** The author has an intimate acquaintance with these Indians, having been adopted as son by Mad Wolf, one of the chiefs. The Indians were shown in their great summer encampment on the plains, and views were given of many of the lodges. These are all painted with various symbols of great interest, the heavens being usually shown at the top of the lodge, and the earth at the bottom, with various sacred animals in the middle. One of the lodges was painted with a pictorial description of the owner's victories and achievements, as also was the chief's war-horse. The great feature of this summer camp was the sun ceremony, for the tribe believes that it is descended from the sun and moon, whose grandchild, the son of the morning star, was sent down to earth. A spotless woman is the chief of the festival, and on arrival at the chosen place this woman, with her attendants and priests, fasts and prays for four days, during which time the other inmates of the camp amuse themselves with mimic warfare and games. On the third day the woman proceeds to a spot already selected, and offers a meat offering of buffalo tongues. On this spot the sun tent, a simple erection of poles, is erected, and after it has been blessed by the holy woman it becomes the central point of all the subsequent ceremonies. These consist of games, acting, and the recitation of their deeds of valour by the chiefs. The ceremonies conclude by the chief priest wishing the tribe prosperity during the coming year.

Royal Meteorological Society, April 21.—Mr. H. Mollish, president, in the chair.—Percolation, evaporation, and condensation: Baldwin **Latham.** The author gave the results of the observations which he had carried out at Croydon on these subjects during the last thirty

years. Two percolation gauges were used, both of which were exactly a superficial yard in area, and contained a cubic yard of natural soil, one of chalk and the other of gravel. The average annual amount of percolation through the chalk gauge was 10·84 inches, and through the gravel gauge 10·34 inches. The average yearly rainfall was 25·46 inches. It appears that the rate of percolation is governed by the rate of rainfall, for when once the gauges have become sensitive, by being thoroughly wetted, the rate at which rain percolates depends entirely on the quantity of rain immediately falling. The evaporator used for determining the evaporation was a floating copper vessel 1 foot in diameter supported by a life-buoy ring, connected by four arms with the evaporating vessel, the whole being floated in a tank of 4 feet internal diameter containing about 3 feet depth of water. The average annual amount of evaporation by this gauge was 18·14 inches, and the average amount of condensation was 0·36 inch.—The meteorological conditions in the Philippine Islands, 1908: Rev. José **Algué.** The year 1908 was one of extraordinary meteorological conditions. Heavy floods occurred, and frequent violent cyclonic storms passed over or affected the archipelago. The author stated that out of the fourteen typhoons of extraordinary intensity which have occurred during the past twenty-nine years, five occurred in the year 1908, the most violent being those of September 23, October 13, and December 5. It seems that the part of the archipelago which is visited the most frequently by these extraordinary typhoons is the northern part of Luzon from the parallel 15° 30′ to the Batanes Islands, and from parallel 11° to 14° N.

Mathematical Society, April 22.—Sir W. D. Niven, president, in the chair.—The principles of the general theory of integral functions: F. **Tavani.**—The equations of electrodynamics and the null influence of the earth's motion on optical and electrical phenomena: H. R. **Hassé.**—Solution of a certain transcendental equation: G. N. **Watson.**—Physical applications of certain conformal transformations of a space of four dimensions and the representation of a space time point by means of a sphere: H. **Bateman.**—Some criteria for the residues of eighth and other powers: A. E. **Western.**—Discontinuities of a function of one or more real variables: Dr. W. H. **Young.**

Institution of Mining and Metallurgy, April 22.—Mr. Edgar Taylor, president, in the chair.—The valuation of mining areas on the Rand: W. Fischer **Wilkinson.** In this paper the author points out that, to calculate the most suitable rate of working for any given area, it is necessary, in the first place, to make an estimate of the probable tonnage and the value of the ore, and that then the problem is to be solved in accordance with the following elements:—capital expenditure required for a given production, the available tonnage and its value, the cost of working, and the rate of interest required. On account of the last-named element, time is the important factor, and the paper proceeds to quote instances of the bearing of this factor on the profitable working of any given property, in the correlation of profit per ton and the suitable duration of life of the mine. Incidentally, the author is in favour of attacking the rich reefs and the richest sections of the poorer reefs first, in order to give a higher grade during the early years of a mine's life.—The "wholesale" idea in gold mining: W. R. **Feldtmann.** The author of this paper is in favour of increasing reduction plant up to the practicable producing limit of a mine, his claim being that large-scale working is directly conducive to the best economic results, and that it is the maximum total net profit during the life of a mine that should be striven for rather than low costs or high profits per ton, as the case may be, one of the factors being the reduction of costs per ton and the other the grade and annual quantity of ore available, these interacting one on the other. This is illustrated by a series of diagrams, which serve to bear out the author's argument that, on a paying mine, an increase in the tonnage crushed, by additions of ore of a yield grade anything in excess of the "unit charge," will result in an increased annual and total working profit.—The computation of the present value of developed and undeveloped mines: W. H. **Goodchild.** In this paper the author deals with certain debatable points in the practice of computing the present gross value of a mining property, giving instances of the different methods of calculation adopted by various authorities, and the influence produced by the peculiar characteristics of a given mine and its state of development.

PARIS.

Academy of Sciences, April 26.—M. Émile Picard in the chair.—Invisible pathogenic micro-organisms and the physical proofs of their existence: A. **Chauveau.** The organism of ordinary vaccine is still unknown; the effects produced by inoculating with vaccine of gradually increasing dilution prove that the virulent agents are constituted by independent corpuscular elements, held in suspension in the fluid. That the virus is not of a crystalline or colloidal nature is shown by the fact that a vaccine covered with water, and allowed to diffuse, does not communicate any virulent properties to the upper layers. The invisible agents of the virulence of vaccine are regarded as being certainly living beings.—The resinous nature of the bark of Sarcocaulon of the Cape and of some Kalanchœ of Madagascar: Edouard **Heckel.**—The hydrodynamical conditions of form in fishes: Frédéric **Houssay.** A description of experiments on the loss of energy during the propulsion through water of six models of geometrical form. From the results, the form of a fish would not appear to correspond to that of minimum resistance; loss of speed would seem to correspond to a gain of stability.—The photographic determination of the colours of the stars: Oesten **Bergstrand.** A grating, with bands 1·5 mm. in width, was placed before the opening of the telescope, thus producing a series of symmetrically placed diffraction spectra at the focus. By measuring the distance between the two spectra of the first order, the effective wave-length of the light from the star in question could be determined. The results are expressed in a scale in which 0 corresponds to a mean wave-length $\lambda=419{\cdot}9\ \mu\mu$, and 12, $\lambda=449{\cdot}6\ \mu\mu$. Stars can be divided into two well-marked classes—white stars ($\lambda=420\ \mu\mu$) and yellow stars ($\lambda=440$ to $450\ \mu\mu$). The qualities of the two groups appear to be quite different, and the transition from the one to the other is sudden.—Congruences of normals and contact transformations: Jules **Drach.**—The theorem of the existence of implicit functions: W. **Stekloff.**—Critical logarithmic points: Mme. Valérie **Dienes.**—A partial differential equation of the hyperbolic type: A. **Myller.**—Hyperelliptic surfaces: M. **Chillemi.**—Stability and diffusion; the action of mass. Mechanical analogies of the laws of displacement of equilibrium: C. **Raveau.**—Polarisation by lateral diffusion: Georges **Meslin.** It is known that when a ray of light passes through a column of a transparent liquid, the light issuing perpendicular to the direction of the ray is polarised. If the liquid contains crystalline particles in suspension, the quantity of light issuing laterally is increased, but the proportion of polarised light is diminished. In the present note a singular exception is described in the case of boric acid associated with a liquid of a refractive index greater than 1·42 (that of boric acid itself). In this case, the light issuing laterally is partially polarised, with its plane of polarisation perpendicular to the plane of diffusion. Another anomaly afforded by boric acid is that liquids in which it is a constituent possess spontaneous dichroïsm.—A divergent amplifying microscope: Alphonse **Berget.** A doubly concave lens is placed between the objective and the eye-piece. The arrangement permits of an objective of longer focal length being employed for a given magnification.—The evaporation of aqueous solutions: P. **Vaillant.** The vapour pressure is determined by observing the loss of weight of the solution placed in a flat dish on a sensitive balance.—Researches on the density of acetylene: E. **Mathias.** Details of a series of observations on carefully purified acetylene. The densities of the liquid and vapour were measured at various temperatures between −23·75° and 32·93°. The critical temperature, measured by the method of S. Young, was found to be 37·05°. The values are compared with the corresponding figures for carbon dioxide.—Cuprous sulphate: A. **Recoura.** By working in an organic medium, in the

absence of water, solid cuprous sulphate, Cu_2SO_4, has been obtained in the pure state, according to the equation $Cu_2O+(CH_3)_2SO_4=Cu_2SO_4+(CH_3)_2O$. This compound is instantaneously decomposed by water, giving copper and cupric sulphate. Cuprous sulphate on oxidation gives a substance which behaves as a mixture of cupric oxide and cupric sulphate.—Researches on the magnesium derivatives of the xylyl bromides: P. **Carré.** The *ortho-* and *para*-xylyl bromides give ditolylethanes: the *meta*-compound gives some magnesium derivative, from which, by the action of trioxymethylene, metatolylethyl alcohol was obtained.—The oxidation of aromatic nitro- and nitroso-derivatives by ammonium persulphate: A. **Seyewetz** and L. **Poizat.** 2 : 4-Dinitrophenol and picric acid are completely oxidised by ammonium persulphate, forming carbon dioxide, hydrocyanic acid, and nitric acid.—Researches on the ketodibasic acids. α-Oxalglutaric acid and α-ketoadipic acid: H. **Gault.**—The composition of bauxite: H. **Arsandaux.**—Respiration in singers: M. **Marage.** The influence of the mode of breathing is paramount in speaking or singing.—The influence of the reaction of the medium on the activity of the maltases from maize: R. **Huerre.** Certain species of maize furnish enzymes the maximum activity of which is exerted in alkaline media; in other species the enzyme action attains a maximum in neutral or very slightly acid media.—The influence of age on the quantity and chemical distribution of the phosphorus contained in nerves: Ch. **Dhéré** and H. **Maurice.**—A metallic filter with regular interstices of variable dimensions, and reducible to ultramicroscopic magnitudes: Émile **Gobbi.** The filter consists of a nickel ribbon wound tightly in a helicoidal form, and held together with a screw. The liquid filters through the folds of the ribbon, and, according to the mode in which the ribbon is wound, can be adjusted to hold back particles of different sizes. Sterile water can be obtained by filtration through one of these filters, and the filtrates after six days' use are still sterile.—The structure of the central part of the Hautes Plaines, Algeria: A. **Joly** and L. **Joleaud.**—The periodic character of the mutability of mesonummulitic Cerithium of the Paris basin: Jean **Boussac.**—The value and the variability of barometric means: Alfred **Angot.**—The earthquake of April 23, 1909: Alfred **Angot.**

DIARY OF SOCIETIES.

THURSDAY, MAY 6.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—Reciprocal Innervation of Antagonistic Muscles. Note XIV. On Double Reciprocal Innervation: Prof. C. S. Sherrington, F.R.S.—Note on a Curious Property of Neon: Prof. J. Norman Collie, F.R.S.—The Properties of Colloidal Systems. I. The Osmotic Pressure of Congo-red and of Some Other Dyes: Dr. W. M. Bayliss, F.R.S.—The Origin and Destiny of Cholesterol in the Animal Organism. Part V. On the Inhibitory Action of the Sera of Rabbits fed on Diets containing Varying Amounts of Cholesterol on the Hæmolysis of Blood by Saponin: Miss Mary T. Fraser and J. A. Gardner.—Some Effects of Nitrogen-fixing Bacteria on the Growth of Non-leguminous Plants.—Prof. W. B. Bottomley.

LINNEAN SOCIETY, at 8.—On some Zoantheæ from Queensland and the New Hebrides: Mrs. Leonora J. Wilsmore.—The Œcological Relations of the Tiger-Beetles: Dr. V. E. Shelford.

RÖNTGEN SOCIETY, at 8.15.—An Illustrated Description of the Historical Collection of Tubes recently deposited at the Albert and Victoria Museum: Dr. G. H. Rodman.—On X-rays Produced at a Magnetically Deflected Kathode Focus: J. H. Gardiner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Theory and Application of Motor Converters: H. S. Hallo.

FRIDAY, MAY 7.

ROYAL INSTITUTION, at 9.—The Campaign against Malaria: Major Ronald Ross, C.B., F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Lower Chalk of Lincolnshire: Rev. C. R. Bower and J. R. Farmery.

MONDAY, MAY 10.

ROYAL SOCIETY OF ARTS, at 8.—Aërial Flight: F. W. Lanchester.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Western Pacific: Sir Everard F. im Thurn, K.C.M.G.

TUESDAY, MAY 11.

ROYAL INSTITUTION, at 3.—Cosmogonical Questions: Prof. Svante Arrhenius.

ZOOLOGICAL SOCIETY, at 8.30.—(1) On Hitherto Unrecorded Specimens of *Equus quagga*; (2) Differentiation of the Three Species of Zebras; (3) On a Portion of a Fossil Jaw of one of the Equidæ: Prof. W. Ridgeway.—On a New Race of Deer from Sze-chuen: R. Lydekker.—The Batrachians and Reptiles of Matabeleland: E. C. Chubb.

WEDNESDAY, MAY 12.

ROYAL SOCIETY OF ARTS, at 8.—The Principles of Heredity as Applied to the Artificial Production of New Forms of Plants and Animals: Prof. A. Dendy, F.R.S.

GEOLOGICAL SOCIETY, at 8.

THURSDAY, MAY 13.

ROYAL SOCIETY, at 4.30.

ROYAL INSTITUTION, at 3.—Newfoundland: J. G. Millais.

ROYAL SOCIETY OF ARTS, at 4.30.—Some Phases of Hinduism: Krishna Gobinda Gupta.

MATHEMATICAL SOCIETY, at 5.30.—Ternary Quadratic Types: H. W. Turnbull.—The Theorem of Gauss in the Theory of Attractions: Dr. J. G. Leathem.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Economics of Medium Sized Power Stations: A Study of Comparisons between Steam, Gas and Oil Engines: A. J. J. Pfeiffer.

FRIDAY, MAY 14.

ROYAL INSTITUTION, at 9.—Solar Vortices and Magnetic Fields: Prof. G. E. Hale.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.—On a Bifilar Vibration Galvanometer: W. Duddell, F.R.S.—Effect of Temperature on the Hysteresis Loss in Iron in a Rotating Field: W. P. Fuller and H. Grace.—On a Method of Testing Photographic Shutters: A. Campbell and T. Smith.

MALACOLOGICAL SOCIETY, at 8.—Descriptions of the Animals of Two Land Shells from Perak; Skeat Expedition in the Malay Peninsula, 1899–1900: Lt.-Col. H. H. Godwin-Austen, F.R.S.—List of Mollusca from Christmas Island, Indian Ocean, and Descriptions of New Species: E. A. Smith.—Further Notes on Holocene and Recent Non marine Mollusca from Perranzabuloe: Rev. R. Ashington Bullen.—On Non-marine Mollusca from an Early Neolithic Interment at Cuxton, Kent: A. S. Kennard.

CONTENTS.