THURSDAY, JANUARY 25, 1906.

HELIUM IN RELATION TO RADIO-ACTIVE PROCESSES.

Radio-activity. By Prof. E. Rutherford, F.R.S. Second edition. Pp. xiv+580. (Cambridge: The University Press, 1905.) Price 12*s*. 6*d*. net.

PROF. RUTHERFORD'S book has no rival as an authoritative exposition of what is known of the properties of radio-active bodies. A very large share of that knowledge is due to the author himself. His amazing activity in this field has excited universal admiration. Scarcely a month has passed for several years without some important contribution from him, or from the pupils whom he has inspired, on this branch of science; and, what is more wonderful still, there has been in all this vast mass of work scarcely a single conclusion which has since been shown to be ill-founded. The general scope of the present work has been noticed in these columns in a review of the first edition. Before passing to the discussion of special points, it is only necessary to say that the second edition fully maintains the reputation of its predecessor for completeness and suggestiveness of treatment.

It is natural to turn eagerly to the paragraph in which Prof. Rutherford discusses what may be called the burning question in radio-activity—Does the α particle consist of an atom of helium? Prof. Rutherford is evidently still inclined to the view that this is the case. He is influenced chiefly by the undoubted fact that helium is a product of the changes occurring in radium, by the approximate agreement in the electrochemical equivalent of the α particles with the value which is considered appropriate to helium atoms, and by the slowness with which the final products of radium are formed. This slowness seems to exclude the possibility that helium, which appears so soon, can be anything but a bye-product.

It is difficult to regard the argument from the electrochemical equivalent as having great weight, for the assumptions which must be made before available measurements can be brought to bear are many and bold.

In the first place, how do we know the electrochemical equivalent of a helium atom? In a case like hydrogen or oxygen we are on safe ground, for experiments on the electrolysis of its compounds enable us to compare the quantity of electricity conveyed with the amount of the element liberated. But no such experiment can be made with helium, for it forms no compounds. It is evident, therefore, that the desired information can only be got by some indirect argument. Unfortunately, the most obvious kind of induction does not lead us to a very satisfactory conclusion. It is found that if we call the charge which a monovalent atom can carry e, then a divalent atom will carry a charge $2e$, a trivalent atom a charge $3e$, and so on. What, then, are we to expect of an atom like helium, which, so far as can be judged from its chemical behaviour and from its position in the periodic classification, has zero valency? Obviously that it should not be able to carry a charge at all in the same sense that the other atoms can do so.

Helium, like other gases, can be ionised by the Röntgen rays, so there is reason to think, from this point of view, that its atom can in some sense be charged.

It has been customary to assume that the appropriate charge to assign to it is that of a monovalent atom. This may be the best view to take provisionally. But further light is much needed.

Again, we have no very direct measurement of the charge carried by an α particle. Prof. Rutherford assumes for that case also the charge characteristic of a monovalent atom, and he has been able to calculate on this assumption the volume of radium emanation and the heating effect of radium. The results in both cases are in satisfactory agreement with experimental data, and Prof. Rutherford is to be congratulated on his remarkable success in showing that such agreement can be obtained. But he would not, in all probability, press the exactness of this agreement as sufficient evidence that the charge of an α particle is exactly that assumed, and not either half or double, for he has had to use many data which cannot but be considered subject to very serious uncertainty. Indeed, the agreement obtained is so good that even if all the premises are correct it must be considered as to some extent fortuitous.

Perhaps the most original chapters in Prof. Rutherford's book are those in which he has so admirably disentangled the complicated series of changes which are involved in the disintegration of radium and its emanation. The idea at one time entertained that radio-activity was determined by high atomic weight must now be abandoned. For it has been made quite clear by these investigations that changes characterised by low radio-activity and slow atomic disintegration are followed by others of far greater rapidity. Radium, in losing atomic weight, turns into the emanation, which, weight for weight, is far more active than its parent.

In the appendix some interesting properties of the α rays are described. This branch of the subject is, however, at present in a very chaotic state, and we shall not discuss it here. One remark may be criticised—nearly the last in the book. Prof. Rutherford thinks that ordinary matter may be emitting as many or more α particles than uranium, if only the velocity of these is less than that minimum velocity which has been found necessary to produce the characteristic phenomena. This is scarcely consistent with the facts if the α particle is a helium atom. For why, in such a case, is helium only found in appreciable quantity in radio-active minerals?

In conclusion, we must once more congratulate Prof. Rutherford on the admirable manner in which he has brought his book up to date, and express a hope that the present edition may have many successors.

R. J. STRUTT.

AN ESSAY TOWARD THE "PRIMA PHILOSOPHIA."

The Metaphysics of Nature. By Carveth Read. Pp. viii+354. (London: A. and C. Black, 1905.) Price 7s. 6d. net.

CRITICAL philosophy or metaphysics Mr. Read divides into two branches, the metaphysics of nature and science and the metaphysics of ideals. In this work he deals only with the former branch, and only with the most general principles of science. He makes it a rule "not to attempt to solve *a priori* any problem that can only be effectually treated by inductive methods." He discusses in the introduction the meaning of terms like belief and knowledge, reality and truth. Then in Book i., entitled "Canonic," he considers various tests of truth, different forms of scepticism, and the great problem of the relativity of knowledge. Book ii.—"Cosmology"—deals with the doctrine of substance. Book iii.—"Psychology"—deals on the same lines with the subject of experience; while the last book—"The Categories"—discusses relation, the physical categories, and the categories of subjective activity.

The author's beliefs on two of the most general of metaphysical problems may be most concisely stated in his own words. Thus on p. 240 he writes:—

"I am recommending as the most coherent and natural way of thinking, on the whole, this hypothesis that the world is essentially a conscious thing; that in consciousness we have immediate knowledge of Reality, but not of the whole of Being; that the rest of Being is made known to us by phenomena; that it is everywhere conscious, but in various degrees, and that the higher degrees are known to us by the phenomena of organisation."

Again, in dealing with the teleological problem on p. 348:—

"Frankly, I wish it were possible to prove or make credible the teleology of Nature, because we might then follow Aristotle in identifying the End of Nature with the End of Humanity; but I cannot help feeling that the weight of argument is against the doctrine of Final Causation. Like transcendent Being, it remains a merely indicative, orectic category."

The influences to which Mr. Read most readily responds are Hume, Spinoza, to some extent Spencer, and, of course, modern science. The defences of Hume often bring out points too apt to pass unnoticed. Thus Hume's "custom" is described as "intuitive reason in the making." Mr. Read, who has a lurking affection for the sceptical—*e.g.* he thinks that the scepticism of the new academy was superior, even as philosophy, "to the fanatical dogmatism of the Stoics and to the gaseous hypotheses of the Epicureans"—points out the elements of Hume's philosophy which were clearly sceptical, but lays over against them the facts that scepticism was partly a disguise with Hume, and that even Hume puts forward pragmatism as the natural remedy for scepticism.

Hume's great follower or controverter, Kant, receives interesting treatment. Mr. Read refuses to join in the "hysterical outcry" against the thing-in-itself; but he finds abundant cause for complaint in Kant's mythological method of arguing from the unity of consciousness to a substance, a "thing" that "forms an idea." Kant's famous statement is quoted:—"If there is no *Urwesen* distinct from the world, if the world is without a beginning and therefore without a Creator, if the will is not free, then moral ideals and principles lose all their validity"; and Mr. Read adds, "It is impossible to find in literature a more desperate sentence than this, or a more false."

One welcomes the clear distinctions drawn in the introduction, chapter ii., between empirical, physical, transcendent, and noumenal reality; the defence, too, of much-abused eclecticism on the ground that after all the great systems in philosophy are themselves patchworks. And unless one is wedded to the theory that philosophy must be dull if it is to be sound, one rejoices in the good sayings—often as sensible as they are pungent—with which the book abounds, such as—"Future generations may have reason to thank those who left them something to do, more than those who anticipated everything," or the description of Hegel's rationalism as only an unintelligent empiricism. But no short notice like this can do justice to the closeness of the argument, the soundness and comprehensiveness of a book which must be ranked among the most important of recent years.

There are one or two animalcules in the ointment. Locke's great work is referred to as "Essays of Human Understanding"; and in talking of Hume's "Treatise" the author gives references to the parts only, forgetting that there are in it books divided into parts. Words like *verbile, questionnaire, glissaded,* do not find favour with all readers. An index might well have been provided, but its absence finds much compensation in an excellent table of contents.

MATHEMATICS FOR THE LABORATORY.

Higher Mathematics for Students of Chemistry and Physics, with Special Reference to Practical Work. By Dr. J. W. Mellor. Second edition, enlarged. Pp. xxi+631. (London: Longmans, Green and Co., 1905.) Price 15s. net.

THIS is the second edition of a book which from the first was recognised as filling a place of its own in our mathematical literature. It is essentially a book for the student of chemistry, for whom a smattering of mathematics used to be supposed to be sufficient. The result was that our college curricula made no provision for training chemists in the mysteries of the calculus, at least no compulsory provision. When at length the eager student came in touch with modern work, say, on the velocities of reactions, or on thermodynamic developments in general, he encountered mathematical methods and even notations quite unfamiliar to him. What was he to do? Go and quaff the heavenly nectar provided by Williamson or Lamb? But this, we learn from Dr. Mellor's preface, brought perplexity rather than clearness of vision. What the student of chemistry wanted was a working knowledge of the methods of the differential and integral calculus, with a minimum of theory and demonstration. The student of physics is somewhat differently circumstanced. From time immemorial physical research and mathematical methods have been more or less closely associated, and every student of physics knew that a certain knowledge of higher mathematics was demanded of him. Yet complaints have been heard even from him that the mathematical courses in our colleges lacked a certain flavour of the real, and were not particularly suited to his needs. It has often been said that there is no royal road to mathematical knowledge. To quote Dr. Mellor himself, a certain amount of drudgery is necessary in some stages. But some roads are easier than others; and in this book chemical and physical problems are introduced, like rest houses along a weary way, to cheer the flagging traveller. Here he finds familiar food for his mind. To change the metaphor, the student is given a new weapon, and at the same time is taught how to use it on material already his.

To what extent the reader, otherwise ignorant of the principles of the differential calculus, will be able to appreciate the first chapter, experience alone can tell. The introduction of sections on proportionality and logarithms in the middle of the discussion of differentiation does not strike one favourably. The author's reference to this in the preface may, however, be accepted as sufficient excuse.

The new edition is fundamentally the same work as the old, but about a fifth more bulky. The increase in size is due partly to a more sparing use of small type, but chiefly to the introduction of new matter. There is also a good deal of re-arrangement of individual sections, such, for example, as the carrying forward of the paragraphs on the Gamma and elliptic functions from chapter iv. (the integral calculus) to chapter vii. (how to solve differential equations). From a physical point of view this is undoubtedly the better arrangement; and there is a further improvement which deserves notice, namely, the leading up to each of these functions by the discussion of a comparatively simple dynamical problem. The most obvious addition is the new chapter on the calculus of variations, in which brachistochrones and isoperimetrical problems are touched upon. Probably the main service rendered by this chapter will be to enlarge the outlook of the student. The class of readers for whom the book is ostensibly written will hardly ever be called upon to apply the calculus of variations, and if they should be they would find the discussion too meagre for them to make effectual use of it; but it is a real service to open a man's mind to the things which lie beyond the immediate purpose of his life. The still too common utilitarian idea that the practical man should be taught just as much mathematics as we know to be necessary for his immediate needs is an idea which cannot be too strenuously contested. The truth is, we never know what will be needed before the year is out. The chemist of the last generation would as soon have thought of studying the properties of Theta functions as of familiarising himself with the modes of solution of the simpler differential equations, or even with the meaning of a differential coefficient; but that attitude of mind is impossible now. The theoretical chemist of the rising generation must know his mathematics, and we are convinced that many will bless Dr. Mellor for providing them with an eminently readable and thoroughly practical treatise.

Throughout the book there are many historic notes which are always interesting in their way. It will not, then, be thought amiss to direct attention to the section on pp. 59 and 60, and to ask why writers are so slow to do Newton justice in regard to his so-called law of cooling. It is now six years since Prof. Crichton Mitchell, in a paper on the convection of heat by air currents (*Trans. R.S.E.*, vol. xl, p. 39), pointed out, what seems to have escaped the notice of every commentator except Fourier, that Newton deliberately placed his cooling body "non in aere tranquillo, sed in vento uniformiter spirante." Dulong and Petit, therefore, and all their copiers, including Dr. Mellor himself, are not giving "a typical example of the way in which the logical deductions of an hypothesis are tested" when they try to apply Newton's law to a body cooling in tranquil air. Crichton Mitchell showed that when Newton's conditions were realised Newton's law held with wonderful accuracy over a considerable range of temperature differences.

C. G. K.

PLANT DISEASES.

Minnesota Plant Diseases. By Dr. E. M. Freeman. Pp. xiii+432. (St. Paul, Minnesota: The Pioneer Press.)

THIS publication is issued for "the people of Minnesota" by authority of the university of that State. It may have special reference to a particular State, but it is quite evident, from a perusal of its pages, that the book will be of service wherever plants are cultivated. The author takes a broad view of his subject, and rightly considers the prevention of disease as a more important matter, from the point of view of the cultivator, than the application of remedies. "Agriculture," says he, "really resolves itself into one great problem, the prevention of plant-disease." Keep the "patient" in good health by careful attention to his physiological requirements, by cleanliness and by strict compliance with the teachings of hygiene. Much more good will ensue from these measures than from the use of insecticides or anti-fungus sprays. A knowledge of the life-history of the plant, as well as a corresponding familiarity with the mode of life of the hostile insect or fungus, is, indeed, essential, but unless combined with the faculty of turning that knowledge to account, the information is, practically speaking, of no value.

The first question that is asked when a diseased specimen is submitted is, "What is the matter with this plant?" The next, and in the view of the questioner the most important, is, "What am I to do to get rid of the disease?" Not one in a hundred cucumber-growers, cultivators of the vine or other crops, asks a question as to the methods of prevention; the ninety and nine ask for a "cure." Yet whilst prevention is often within reach, cure, in the proper sense of the word, is frequently impossible. The diagnosis of the disease must be left to the skilled expert, the means of prevention should be known to all intelligent cultivators, the remedy may be prescribed by the plant-doctor, whilst the "cure," which often means the bonfire, may be entrusted to the labourer.

Another point which cannot be overlooked in considering the prevention of epidemic diseases is the necessity for concerted action. If one cultivator is alive to the exigencies of the case his labour is often vain if his neighbour be slovenly and apathetic.

The book before us is divided into two parts, the first dealing with the fungi which are injurious to plants generally, the second with the specific diseases of Minnesota vegetation. The account of the nature, mode of growth, and habits of fungi is written clearly and in a style readily comprehensible by the reader of average intelligence. It forms, indeed, an excellent introduction to the study of fungi.

A separate chapter is given to the history of the bacteria which presents in a concise form many details of the utmost importance to cultivators. After these generalities attention is directed to the fungous diseases most prevalent in Minnesota. To these we need not here specially refer, nor to the sections on fungicides and spraying apparatus. We can only add that the book is well illustrated and provided with a copious index. We commend it to the notice of all who are interested in plant-diseases, and especially to foresters and cultivators of field or garden plants.

OUR BOOK SHELF.

Mesure et Développement de l'Audition. By Dr. Marage. Pp. 119. (Paris, 1905.)

THIS small volume by Dr. Marage is of scientific value inasmuch as it contains an account of a method by which acuteness of hearing can be measured, and by which any degree of deafness can also be stated with accuracy. Aurists for many years have made use of the ticking of a watch, the sound of a tuning-fork, or a percussion sound as a source of sound, and they state the degree of deafness by a measurement of the distance at which the patient can hear the sound as compared with the efficiency of a normal ear. The best of all acoumeters, no doubt, is the human voice, as it gives sounds to which the ear is adapted; but no two human voices are alike, in consequence of the variations in quality caused by the vocal resonating cavities.

Dr. Marage, however, has invented a siren which is furnished with resonating masks (casts of the vocal cavities as adapted for the vowels OU, O, A, E, and I). This apparatus utters these vocal tones with singular purity. The form of the mask, and especially that of the oral opening in each case, suppresses most, if not all, of the overtones for each vowel, and the laryngeal vowel tone (produced by the siren) is alone sounded. Further, he has shown that the intensity of the sound of this instrument, as measured by a special water-manometer, is proportional to the pressure of the air which traverses the apparatus. The siren can be adjusted for any vowel, and the apparatus is always at the same distance from the ear. The measurement of the auditive acuity is given in the number of millimetres of water shown in the manometer when the sound of the particular vowel is heard. Thus any vowel sound is heard with a pressure of 1 mm. by a normal ear; if the pressure must be raised to 40 mm. before the sound is heard the auditive acuity is 1/40, if at 60 mm. 1/60, if at 200 mm. 1/200, and so on.

Dr. Marage also shows an ingenious method of recording on a chart the degree of acuity for each vowel, always in mm. of water, and if the points for the various vowels are joined a curve is produced. The form of this curve varies with different pathological conditions of the middle and internal ear, so that after the patient's ear has been tested for the vowel tones by the siren, and the curves have been plotted out, the form of the curve is of value in diagnosis. Lastly, Marage uses the siren to massage the drum-head and chain of bones by giving to the ear for a certain time, say a daily massage of ten minutes, using the vowel tones of the instrument, and he asserts, and shows by charts, that in a large percentage of cases of many forms of ear trouble, and in some cases even of deaf mutism, there is benefit derived from the massage treatment. These results cannot be criticised in a scientific journal, as they pertain more to the region of the practical aurist, but there can be no doubt of the value of the method of Marage as a method of accurately determining acuteness of hearing. JOHN G. MCKENDRICK.

American Insects. By Vernon L. Kellogg. Pp. vi+674; 812 illustrations and 13 plates. (New York: Holt and Co.; Westminster: A. Constable and Co., Ltd., 1905.) Price 21*s.* net.

THIS work is intended as an introduction to North American entomology. It consists of a systematic review of the various orders of insects met with in America north of Mexico, and of introductory and supplementary chapters dealing with special subjects. The three introductory chapters on structure, physiology, development and classification are well done, a great deal of information being condensed in these 50 or 60 pages.

The supplementary chapters are, however, the best part of the book. They are (1) insects and flowers; (2) colour and pattern and their uses; (3) insects and disease. These subjects are treated in an intelligent manner, with an absence of dogmatism that is very commendable.

In some parts of the work the author is a little more rash. Thus he concludes his account of the slave-making ant, Polyergus, with the dictum "specialization is leading Polyergus to its end!" Whether this is the case must be left to the future to decide. It would have been simpler to say that Polyergus has mandibles unsuited for industrial purposes, and correlatively possesses slave-making habits that do not appear to be very successful.

Of the systematic part of the work we cannot speak so highly; this is chiefly due, it is only fair to say, to inadequate space. There are, as the author says, 10,000 kinds of beetles in North America, as against 1000 kinds of birds. It is small wonder that the attempt to condense an account of 10,000 species and their habits and life-histories into 54 pages does not leave a satisfactory impression. The extensive orders Coleoptera and Diptera have suffered most from their abbreviation. The Coleopterous portion, moreover, has not been adequately revised, the larva of a Longicorn beetle being figured as a type of the larvæ of the Buprestidæ.

Notwithstanding these drawbacks, the work is probably the best that exists for anyone desiring an introductory work on North American insects compressed into a single volume. D. S.

First Steps in Quantitative Analysis. By J. C. Gregory. Pp. vi+136. (London: Edward Arnold, 1905.) Price 2*s.* 6*d.*

IN this little book the author has aimed at "providing a grounding in the fundamental principles of quantitative analysis. It includes the use of the fundamental volumetric solutions and several gravimetric estimations." Of the existence of a considerable class of students whose requirements would be satisfied by the scope of the work there can be little doubt, and a small laboratory manual dealing with a few typical gravimetric and volumetric processes cannot be regarded as superfluous. The author's choice of material leaves little to be desired, but exception may be taken to matters of detail. The percentage strength of a solution is defined as the number of grams of substance in one hundred cubic centimetres, a definition which is scarcely acceptable to the majority of chemists. The first alternative method described on p. 64 for the preparation of a normal sodium hydroxide solution may perhaps give results accurate to 1 per cent., but is scarcely consistent with the employment of a multiplying factor containing five significant figures. Such inconsistency in the use of significant figures is not infrequent, and detracts considerably from the value of the book. On p. 67 it is stated that "the specific gravity of strong hydrochloric acid is 1.16 and the liquid contains 31.79 per cent. by weight of hydrogen chloride"—the temperature is apparently of no consequence whatever. A brief consideration of the theoretical side of the methods and operations involved would have made the book considerably more useful as an introduction to quantitative analysis. H. M. D.

Man: an Introduction to Anthropology. By Dr. W. E. Rotzell. Second edition. Pp. 186. (Philadelphia: J. J. McVey, 1905.)

THE author of this book is a lecturer on botany and zoology in Philadelphia, but the systematic details he adopts are those of "Prof. Alexander Macalister, of the University of Dublin, and of the late Prof. H. Alleyne Nicholson, of the University of Toronto," so no one can accuse him of being up to date in his own subject. "Anthropology," he informs us, "seems to be, unfortunately, one of those subjects about which the vast majority of persons know very little," and with a zeal which far exceeds his knowledge he attempts to remedy this defect; but it is evident his information is second-hand, imperfectly comprehended, and ill-digested.

The following quotations will serve to substantiate this criticism:—"The North Mediterranean branch (of the White or European Race) comprises the Basques, the Aryans, and the Caucasic peoples." "The Indic group (of the Aryans) inhabit an extensive region of Southern Asia. At present there are many different tribes and castes inhabiting the great Indian peninsula, the forms of speech spoken by them presenting numerous diversities"; except for a word or two about Sanskrit and Buddhism, this is all that is given on the ethnology of India. In his final chapter, on the development of culture, Dr. Rotzell puts forward the view that the blazing of trees was the beginning of writing.

Elementary Algebra. By W. G. Borchardt. Pp. vii+492+lxiii. (London: Rivingtons, 1905.) Price 4*s.* 6*d.*

THE arrangement of the subject adopted in this work differs from that adopted in many other works, simplicity and ease for the beginner being the chief object. The fundamental operations (addition, subtraction, multiplication) are illustrated graphically on squared paper, and the solution of simple equations is given immediately afterwards, such subjects as fractions, highest common factor, and lowest common multiple being postponed; in fact, fractions are left until the beginner has acquired a considerable skill in the solution of equations. Great use is made of graphic illustration, and by means of it many difficulties are removed from the path of the beginner.

The plan of the book leaves nothing to be desired on the score of simplicity; it is about the most simple work that we have seen. The advanced part of the book may be said to begin with chapter xxxii., which treats of the theory of indeterminate equations. The general theory of quadratics follows, as well as the discussion of progressions, binomial and multinomial theorems, &c. Every branch is illustrated by a large collection of examples, with answers.

Illustriertes Handbuch der Laubholzkunde. Part iv. By C. K. Schneider. Pp. 449–592. (Jena: G. Fischer, 1905.) Price 4 marks.

A PORTION of the Rosaceæ is treated in this part, beginning with Spiræa, passing from the Spiræaceæ to the Rosaceæ and then to Prunus. Why the author distinguishes Spiræaceæ and Drupaceæ as orders is not obvious, but this causes no inconvenience to anyone using the book for practical purposes; and in this connection it should be stated that the analytical tables for running down the genera are made as concise as possible, and that cross references are inserted in the margin to facilitate the comparison of subdivisions.

The part includes three large genera, Spiræa, Rubus, and Rosa; while examining the Spiræas in the Boissier herbarium, Mr. Schneider came across several specimens, chiefly Asiatic, that he regards and has named as new species. In the case of Rubus, a selection has been made of European types and a number of foreign species that may be found suitable for introduction into Europe. Undoubtedly the most interesting portion is that devoted to the roses; the treatment follows very closely the arrangement given by Keller in Ascherson and Graebner's synopsis, but Keller's subsections are classed as sections, a system that is of practical convenience, although it tends to magnify the importance of the subsections. Amongst the changes noted, Schneider follows Keller in superseding *Rosa indica*, L., by *Rosa chinensis*, Jacq., and *Rosa damascena*, Mill, perhaps on account of its antiquity, is numbered as a species.

Esquisse d'une Théorie biologique du Sommeil. By Dr. Ed. Claparède. Extrait des *Archives de Psychologie*, T. iv. Pp. 114. (Genève: H. Kundig, 1905.) Price 3.50 francs.

IN this essay, the contents of which have appeared in certain journals, the author first examines the various theories which have been propounded to explain the occurrence of sleep, and having found these wanting proceeds to formulate a theory of his own.

The various theories of sleep are first classified and discussed, and the difficulties in accepting them stated. All the common theories regard sleep as a cessation of function in the organism, a negative or passive state or phase. The author, however, regards sleep as an active state, a defensive mechanism of the nature of a reflex action, an instinct which has for its object the precipitation of the organism into a condition of inertia whereby exhaustion is prevented. We therefore sleep, not because we are exhausted or asphyxiated or auto-intoxicated, but in order to ward off such effects, and many interesting facts are quoted in support of this hypothesis. The essay deals in a concise and interesting manner with the whole subject of sleep, and is well worthy of perusal.

LETTERS TO THE EDITOR.

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

The Percy Sladen Expedition in H.M.S. "Sea'ark" to the Indian Ocean. The Seychelles Archipelago.[1]

AFTER leaving the *Sealark* and dispatching our collections home, Mr. Forster Cooper and I spent seven weeks in exploring the Seychelles Archipelago as thoroughly as possible, dividing our time between Praslin and Mahé as centres. We camped for eighteen days on the former island, and then separated, Mr. Cooper being responsible for Silhouette Island, the fauna of which appeared to be almost unknown, while I visited various parts of Mahé and examined its reefs and neighbouring islets. Unfortunately the weather had been exceedingly dry, and continued to be so during the first half of our stay, while it was correspondingly wet during the second half. As a result, land collecting was at all times extremely laborious, and insects were throughout found to be scarce, both in species and number. Other groups of land animals we believe to have been fairly thoroughly collected.

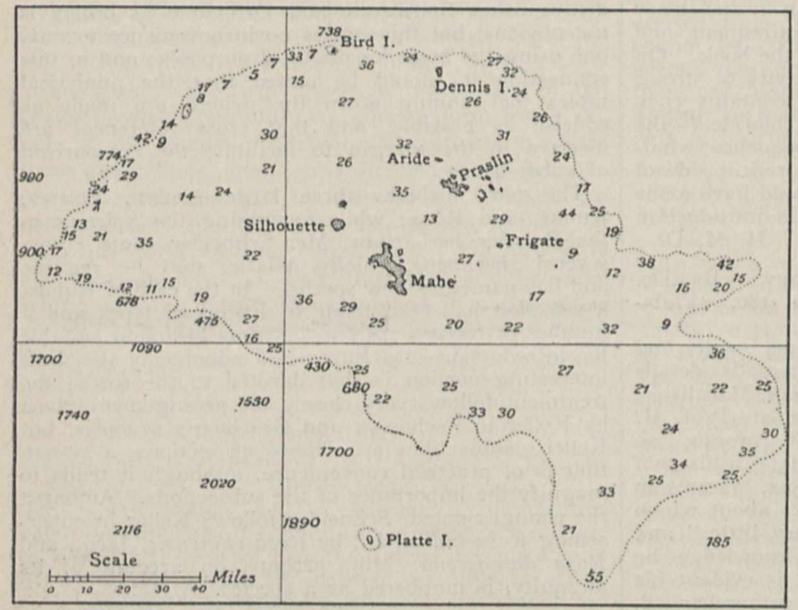

FIG. 1.—Seychelles Bank showing the 100-fathom line.

The Seychelles Archipelago comprises a number of islands arising on a submarine bank, which extends in a more or less east and west direction, about 190 miles long by 100 miles broad (Fig. 1). It was fairly regular in contour save to the south-east, where a horn stretches out for some distance along the line towards Mauritius. Separated from this same projection by deeper water are three similar but smaller banks, of which that of Coetivy alone has land, and in correspondence there is to the south-west the Amirante Bank with its little group of islands.

The Seychelles Bank itself has an average depth of 30 fathoms, and our soundings off it to the north-west, east, and south show that it has a contour similar to those of typical coral reefs and banks. An outer rim is indicated along the whole of its north-western half by a series of shallower soundings, but to the south-east the depth does not markedly shoal (Fig. 1). It has two typical surface-reefs with coral islets to the north, Bird and Dennis, but elsewhere the rim is generally covered by at least 7 fathoms of water. Between these two islands, and to the west of Bird, the character of the bottom is somewhat similar to what we found at the edges of the submerged Saya de Malha and Nazareth Banks, and indicates the upgrowth of a rim. The fauna was more varied, but the bottom was less covered by nullipores and corals, and a few green algæ were abundant. All sedentary organisms were covered with dirt and unhealthy between Bird and Dennis Islands, where there would appear to be a natural outfall for the tidal and other currents. In this position there is certainly no upgrowth of the rim, while elsewhere it must be exceedingly slow. The bottom within the rim is sand, muddy sand, or mud, the latter held together by the roots of algæ. Strong currents sweep across it, and even during our visit, between the two trades in dead calm weather, the sea-water was always cloudy, so that, except in favoured spots, corals could scarcely grow up into reefs.

The islands of the Seychelles naturally divide themselves into two groups to the west and east, with Mahé and Praslin as centres (Fig. 2). The former comprises Mahé, Silhouette, and North, with a series of small islets around the first, outlying buttresses and peaks of the same, with only a few fathoms of water between. Praslin also is similarly surrounded by a series of tiny islets and rocks, but in addition there are eleven other islands in its group (of which we visited five), separated by considerable channels. Mahé and Silhouette attain heights respectively of 2993 feet and 2467 feet, but Praslin and the eastern islands do not exceed 1270 feet. All islands were found to be formed of similar, coarse granites (or granulitic quartzes), with narrow, vertically extending dykes of finer grained black rock, apparently a variety of granite, along which the mountain streams have invariably cut their courses. In addition, many of the islands have against their coasts, in bays and suitable situations, flats of sand, largely coraliferous. Some of these have doubtless been formed by a washing up of sand from the sea, and some are partially at least of delta formation, but in places there is evidence of a recent elevation of more than 30 feet. On the island of Silhouette, Mr. Cooper in five situations found masses of coral rock, cemented on to the granite, at various heights between 15 feet and 30 feet above the low-tide level, and around the coasts of Mahé and its smaller islets there is evidence of a similar upheaval. Besides this, there are indications (particularly in Mahé) of an ancient elevation of upwards of 200 feet. Definite rocks belonging to it do not, so far as I could find, still exist. Marine action prior to its occurrence perhaps accounts for the almost continuous line of precipices, which at various distances from the present coast extends along the eastern or windward side of Mahé. The question, however, requires further investigation. In any case, the deep cañons of many of the mountain brooks, and the very extensive weathering of the granites, indicate the not inconsiderable antiquity of the land as such.

Barrier reefs nowhere exist around the islands of the Seychelles Group, and fringing reefs only in certain somewhat protected situations (Fig. 3). Mahé Island extends more or less north and south, with two conspicuous points to the west. A fairly continuous reef lies along its east side, but there is no reef off its north and south points, and reefs only occur in the bays of its western side. Silhouette is a round island with practically no reef, while Praslin has reefs in its bays alone. La Digne, Curieuse, and the smaller islands have merely patches of reef. On examining into the causes of this we found a luxuriance of coral growth even off the points of the islands, but practically a complete absence of nullipores. Indeed, these calcareous algæ are essential in the Indian Ocean for the consolidation of corals into true reefs. Where fringing flats actually do occur, they would appear generally to consist of a basis

[1] For earlier reports see NATURE, April 13, August 10, October 5, November 9, and December 21, 1905.

of granitic rock with quite a sparse covering of calcareous matter, or to be a filling in with the remains of some of the reef organisms between masses or islets of granite and the land. The reef in the large bay to the north of

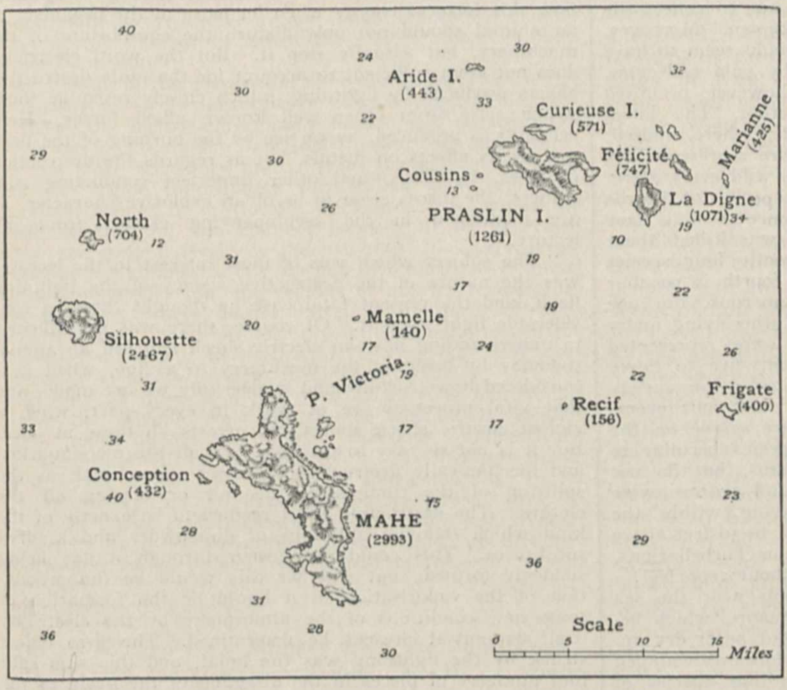

Fig. 2.—Islands of the Seychelles Group with heights in feet and soundings in fathoms.

Praslin, extending along the coast for $1\frac{1}{2}$ miles between two points, is a good instance of this, one islet and three series of granite masses lying at almost equal intervals imbedded in its seaward edge. The boat passages through the reefs are in most situations mere outfalls for the tide, and show no connection with the fresh-water streams off the land. Finally, it is interesting to note that the actual surfaces of the flats are covered with a far greater variety of large seaweeds than we found in any of the purely coral groups we visited in the *Sealark*.

The land animals necessarily to a large extent depend on the plants, and I considered it inadvisable to attempt their complete collection in the limited time at our disposal save in the indigenous jungle. Small mangrove swamps occur on the sea-shore, but behind these the land has been almost completely cleared for the cultivation of cotton, coffee, cassava, cocoa, and vanilla to a height of 1500 feet. Below this there are only a few isolated endemic trees, and above there are in patches in the jungles large numbers of oranges, limes, citrons, and cinnamons, with an undergrowth of the Mauritius raspberry, all introduced plants. Indeed, there are, except in Silhouette, only a few summits and precipitous slopes which have not been at one time or another completely planted, and it seems possible that even these may be destroyed within a few years for the cultivation of various rubbers. Such jungles as now remain consist mainly of palms (Roscheria, Stevensonia, Nephrosperma, Verschaffeltia), various screw pines (Pandanus), Dracæna, and the bois rouge (Wormia), with bare ground beneath covered by their strong leaves, clumps only of Curculigo. Open spots, however, have a dense undergrowth of ferns, Lycopodia, Selaginellæ, Psilota, and mosses, which also cover the lower parts of the trees. In effect, it is a typical, tropical, moist forest undergrowth, noticeable mainly for the comparative absence of climbing plants and herbaceous dicotyledons, and for the fact that nearly all the larger trees are peculiar Seychelles species, and often genera. Most of the giant trees (Maba, Stadtmannia, Afzelia, Campnosperma, &c.), have been singled out and cut, but bare stems of capucin (*Northea seychellarum*) stand up everywhere above the foliage. The destruction of the latter, which probably will shortly be complete, we discovered to be due to a green beetle, which deposits its eggs singly in the new leaf-buds, the resulting maggot consuming all their softer parts.

The most interesting feature in the botany was the sharp distinction of the cotyledonous plants into three classes, the calciphilous, the siliciphilous, and the indifferents, the latter forming a smaller percentage of the whole than either of the other two. The calciphilous species are practically the same as we found on all the coral islands we visited, and are scarcely more numerous. This group of plants was, I consider, ocean-carried, the Seychelles being in respect to it as oceanic as any island of the Chagos Archipelago. Moreover, of the other trees many seemed to possess seeds, which could have been brought by currents, &c., to the islands. The finest individual species of tree was the coco-de-mer, or double coconut (*Lodoicea seychellarum*), which is peculiar to

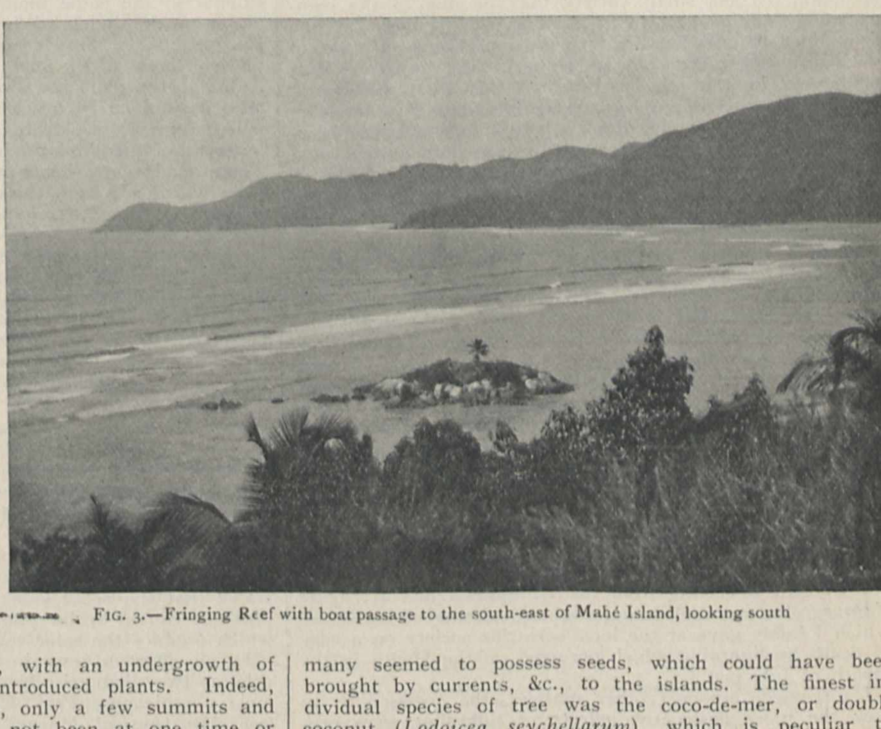

FIG. 3.—Fringing Reef with boat passage to the south-east of Mahé Island, looking south

Praslin. Its palms are either male or female, and our examination of more than 300 of its nuts showed that they are of two distinct, structurally different forms in approximately equal proportions, both kinds growing on the same female tree. The case is, so far as I know, unique.

Of the land animals we did not attempt to collect the birds, as they were already sufficiently known. Moreover, most of the peculiar Seychelles species would seem to have been nearly, if not entirely, destroyed by paid collectors. The Government of the Seychelles has, however, promised an ordinance to hinder further destruction. The introduced birds do not belong to the jungle, where, indeed, land birds are seldom seen. Mammals are represented by rats, mice, and bats, and the tenrec runs wild everywhere. Of reptiles we obtained about eleven species of lizards and three snakes. The crocodile would once seem to have been a regular inhabitant, but the last was killed about seventy years ago. Three of the apparently four species of frogs occur at any elevation, but the fourth is peculiar to the high jungles. Cœcilians are numerous, the one genus being an earth burrower, and the other lying under damp leaves in the jungles. Mollusca were represented among the indigenous vegetation by twenty-five to thirty species, including two slugs, and we obtained a fair variety of insects and arachnids. Isopods were numerous everywhere, but centipedes and millipedes were scarce on the high lands, and seemed to consist of species peculiar to them. We carefully searched for Peripatus, but do not think it exists in the archipelago. Land worms were scarce; one species was peculiar in living within the bases of the screw pine leaves, even 40 feet to 50 feet above the ground. We obtained no land leeches or Turbellarians, but found two species of Nemerteans at about 2000 feet.

The fresh-waters consist of certain pools near the sea and a large number of tiny mountain streams, which become roaring torrents in the wet season, but never dry up. In a pool at La Digne we obtained one tortoise with hinged plastron, and in the streams there were four species of fish. The Crustacea comprise at least two species of prawn and a crab, all living up to more than 2000 feet. The Mollusca number only three, and for the rest there were the usual genera of fresh-water insects, &c.

The number of species of land and fresh-water animals would on the whole appear to be singularly few, and individuals were, with a few exceptions, by no means abundant. Their small variety may be due to the comparatively few plants which grow in the islands, but one is inclined to question the former connection of the group with any larger land mass. In any case, our work has made certain that the archipelago has been sufficiently collected for a thorough examination into this question from a biological point of view. It is our opinion, however, that such a research should include both animals and plants considered together. In any case, the Seychelles is the continuation of a broken line extending north from Madagascar, and its rock would seem to be similar to that which forms the great central plateau of that island.

Since I returned to England I have received a letter from Commander Boyle Somerville giving the soundings obtained by H.M.S. *Sealark* on her return to Ceylon from the Seychelles. He has confirmed by additional soundings the complete separation of the 2000-fathom lines of the Chagos, Maldive, and Seychelles groups. I have also heard from Mr. D. Matthews that he has obtained about 1000 samples of sea-water from the Indian Ocean during the last nine months, and analysed about 700. Mr. Bainbrigge Fletcher, H.M.S. *Sealark*, reports that a considerable number of the Chagos Lepidoptera appear to be new species or varieties.

J. STANLEY GARDINER.

Zoological Laboratory, Cambridge, January 15.

What Causes the Destructive Effects of Lightning?

I ENCLOSE a cutting from the *Hampstead and Highgate Express* (January 20) containing an epitome of a lecture which I lately gave at the local scientific society on a case of death by lightning which occurred on the Heath in the month of July last.

I discussed, amongst other matters, the question as to how the more destructive effects of lightning were produced, and now my object in writing to NATURE is to ask you, Sir, or any of your readers, if you can inform me whether this question has been solved in any probable manner. In the case of the death of an animal from lightning I think we may safely rest on the word electricity as sufficient, for it is not difficult to understand how this form of energy when let loose in the organism of an animal should not only disturb the equilibrium of the machinery, but actually stop it. But the word electricity does not seem sufficient to account for the more destructive effects produced by lightning, which closely resemble those which arise from other well known allied forces. Heat certainly is produced, as we see by the burning of the flesh and by its effects on metals, but as regards the destruction of trees, buildings, and other imperfect conducting substances, the forces seem to be of an explosive character, as are mentioned in the accompanying extract from my lecture.

"The subject which was of most interest to the lecturer was the nature of the destructive agency of the lightning flash, and the present fatal case he thought threw a considerable light upon it. Of course, there was no difficulty in understanding how an electric shock can kill an animal suddenly by bringing the machinery to a stop, when it is considered how fearfully and wonderfully we are made, and that vital processes are at work in every part, when a violent electric shock comes and arrests all these at once. But it is not so easy to perceive how all the more marked and mechanically destructive processes occur, such as the splitting of the timbers in the hut or tearing off the clothes. The destructive effect seemed to be exactly of the kind which follows explosions of gunpowder and kindred substances. This could only occur through a gas being suddenly formed; but whether this would be the production of the vaporisation of a liquid or the formation of some new conditions of the atmosphere by the electricity itself cannot at present be determined. The first object struck by the lightning was the finial, and this was split into numbers of pieces in the direction of the grain of the wood, and the same effect was seen on all the upright posts down which the lightning ran; but, midway across the middle of the hut was a transverse beam, through which the flash passed. At this spot about a foot of the wood was torn off, but in a transverse or horizontal direction in the course of the grain. If a chisel had been driven into the cross beam it would have broken the wood exactly in the same manner; or, indeed, any other force acting on the middle of the splintered wood as an explosive. The coat, and more especially the shirt, showed the explosive force which had produced the rents still better. Although the rents ran down the arm, they had no appearance as if done by an instrument, but rather by a violent pull exerted from side to side, for not only was there one large rent, but similar partial ones running parallel to it. These could only have been done by forcibly stretching from within; in fact, the only way suggested would be an explosion of gas taking place in the shirt sleeve, and so forcibly thrusting it out, causing the fibres of the fabric to give way. The split boot, which was nearly off the foot of the child, could not be imitated except by placing a charge of dynamite within it."

Not professing to have much knowledge of what has been written on the modes and causes of the great destruction caused by lightning, I am writing to obtain more information on the subject. SAMUEL WILKS.

January 20.

The Probable Volcanic Origin of Nebulous Matter.

IN papers published some fifteen years ago (see, among others, Nos. 2 and 4 of *Contributions from the Lick Observatory*) I considered certain phenomena produced by streams of finely divided matter ejected from the sun, each stream necessarily taking on the form of a helix, and stated that the nebulosities surrounding certain stars were probably caused by the presence of streams similar to those which produce the solar corona.

In an effort to explain the fact that in certain spiral nebulas two diametrically opposite streams are, as a rule, most conspicuous, Prof. Chamberlin advanced the theory (see *Astrophysical Journal* for 1901, p. 17) that the disruption of one body through tidal action and centrifugal force caused by the near passage of another body moving with great velocity would account for the observed phenomena. I am of the opinion that no forces except those originally resident in the central body itself are essential for the creation of such structures.

As a supplement to my note in NATURE for January 14, 1904, I now wish to offer a very simple theoretical explanation of the manner in which the ejective force becomes so very powerful.

As a result of the decrease in temperature from the centre to the surface of an incandescent mass exposed to the cold of space, the surface-crust finally formed will be punctured at various points by the imprisoned gases, thus also allowing the more refractory matter from the interior to overflow the region immediately surrounding each vent; the increased weight of the locally thickened crust causes the lower opening (of the channel formed) to be depressed below the general level; as the height of the surface-cone increases the simultaneously formed inverted cone is forced deeper and deeper into the regions of greater temperature and pressure, where matter exists in the form of compressed gases. The more easily volatilised materials of the depressed mass will be dissipated, leaving only the more refractory elements to form the inverted cone.

So long as there is a free flow of gaseous matter, the higher the volcanic cone the greater will be the ejective force, and, owing to internal reactions, diametrically opposite vents will be most powerful. We therefore reach, as it seems to me, the theoretical conclusion that *in the act of cooling, an originally incandescent body has the power to create conditions which will enable it to remove a part of its mass, in a finely divided state, to distances which may be far beyond the sphere of its own sensible attraction.*

J. M. SCHAEBERLE.

Ann Arbor, January 8.

On an Alleged New Monkey from the Cameroons.

IN NATURE for October 26, 1905, Dr. H. O. Forbes described, as representing a new species, a monkey (Guenon) from the Cameroons, which he named *Cercopithecus crossi* in compliment to Mr. Cross, of Liverpool, to whom it belonged. The description tallied so closely with that of *C. preussi*, based by Matschie in 1898 upon specimens also from the Cameroons, that I strongly suspected the two species would prove to be identical. That this is the case I have now no hesitation in affirming after examining the type of *C. crossi*, which Mr. Cross has sent to the Zoological Gardens in London.

R. I. POCOCK.

Zoological Society's Gardens, January 17.

Sounding Stones.

IT may be of interest to add to the list of musical stones provided by your correspondents another limestone, viz. the very hard, crystallised, coral rock of the coasts of British East Africa. Among the bizarre forms assumed by these rocks under the erosion of the sea, isolated pillars with projecting arm at the top, like a gallows or an inverted capital "L," are common in places. This horizontal arm in many cases gives a clear musical note when struck with a stone or hammer, being thus a ready suspended natural gong.

CYRIL CROSSLAND.

Broughton in Furness, January 18.

Chinese Names of Colours.

IN NATURE of January 11 (p. 246) Mr. A. H. Crook refers to some colour terms used by Chinese. *Ts'eng* (Cantonese) or *ch'ing* (Pekingese) is a vague Chinese term applied to black, grey, "neutral tint," ocean green, sky colour, blue, &c., but nearly always with a gloss or sheen upon it. The fresh turnip-like pears of China are called in Canton *süt*$_{o}$ *li*, or "snow-pears" (the small circle following the *t* indicating the "tone" of the word). Williams's Dictionary of 1878 gives *hsüeh-ch'ing* (Pekingese) or *süt*$_{o}$*-ts'eng* (Cantonese) as "a purple colour," and the allusion is evidently to that bluish glassy tinge that frozen snow takes, as seen in glaciers, icebergs, and so on; in short, all "vitreous" or glassy hues, from beer-bottles to mother-of-pearl, are *ts'eng*.

E. H. PARKER.

THE WORK OF THE NATIONAL ANTARCTIC EXPEDITION.[1]

CAPTAIN SCOTT is warmly to be congratulated on the two interesting volumes in which he describes the work of the National Antarctic Expedition and gives his conclusions as to its results. The book, naturally dedicated to Sir Clements Markham, is a most valuable contribution to the knowledge of what will probably always be one of the most interesting parts of the Antarctic continent. It is written in a charmingly easy and fluent style; the narrative is modest and frank; and the story is always pleasant reading, from its evidence of the uniform good temper which prevailed throughout the expedition, of Captain Scott's capacity for handling his men, of his sympathetic appreciation of their high endeavour, and of his keen interest in all branches of the work. The book is illustrated by a series of fine photographs, many of which were taken by Lieut. Skelton, and its value is greatly increased by the beautiful sketches of Dr. Wilson.

The story of the expedition is full of incident and adventure in most of which Captain Scott had a large share, as he exposed himself to its greatest risks. The two main achievements of the expedition are Captain Scott's fine sledge journeys with Dr. Wilson and Lieut. Shackleton to the farthest south, and with Evans and Lashly to the farthest west that was reached in Victoria Land. Both these undertakings were daring and arduous in the extreme. The sledge journey to the south reached the latitude of 82° 16′ 33″ from 77° 51′, and this spirited performance would probably have been even more successful but for the death of the dogs. The journey westward on to the plateau of Victoria Land Captain Scott describes as even more severe than that to the south, and regarding it he says:—"I cannot but believe we came near the limit of possible performance."

The scientific results of the expedition cannot yet be fully stated, as the collections and observations have not been worked out; and we shall have to wait in most cases for the reports of the experts to whom the material has been entrusted. Captain Scott's book contains accounts of the chief work in geography, in vertebrate zoology, and in geology. The Antarctic mammals and birds are described in an interesting chapter by Dr. Wilson, in which the most important contribution is the account of the life-history of the emperor penguin, which was studied on its breeding-grounds by himself and Lieut. Skelton. The volumes contain no technical information about the invertebrates, &c., and it is disappointing to learn that we cannot expect any additions to the deep-sea fauna of the Southern Ocean. The wealth of new material collected by the *Challenger* in its one deep haul in the Antarctic, led to hopes that valuable results would be achieved by the powerful deep-sea equipment of the *Discovery*; but apparently it was very little used, owing to the short time spent at sea, and possibly on account of the limited coal supply. One dredging is referred to at the depth of 610 fathoms, another at 100 fathoms, and a third, also in shallow water, off the great ice-barrier. The invertebrate fauna, of which Mr. Hodgson has already described elsewhere some of the more interesting discoveries, seems to have been chiefly collected under the ice in McMurdo Sound by means of his very ingenious devices.

The principal geological results are stated in a

[1] "The Voyage of the *Discovery*." By Captain R. F. Scott, C.V.O. Vol. i. Pp. xx+556. Vol. ii. Pp. xii+508; with two maps and 272 illustrations. (London: Smith, Elder and Co., 1905.) Price 42s. net.

valuable appendix by Mr. Ferrar, which is to be followed, in the volumes on the scientific work of the expedition, by a more detailed account of the rocks, and we may hope also by more precise information about the ice. Captain Scott describes the admirable pains devoted to the observations in physics and meteorology, the results of which are being worked out.

The geographical work—"surveyed under the direction of the R.G.S.," the chart informs us—is stated and discussed at length. The chief geographical results were achieved by the sledging parties. The results thoroughly justify those who advocated the selection of McMurdo Sound, or Bay as it was then called, as the winter quarters, owing to its high latitude, its exceptionally interesting geographical position, and its easy accessibility in the summer. There is one quaint mistake in the book in reference to the main hut erected there, which is described (p. 215) as of a design used by "outlying settlers in that country" (Australia); whereas the design was based on Peary's Greenland hut, and the modifications, suggested by Australian experience, were devices used there to render the walls of the frozen meat warehouses impermeable to heat and cold.

The headquarters were established near Mount Erebus, which is still in quiet activity, and (disregarding the feelings of those who like scientific precision in geographical terms) the volcano is described throughout the book as giving forth smoke, fire, and flame.

The widest popular interest is perhaps felt in the "great icy barrier," owing to the mystery suggested by its name, and perhaps, in part, to what, according to Captain Scott, was Ross's exaggeration of its height and uniformity. Ross's conclusion that this ice-sheet is afloat along its seaward face has been fully confirmed; and the important discovery has been added, by observations on a food depôt, that the ice is moving in one place at a rate estimated at 608 yards in 13½ months. Captain Scott regards this ice-sheet, a smaller sheet in Lady Newnes Bay, and a mass ashore at Cape Crozier, as relics of a vast sheet of glacier ice, which once filled the whole of the Ross Sea, and floated when the reduction in its thickness rendered it buoyant.

The geographical problem of most importance is the form and area of the Antarctic continent. It is gratifying to those who believe in the value of geographical homologies, to find how fully the suggestions based on them have been justified by the work of the Antarctic expeditions. The important discovery of Coats Land by the Scotch expedition has revealed the southern shore of the Weddell Sea even further north than the position assigned to it in Sir John Murray's sketch-map. The German expedition has re-established faith in the continuity of the land, in an area where the soundings of the *Challenger* had thrown doubt on it, and where it was possible that there might be a deep southern indentation opposite the basin of the Indian Ocean.

The only serious alteration suggested in the outline of Murray's Antarctica is that the Pacific coast between Graham's Land and Victoria Land may possibly be further south than was expected. The

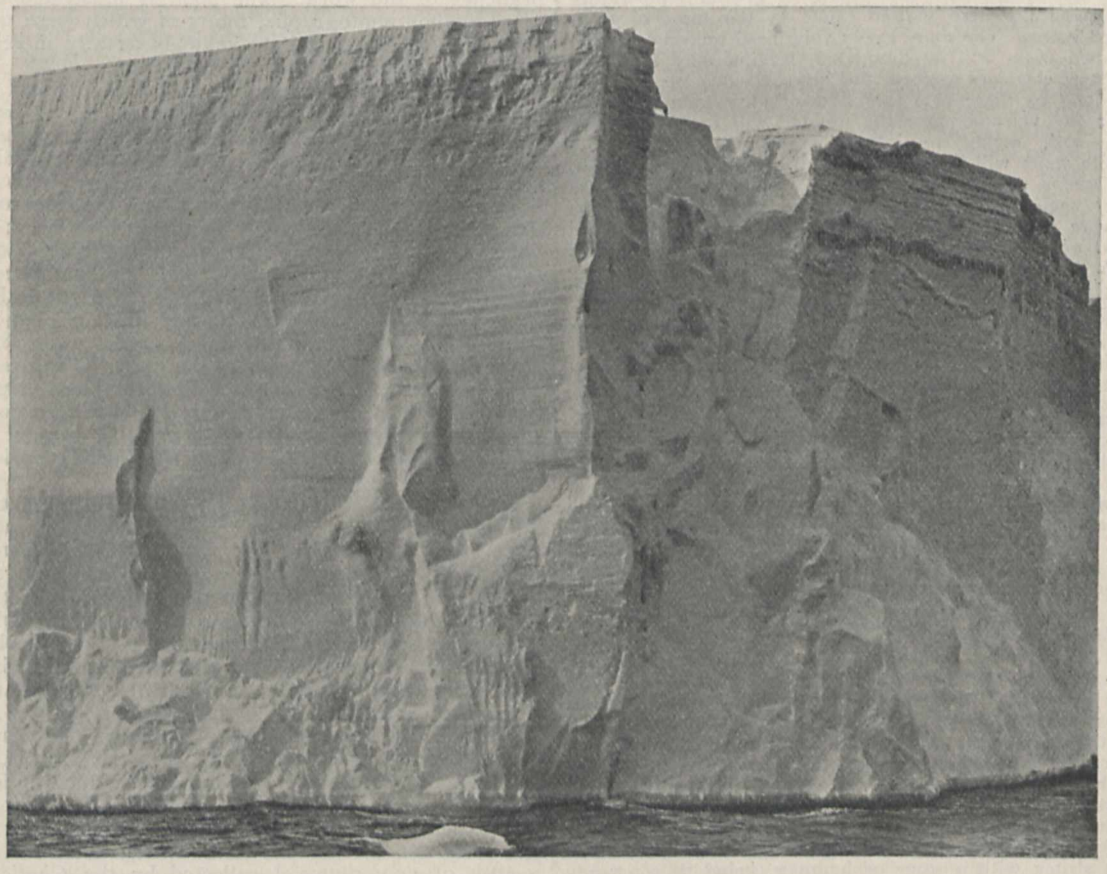

FIG. 1.—Highest Ice-wall (230 feet) on the Ice-Barrier, showing the regular stratification. From "The Voyage of the *Discovery*."

projection eastward of Ross Island and the peaks called by Ross the Parry Mountains, which were all regarded as part of the mainland, suggested that behind Ross's ice-sheet the mountains of Victoria Land trend to the east. Captain Scott tells us that the Parry Mountains do not exist; but a group of islands, White Island, Black Island, and Minna Bluff, occur in almost the same relation to Mounts Erebus and Terror as Ross marked his Parry Mountains. Behind this archipelago there is a great bight, the land first trending somewhat westward, and bending to the east after about 81° S. Thence, so far as Captain Scott could see, the land has an average trend to S.S.E. from Mount Wharton to the most distant southern peak observed beyond Mount Longstaff. Captain Scott concludes that the mountains continue in the same direction to Graham's Land. There is nothing *a priori* improbable in the connection of Victoria Land and Graham's Land along this line; for coasts of the Pacific type are characteristically straight for long distances, and have broad open curves rather than sudden bends.

This does not affect the essential part of my suggestion made in NATURE, April 25, 1901, "that we may expect the greatest elevations on the Antarctic Lands will lie along the Graham's Land-Victoria Land line, and will be near the sea. To the south of the main mountain range there may be an undulating ice-covered region descending slowly across the Pole to the shore of the Weddell Sea. The main ice drainage would then be not from the Pole radially in all directions; the ice-shed would run along the Pacific Shore with a short steep northern face and a long gradual slope southward to the Pole and across it northward to the Atlantic." This view is fully supported by Captain Scott's opinion that, according to his view of the course of the main mountain chain, "the geographical pole would be situated 200 miles more from it, and on the high ice-plateau which must continue behind" (vol. ii. p. 427).

The lands, problematical and proved, to the south of the Pacific probably belong to one of those island festoons, which are still so characteristic, and apparently once occurred along all the Pacific coasts. The only objection to placing the main coastline of the South Pacific south-west of Ross's ice-sheet, instead of along a line north-eastward through King Edward Land, is the ice-barrier, on Captain Scott's theory of its formation. If it be land ice, and be flowing rapidly northward, a mile in three years, it must be fed from snow-fields among mountains to the south, and is probably confined between high lands to east and west.

FIG. 2.—A camp on the "Ross's Ice-Sheet," showing the snowy texture of the surface. From "The Voyage of the *Discovery*."

It is here that we feel most the need of more precise information regarding the ice of Ross's ice-sheet, as Ferrar proposes it should be re-named. That this ice is land ice flowing out to sea has been the generally accepted explanation of the facts described by Ross. The difficulty presented by Ross's ice-sheet, if it be advancing northward along its whole face at anything like the rate of the ice movement round Minna Bluff, is that its surface appears to be practically level, so far as it was followed by Royds to the south-east and by Scott to the south. Hence its rapid movement cannot be due to flow down a slope as in the case of ordinary glacier ice. The best photograph of the ice (vol. i., p. 192) shows that it is very regularly stratified, and there is no visible interglacial material; the ice appears very different from that typical of glaciers. A photograph of a block of the barrier ice, of which the structure had been brought out by throwing over it a bucket or two of hot water, would have been very useful. The characters of glacier ice are so distinctive that any precise information as to the structure of the barrier ice would have left no doubt as to its nature. The photograph (Fig. 1) which gives most information about the ice suggests that, at least the part above sea-level (see also Fig. 2) has been formed by the accumulation of layers of snow upon the surface, more quickly than the ice was dissolved by the sea beneath. If this view of the origin of the ice sheet be correct, both its horizontal position and the gentle undulations of its surface are intelligible; and it forms no obstacle to belief in the connection of Graham's Land and Victoria Land along the shortest and most direct line. In this case Ross's ice-sheet will agree in character with the floebergs of Sir George Nares's Palæocrystic Sea, except that they were supposed to have grown by the additions of layers of ice from the sea below, instead of by the fall of snow from above. In this connection, some information as to the rate of solution and growth of the ice in sea-water at various temperatures would have been useful. Captain Scott tells us that such observations were suggested in the "Antarctic Manual." I have been unable to find there the passage referred to. The suggestion is, however, dismissed (vol. i., p. 305) as ridiculous. More than once during the course of the expedition the observations desired were accidentally noticed, but the conditions are not stated with sufficient precision to be of service.

The structure of Victoria Land, both geographically and geologically, is much as was expected from the considerations which led to the conclusion, first suggested by Ritter, that the eastern coast of Victoria Land represents the continuation of the volcanic line of New Zealand, and that a plateau occurs behind it. The discovery of the plateau structure seems to have occasioned surprise, though the hope was expressed in NATURE, April 25, 1901, p. 612, that one party would "cross the volcanic mountain chain to the plateau that probably lies beyond it." The geological structure, as described in Mr. Ferrar's interesting chapter, consists of low-lying archæan coast hills, beyond which occur sheets of horizontal sediments and broad sheets of plateau basalts. Huge volcanic cones occur off the main coast line, like the worn down volcanic hills of Dunedin and Bank's Peninsula in New Zealand, and apparently there are great volcanic cones on the plateau near its edge. It would be difficult to find land with a structure more typical of the Pacific coast type.

In contrast to the extensive discoveries achieved by the sledging parties from the winter quarters are the limited results obtained at sea, which make the title of the book, "The Voyage of the *Discovery*," somewhat of a misnomer. In the book 176 pages are devoted to describing the whole voyage of the *Discovery* from London to London, and 698 pages to describing the sledging and other work on shore. It was hoped that the *Discovery* would have thrown some light on the two chief problems offered by the outline of Antarctica, in the area reserved for the British sphere of operations. After the discovery of Coats Land by the Scottish expedition, the longest unknown stretch of the Antarctic coast is that south of the Pacific. It was believed from the work of Ross and Cook that land exists connecting Graham's Land to that on the eastern edge of the barrier. The *Discovery* has confirmed the existence of land close by the point where Ross described his "strong appearance of land"; but the necessity for the whole expedition returning to winter on McMurdo Sound prevented the discovery of its nature. Captain Scott seems disposed to regard this land as probably volcanic, and Mr. Ferrar as probably continental.

It was also hoped that the expedition would determine the character of the land to the west of Cape Adare; for a section along that coast, which cuts across the grain of the continent, would no doubt give more information as to its structure, than could be obtained along the coast of Victoria Land or by a traverse of the ice-clad interior. But here again the expedition had to return from the threshold of the unknown regions. This was Captain Scott's misfortune, and was in no way his fault. It was the result of the plan of the expedition being to keep the *Discovery* at the winter quarters. The limited work done by the *Discovery* at sea, and its inability to accomplish the much desired deep-sea trawling, is possibly due to the heavy demands on the available coal supply made by her engines; for the 500 horse-power which they gave required a large consumption of fuel, and this rendered impossible any prolonged period of full steaming away from a coaling station. Whether the *Discovery* was a complete success as a ship appears doubtful. Captain Scott praises many features in its design, and of its magnificent strength there can be no question. But in spite (vol. ii. p. 327) of what Captain Scott calls the "depth of sentiment" he naturally feels for the ship, "which for long proved such a comfortable home," he says that when they tested her sailing qualities they "found to our chagrin that they were exceedingly poor"; she had a fine capacity for rolling, sometimes going over 90°, and he describes (vol. ii. p. 375) her "lurching from side to side in the most uncomfortable fashion while our consort [the *Terra Nova*] followed in our wake with scarcely a movement." Her leakiness is described as a continual source of trouble, and the only expression of irritation in the book is at "another very stupid arrangement" in the ship (vol. i. p. 339). But for the somewhat meagre results achieved by the *Discovery* Captain Scott is not responsible; if the ship could have been kept at work at sea, while Captain Scott was doing his sledge journeys on land, a wider and richer harvest of results would doubtless have been obtained.

J. W. GREGORY.

RECENT ETHNOLOGICAL PUBLICATIONS FROM THE FIELD COLUMBIAN MUSEUM.[1]

OF peculiar interest is Dr. Dorsey's account of the ceremonial organisation of the Cheyenne, which dates back, according to tradition, to two or three thousand years ago, being founded by Motzeyeuff, a prophet who came as a messenger from the Great Medicine with four great medicine arrows, which were sent to the Cheyenne as an emblem for their future, as they possessed magic, and the Great Medicine decreed they should produce effects beyond natural powers. These arrows are still preserved, but two of them are in the hands of the Pawnee. The prophet organised five societies—the Red Shield, Hoof-rattle, Coyote, Dog-men, and Inverted Bow-string. The first two of these are concerned with

[1] Voth, H. R.: "Oraibi Natal Customs and Ceremonies." Field Columbian Museum, Chicago 1905. *Anthropological Series*, vol. vi., No. 2. "Hopi Proper Names," *ibid.* vol. vi., No. 2. "The Traditions of the Hopi," *ibid.* vol. viii.
Dorsey, G. A.: "The Cheyenne: I. Ceremonial Organisation," *ibid.*, vol. ix., No. 1. "The Cheyenne: II. The Sun-Dance," *ibid.*, vol. ix. No.

the capture respectively of the bison (buffalo), elk, and deer. The Coyote society derives its name from the fact that its members imitate the coyote in their power of endurance, cunning, and activity; they outstrip their fellow-tribesmen in running long distances, playing games, &c. The Dog-men were raiders. It would therefore seem evident that, judging from the analogies in Australia and Torres Straits, these are

FIG 1.—Self-inflicted torture by a Cheyenne, for performance of the sun-dance. The thongs are attached to the centre-pole. From a painting by a native artist.

in reality ancient totemic clans which were re-organised by the prophet and still retain their magical functions. The Inverted or Bow-string Warrior society is but little known throughout the tribe; it was founded by the prophet subsequently to the others; there was no chief, each warrior being independent of the rest, though all dressed alike and were always prepared for war. The close observance of the regulations of this society by its members gives them a character distinct from that of the other societies, and they are regarded as pure. They rejoice in the beauty of nature as the work of the Great Medicine, who created the rivers, hills, mountains, heavenly bodies, and the clouds. They are the philosophers among the people. Since the advent of the white man a sixth warrior society, the Owl-man's Bow-string or Wolf Warriors, has been founded; it alone, of all the warrior societies, dances with guns, and they shoot blank cartridges. This paper is illustrated by a number of plates, most of which are facsimiles of coloured drawings by Cheyenne artists; they illustrate the ceremonial costumes and paraphernalia of the members of the societies, as well as sun-dance myths; the drawings are so much in advance of those usually drawn by backward peoples as to suggest that the artists learnt from Europeans. It would have been an advantage if Dr. Dorsey had said a little more about the conditions under which they were executed; the idea of illustrating a memoir by native talent is a good one.

The Cheyenne sun-dance is described in considerable detail in a separate memoir, and is copiously illustrated with 105 figures, nearly all of which are from photographs, and some fifty plates, many of which are in colours. In 1903 Dr. Dorsey published an elaborate monograph on the Arapaho sun-dance (*cf.* NATURE, June 28, 1904), and now we have from his pen a companion account of the same dance as performed by another tribe of Plains Indians. The name given by the Cheyenne to the sun-dance is the New-Life-Lodge; according to the interpretation of the priest, the name means not only the lodge of new life, or lodge of new birth, but it is the new life itself. The performance of the ceremony is supposed to re-create, to re-form, to re-animate the earth, vegetation, and animal life; thus it is the ceremony of the re-birth. As one of the priests put it, "Formerly this dance represented only the creation of the earth. The Cheyenne grew careless and combined other things with the ceremony. At the time of the Love-tipi (or Sacred Lodge), though everything is barren (referring to the bare space made within the tipi), the earth is beginning to grow. Now it has grown. Thus they make the earth, buffalo wallow, grease, wool, and sinew to make growth. By the time of the end of the lodge things have grown, people have become happy; the world has reached its full growth, and people rejoice. When they use the bone whistle they are happy like the eagle, which is typical of all birds and of happiness."

It would take too long to describe the ceremonies, which are evidently very ancient and sacred. Thanks to the labours of Dr. Dorsey and other American colleagues, the religious symbolism of the Plains Indians is beginning to be understood, and researches such as these will afford valuable data to the students of comparative religion. The rite of sacrifice by means of self-inflicted torture was common to many of the Plains tribes, but, so far as is known, it was practised by no tribe to a greater extent than by the Cheyenne. The torture depended upon a vow taken voluntarily; the form most intimately connected with the sun-dance was by attachment in one way or another to the centre-pole; a drawing by a Cheyenne (Fig. 1) illustrates this, and in addition the suspension of buffalo (bison) skulls to the skin. A second form of torture was practised about the camp-

FIG 2.—Incident during self-inflicted torture of a Cheyenne in 1903. Two fragments of old buffalo (bison) skulls were dragged around the inside of the camp circle by thongs attached to the Indian's back.

circle rather than within the sun-dance lodge. Of this form the commonest method was for the dancer to drag one or more dried buffalo skulls attached to skewers inserted in his back, just as the skewers were inserted in the breast in the previous form of torture (Fig. 2).

Mr. H. R. Voth continues his valuable investigations on the Hopi Indians with a particularly interesting account of the customs and ceremonies connected with birth in Oraibi, the largest of the seven Hopi villages, and a suggestive paper on Hopi proper names. When a child is twenty days old it receives its first names from the grandmother, or other close relative on its mother's side, and from other women, all of whom must belong to the clan of the mother and child. The "child-name" is retained until the child is initiated into some order or society, when a new name is given, and at every subsequent initiation a fresh name is given. All Hopi proper names have some reference to the clan totem of the name giver, never, unless coincidentally, to the clan totem of the bearer of the name. The same investigator publishes 110 traditions of the Hopi, which were collected in the vernacular and without an interpreter.

A. C. H.

NOTES.

SIR WILLIAM THISELTON-DYER, K.C.M.G., F.R.S., has been elected a member of the American Philosophical Society.

BARON DE GUERNE has been elected president for 1906 of the Paris Geographical Society, M. E. H. Martel chief vice-president, and Baron Hulot general secretary.

THE editors of the *Geological Magazine* have issued invitations to a reception to be held on the evening of February 8, to commemorate the publication of the five hundredth number of that periodical.

PROF. KARL VON FRITSCH, president of the Leopold-Caroline Academy, and professor of geology and palæontology in the University of Halle, died on January 9 in his sixty-seventh year. Of his written works, the most widely known is his "Allgemeine Geologie."

FROM Basel we learn that Swiss engineers have sketched out a plan for connecting Switzerland with the North Sea and the Mediterranean by means of an immense canal system at an estimated cost of 324,000,000 francs. On the one side Rotterdam is to be reached from Lake Constance by means of the Rhine, and on the other side Lake Como is to be brought into connection with the Mediterranean by means of the River Po.

THE sum of nearly 2000*l.* has been given by Judge Holek (Denmark) for the purpose of effecting Porsild's plan of a biological station in Greenland, and the Danish Government has agreed to be responsible for a large part of the annual upkeep of the station, which is estimated to run to 11,000 kroner (111*l.*). The most eminent travellers in polar regions in general, and in Greenland in particular, have testified to the value of such a station.

ON Thursday next, February 1, Mr. Benjamin Kidd will begin a course of two lectures at the Royal Institution on "The Significance of the Future in the Theory of Evolution," and on Saturday, February 3, Mr. J. W. Gordon will deliver the first of two lectures on "Advances in Microscopy." The Friday evening discourse on February 2 will be delivered by Prof. S. P. Thompson on "The Electric Production of Nitrates from the Atmosphere," and on February 9 by Mr. H. F. Newall on "Eclipse Problems and Observations."

A NOTE special to Monday's *Pall Mall Gazette* announces that "a new system of wireless electrical communication that seems admirably suited for connection over distances of a few miles, and that possesses the advantage of cheapness, reliability, and secrecy in a degree that probably exceeds all the other systems, has just emerged from some very successful trials in Germany." The experiments described were made near Berlin by Mr. E. Ruhmer, but the "special" news referring to them adds nothing to the account of his system given in NATURE two years ago (February 18, 1904, vol. lxix., p. 373) in an article on "Photo-telephony."

MR. ELNAR MIKKELSEN, the young Danish explorer who, in conjunction with Mr. Leffingwell, an American, is organising an expedition to the Beaufort Sea, has just left this country for the United States. It is proposed that Mr. Leffingwell and other members of the expedition shall travel down the Mackenzie River in the early summer of this year, while Mr. Mikkelsen, should he be able to obtain a suitable vessel, will leave San Francisco in April, and after spending some time on the Siberian coast purchasing necessary equipment, meet the rest of the party at the mouth of the Mackenzie some time in the latter part of August. Thence the expedition will make its way to Cape Kellet, in Banks Land, and begin the exploration of its special region. The work to be undertaken depends to some considerable extent on the arrangements which it may be possible to make with regard to the fitting out of a ship.

AT a meeting at the Royal United Service Institution on January 18, Major Goodwin, D.S.O., delivered a lecture on "Military Hygiene on Active Service." After briefly describing the origin and causation of those diseases which affect armies in the field, and discussing and comparing the statistics of the Boer and Russo-Japanese wars, the lecturer suggested that there are two principal measures, which, if organised and perfected, will entirely remedy, in his opinion, the great evil which has existed in the past. The first measure is sanitary organisation—a corps should be formed of officers and men specially trained in all the methods of sanitation—the second is the necessity for the further education of regimental officers and men in sanitary principles.

THE annual general meeting of the Entomological Society of London was held on January 17. Mr. F. Merrifield, the president, read an address on the general operation of temperature on the growing organism of lepidopterous insects, based on a series of experiments, especially with reference to the remarkable limitations imposed by climatic and artificial conditions. The report of the society showed that for the first time in its history the number of ordinary fellows had reached five hundred. The officers and council were elected for the session 1906–7 as follows:—President, Mr. F. Merrifield; hon. treasurer, Mr. A. H. Jones; hon. secretaries, Mr. H. Rowland-Brown and Commander J. J. Walker, R.N.; librarian, Mr. G. C. Champion; other members of the council, Mr. G. J. Arrow, Mr. A. J. Chitty, Mr. J. E. Collin, Dr. F. A. Dixey, Mr. H. Goss, Mr. W. J. Kaye, Mr. H. J. Lucas, Prof. E. B. Poulton, F.R.S., Mr. L. B. Prout, Mr. E. Saunders, F.R.S., Mr. R. S. Standen, and Mr. C. O. Waterhouse.

DR. H. J. P. SPRENGEL, F.R.S., the inventor of the mercury air-pump, whose death we announced last week, was for three years an assistant in the chemical laboratory of Oxford University; afterwards he worked in the laboratories of Guy's and St. Bartholomew's Hospitals, London. He was elected a Fellow of the Royal Society in 1878. His air-pump, which he described to the Chemical Society in 1865, led to results which had an important influence on the development of both science and industry in the latter part of last century. It provided a convenient method of obtaining vacua of very high tenuity, and contributed greatly to the perfection of the incandescent electric lamp. Dr. Sprengel devoted much time to the study of detonation and explosives, and in 1871 took out patents for a class of explosive substances which were non-explosive during their manufacture, storage, and transport. He was the first to direct attention to the value of picric acid as an explosive when fired by a detonator. In addition to papers on his vacuum pump and kindred subjects, Dr. Sprengel published the following contributions to science among others:—Atomised water as a substitute for steam in a chemical process, 1873; improvements in explosive compounds, 1871; on a new class of explosives, 1873; the Hell-Gate explosion near New York and so-called "Rackarock," 1886; the discovery of picric acid as a powerful explosive and of cumulative detonation with its bearing on wet gun-cotton, 1902.

THE fifty-fifth meeting of the American Association for the Advancement of Science was held at New Orleans, and began on December 29 last. The membership of the association has now reached 4500. It has been decided to hold two meetings during 1906, one in the summer at Ithaca, N.Y., the other in the winter at New York City. At the recent meeting, the address of the retiring president, Prof. W. G. Farlow, dealt with the popular conception of a scientific man at the present day. The presidents of the different sections delivered their addresses on various days throughout the meeting. Prof. Ziwet, at the first meeting of the section of mathematics and physics, took for his subject the relation of mechanics to physics. Prof. Kinnicutt, in the section of chemistry, considered the sanitary value of a water analysis. Prof. Merriam, in the section of zoology, discussed the question, Is mutation a factor in the evolution of the higher vertebrates? The subject of the partition of energy was taken up by the president of the physics section, Prof. Magie; and the generic concept in the classification of the flowering plants was dealt with by Prof. Robinson in the section of botany. Prof. Knapp, in the section of social and economic science, considered the subject of transportation and combination. In the section of mechanical science and engineering, Prof. Jacobus addressed the meeting on commercial investigations and tests in connection with college work. The experience at New Orleans makes it doubtful whether the experiment of scattering the addresses of the presidents of sections through a week is a wise departure.

WE have received copies of the reports of the Bristol Museum and Reference Library for 1904, and of the Bristol Museum and Art Gallery for 1905. The change in the title of the institution is due to the opening of the Art Gallery, which took place in February of last year, when the inaugural address was delivered by the late Prof. Herkomer. About the same time Mr. F. G. Pearcey entered the museum as assistant curator, and since his appointment a thorough re-arrangement of the zoological exhibits has been undertaken, while large additions have been made by gifts and purchase.

BOTANICAL surveys undertaken with the object of studying the distribution of plants over a limited area have been prepared by several workers in Scotland and England. Mr. G. H. Pethyridge and Mr. R. L. Praeger publish in the *Proceedings of the Royal Irish Academy* (vol. xxv.) a survey of the vegetation of the district lying south of Dublin. The authors distinguish four zones, littoral, agrarian, hill pasture, and moorland. It was observed that the three associations of *Ulex Europaeus, Ulex Gallii*, and Calluna maintain a definite succession in altitude, *Ulex Europaeus* occurring at the upper limit of the agrarian zone, and Calluna forming the most important feature of the moorland. The association in which Pteris is the dominant member occupies positions in each of the three former associations, holding its own where it is favoured by well-drained soil and a sheltered situation. The paper is accompanied by six illustrations, of which the one reproduced shows the characteristic rounded hummocks of *Ulex Gallii* in the foreground; in the background the farmland is seen below with *Ulex Europaeus* just visible in the middle distance and Calluna clothing the summit of the hill.

Photo. *R. Welch.*
FIG. 1.—Piperstown Hill, showing, in ascending order, farm land, *Ulex Gallii* association, and Calluna association.

THE educational advantages of the Central Museum at Brooklyn, New York, form the subject of the first article in the January issue of *Museum News*, in which attention is specially directed to the exhibits of typical groups of mammals, birds, and reptiles. It would seem, however, that the museum authorities themselves stand in need of education, otherwise they would scarcely have stated "that the present revolution in Russia bids fair to complete the extermination of the European bison by killing off the Lithuanian herd." They appear to be quite unaware of the existence of this animal in a truly wild state in the Caucasus.

In addition to several papers relating to the human subject, the January issue (vol. xl., part ii.) of the *Journal of Anatomy and Physiology* contains contributions on the anatomy and development of the lower mammals. Among these is one by Dr. T. H. Bryce on the development of the thymus gland in the lung-fish, *Lepidosiren paradoxa*, in the course of which the author arrives at the important conclusion that, at least up to an advanced larval condition, this organ has absolutely nothing to do with the development of leucocytes. Apparently the leucocytes take origin in a tract along the hind kidney, and, at any rate, there is evidence of their existence before the thymus cells have lost their epithelial characters. In another paper Prof. Symington discusses the bearing of the structure of fœtal whale-flippers on the development of additional digits and joints in the hand and foot of vertebrates generally. In cetaceans the suppression of nails or claws has led to the development of a cartilaginous rod at the end of each digit which is apparently a reversion to the primitive mammalian condition. "Such a condition would obviously facilitate the development of additional cartilaginous elements to adapt the limb to its newly acquired function as a balancing and steering organ." Hence the occurrence of "hyperphalangism" is easily accounted for, while indications of incipient "hyperdactylism" are afforded by rudiments in some cases of the development of a sixth digit.

In the annual report of the Botanical Department, Trinidad, for the year 1904–5, the superintendent, Mr. J. H. Hart, directs attention to the advantages of budded over seedling oranges in maintaining the qualities of any selected strain. Trinidad oranges have been successfully transported to England from time to time, and last year a consignment of mangos was sent over that carried well, and was said to compare favourably with the best Indian fruit. Among shade trees for cacao, *Gliricidia maculata*, the "Madura" of Central America, has been in considerable demand, and Honduras mahogany has also been planted. The cotton experiment plots suffered severely from the "boll rot."

Mr. D. McAlpine records in *Annales Mycologici* (vol. iii., No. 4, 1905) the discovery of a peculiar set of rusts on species of Acacia in Australia that he places in a new genus, Uromycladium. The characteristic of the genus is a branched carpophore producing at the ends of each branchlet one to three separate teleutospores, or in place of one of the teleutospores a colourless vesicle or cyst. Mr. McAlpine regards the genus as a link between Uromyces, which has a single teleutospore, and Ravenelia, a peculiar genus in which the stalk is compound and a number of spores are joined together at the top, with vesicles below. Of the seven species enumerated, uredospores and spermogonia are known for some, but no æcidia have as yet been found.

The *Times* of January 12 contains a comprehensive summary of the rainfall of 1905, by Dr. H. R. Mill. The work is valuable from a double point of view—from the vast amount of material relating to the rainfall of the British Islands that Dr. Mill has at his disposal, and from the almost incredible shortness of time in which he has been able to compile his statement, in advance of the usual annual rainfall volume, which takes at least six months to produce. The author points out that during an average year no spot with a fall of less than 20 inches appears on the rainfall map of Great Britain; last year there were about 7500 square miles, while the area with rainfall exceeding 40 inches measured some 29,000 square miles, or less than a quarter of the country. In an average year more than a third of the area of the country has a greater fall than 40 inches. A table based on a thirty years' average which accompanies the paper shows that none of the fifty-one stations quoted for England and Wales reached the normal amount, that only one did so in Ireland, and about half the stations in Scotland. From these figures Dr. Mill estimates that the general rainfall for England and Wales was only 83 per cent. of the average; for Ireland, 89 per cent.; for Scotland, 96 per cent. In other words, for every inhabitant of the British Isles there was last year 224,000 gallons less rain than in an average year. Further, that the year 1905 has justified the three years' cycle of one wet year followed by two dry years; the probability of 1906 proving a wet year has not been contradicted by the weather of the first half of January.

Mr. van der Grinten, whose projection of the whole globe in a circular map, published last year, attracted considerable attention, deals with another case—that of the "apple-slice" shape—in *Petermann's Mitteilungen* (p. 237, 1905).

Dr. Gerhard Schott contributes a paper on the relief of the bed of the Southern Ocean, and the distribution of bottom temperatures, to *Petermann's Mitteilungen* (No. 11, 1905). The soundings and temperature observations of recent expeditions are made use of, and the author has compiled an admirable bathymetrical chart showing the state of our knowledge of the region in 1905.

The *Zeitschrift der Gesellschaft für Erdkunde* (No. 9, 1905) contains a paper on the geographical conditions determining the distribution of moorlands, by Dr. F. Solger. The chief factors taken into consideration are rainfall, surface topography, and elevation, and the relations of these three factors in different types of moorlands are discussed.

The publishers of *l'Elletricista* have issued a useful little book, by Dr. G. Agamennone, under the title of "La Registrazione dei Terremoti." The words "in Italia" should have been added to the title, as the book is confessedly devoted to Italian work, and hardly refers to that which has been done elsewhere, especially in Japan, where the ideas embodied in the Italian instruments were, with few exceptions, anticipated in the publications of the Seismological Society of Japan. The omission is justified by the plea of the author that any attempt at adequate recognition of the work done in other countries would have swollen the book to an undesirable size; as it is, we have a well got up and clearly written account of the seismoscopes and seismographs used in Italy, which are singularly efficient if somewhat more cumbrous than the English or Japanese patterns.

The *Rendiconto* of the Bologna Academy (vols. v.–vi.), covering the period 1900–2, has just been sent out. It contains a series of illustrated papers by Dr. Francesco Crevatin on the terminations of nervous systems; also papers by Prof. Augusto Righi on the magnetic field of a moving charge and on the acoustic properties of condensers, by the late Prof. Emilio Villari on the heating effects of electric discharges and on Röntgenised air, by Prof. Ferdinando Paolo Ruffini on the three cusped hypocycloid, and others.

We have received the annual report of the Circolo Matematico di Palermo, which shows an increase in its membership roll from 27 in March, 1884, and 195 in

March, 1904, to 255 in March, 1905. Of these 36 are resident, 138 non-resident, and 81 foreign members. The society owes its present position as a mathematical society of international rank largely to the personal exertions of Prof. Guccia, and further evidence of this activity is shown by the offer of a "Guccia medal" and prize of 3000 francs, to be awarded at the mathematical congress at Rome in 1908, for the best essay marking an advance in the theory of algebraic twisted curves.

MR. HENRY FROWDE has published an edition of Wordsworth's "Guide to the Lakes," with an introduction, appendices, and notes by Mr. Ernest de Sélincourt. Though Wordsworth is, throughout the book, rather the lover than the student of nature, yet the volume contains much that will appeal in a special manner to men of science—for example, the remarks on stone circles—and everything the volume contains will serve to increase the enthusiasm with which scientific students approach natural phenomena.

THE 1906 issue of their "Nature Calendar" has been published by Messrs. George Philip and Son, Ltd. It is a little difficult to understand the plan on which the notes for the months have been arranged, and on what principle the entries for successive days have been selected. Under the date January 25, for instance, are to be found the following statements:—"Jackdaws begin to come to churches"; "First appearance of Yellow Wagtail"; and "Honeysuckle leafing." A young, uninitiated nature student, who observed a jackdaw going to church, or came across a yellow wagtail, or found honeysuckle in leaf before January 25, might have his faith in naturalists' calendars seriously shaken.

A SECOND edition of Prof. Douglas H. Campbell's work on "The Structure and Development of Mosses and Ferns" has been published by Messrs. Macmillan and Co., Ltd. The first edition was published in 1895, and was reviewed at length in our issue for January 2, 1896 (vol. liii. p. 194). Portions of the work have been re-cast entirely, this being especially the case with the eusporangiate ferns. The whole book has been carefully revised and new matter has been introduced, including two special chapters on the geological history of the Archegoniates and the significance of the alternation of generations. Some of the new material is published now for the first time, but much of it is based upon papers written by Prof. Campbell during the last ten years.

OUR ASTRONOMICAL COLUMN.

PERIODICAL COMETS DUE TO RETURN THIS YEAR.—Writing to the *Observatory* (No. 366), Mr. W. T. Lynn directs attention to the fact that two known periodical comets are due to return during the present year—Holmes's comet in the spring, Finlay's in the summer. The former has already been noted in these columns. Finlay's comet was discovered at the Cape on September 26, 1886, and performed its perihelion passage on November 22 of the same year; its period is about 6·6 years, and on its return in 1893 it was first seen by the discoverer himself, and passed perihelion on June 16. On its return in 1899 the comet was unfavourably situated for observation, and so escaped detection.

A note published in No. 1, vol. xiv., of *Popular Astronomy* mentions six other periodical comets as being due this year, viz. Barnard's (1884 II.), E. Swift's (1894 IV.), Denning's (1881 V.), Swift's (1889 VI.), and the two lost comets, Biela's and Brorsen's. Of these, the first and second will be unfavourably placed for observation; the third has not been seen since 1881, but will be more favourably placed this year; the fourth was very faint in 1889, and any small change in the period may have rendered it wholly invisible.

THE ANNULAR NEBULA IN CYGNUS (N.G.C. 6894).—An interesting photographic study of the very faint annular nebula N.G.C. 6894 has recently been made at the Meudon Observatory by M. G. Tikhoff. Using the 39-inch reflector, the observer obtained four photographs, of which he has measured the two best, taken on September 27 and October 27 with exposures 2h. 20m. and 3h. respectively.

These photographs showed the nebula to have the form of an elliptical ring with a condensation in the centre, the space between the nucleus and the outer ring being fairly bright. The extremities of the major axis of the ellipse are sharp, but several faint appendices are clustered around the ends of the minor axis. Measurements of the plate obtained on September 27 showed the length of the major axis to be 44″·8, that of the minor axis 37″·3, but if the appendices be included the length of the latter becomes 50″·8. The nebula really consists of two rings, a broad outer one and a narrow inner ring, but the duplication is interrupted on the north-west by the star discovered by Lord Rosse in 1855. The outer ring has several condensations in it, of which the two brightest are nearly opposite to Lord Rosse's star.

M. Tikhoff recalls the fact that all observers of this nebula have commented on its similarity to the ring nebula in Lyra, and advances the opinion that it is probably in a later stage of development, for whereas the Ring Nebula has only one condensation, this Cygnian nebula has many.

RIGHT ASCENSIONS OF THE EROS COMPARISON STARS.—In Nos. 4059–4060 of the *Astronomische Nachrichten*, Dr. Fritz Cohn, of Königsberg, gives a catalogue containing the definitive positions of the Eros comparison stars contained in the two lists iussed by the international committee. The positions are given for 1900·0, and two supplementary tables give the proper motions necessary for reducing the places of the few stars known to be in motion to the equator of 1901·0.

OBSERVATIONS OF NOVA PERSEI (NO. 2) AND NOVA GEMINORUM.—The results of a series of magnitude observations of Novæ Persei and Geminorum are given in No. 4066 of the *Astronomische Nachrichten* by Dr. K. Graff, of the Hamburg Observatory. The Nova Persei observations extend from March 11, 1902, to August 24, 1905, and show one or two apparent oscillations of the brightness. On the latter date the magnitude of this star was recorded as 10·73.

The record for Nova Geminorum contains the results of six observations made between September 16, 1903, and November 10, 1904, and shows an apparent increase in the brightness between January 20, 1904, and the final observation; the latter was, however, somewhat uncertain, and gave a magnitude of $<$12·0.

On November 28, 1905, Prof. Max Wolf found that the magnitude of Nova Persei on the Pickering scale was 11·65, but compared photographically with the stars given by Father Hagen the magnitude came out as 10·6.

DOUBLE STAR ORBITS.—Prof. Doberck publishes four possible orbits for τ Ophiuchi and two for γ Centauri in No. 4063 of the *Astronomische Nachrichten*. Of these, he finds, on comparison, that the following agree most closely with observational results:—

τ Ophiuchi	γ Centauri
$\Omega = 76^\circ\ 12'$	$\Omega = 3^\circ\ 21'$
$\lambda = 17\ 45$	$\lambda = 285\ 2$
$\gamma = 66\ 4$	$\gamma = 81\ 47$
$e = 0{\cdot}5338$	$e = 0{\cdot}2958$
$P = 223{\cdot}82y.$	$P = 211{\cdot}93y.$
$T = 1814{\cdot}79$	$T = 1851{\cdot}63$
$a = 1''{\cdot}307$	$a = 1''{\cdot}924$

The value of the hypothetical parallax for τ Ophiuchi is 0″·035, and for γ Centauri 0″·054. In the elements of the latter, the epoch and the longitude of periastron are somewhat uncertain, and for this star the motion is retrograde.

ECONOMIC GEOLOGY IN THE UNITED STATES.

THE energy shown by all branches of the United States Geological Survey increases year by year, and it is impossible to overestimate the importance of the results achieved during the twenty-five years of its existence. The prompt return made for the pecuniary support accorded to the survey is best shown by the numerous publications, appearing each year, which are devoted to the development of the mineral resources and to the advancement of important engineering projects. The miner is thus taught the practical value of geological work, and mining development is placed upon a scientific basis. A large number of bulletins have recently been published which, though describing researches of an essentially scientific nature, deal with the economic resources of specified districts. Half a dozen of these bulletins, well illustrating the educational value of the survey's work to those engaged in the mining industry, have been selected for brief notice. Of these the most important is No. 260, "Contributions to Economic Geology, 1904," in which Mr. S. F. Emmons and Mr. C. W. Hayes, the geologists in charge of the sections dealing with ores and non-metallic minerals respectively, bring before the public with all possible speed the economic results arrived at by the survey. The bulletin covers 620 pages, and contains sixty-three contributions from thirty-seven members of the survey who have been engaged throughout the year in economic work. The production of gold and silver in the United States in 1904 is discussed by Mr. W. Lindgren, who has made a novel classification of the ores into (1) placer or detrital deposits, and (2) ores from rock *in situ*, further subdivided into quartzose ores, copper ores, and lead ores. The percentage of the total production derived from the four classes thus established is as follows:—

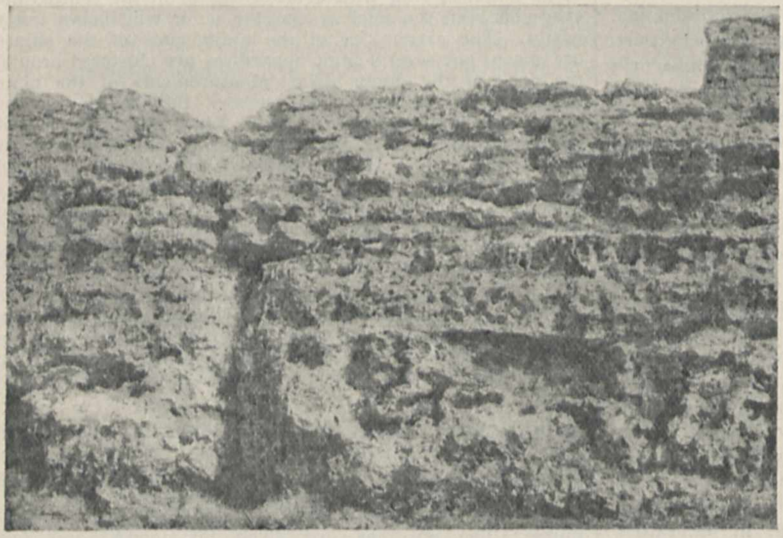

FIG. 1.—Weathered Surface of Galena Limestone near Rockdale, Iowa.

	Placers	Quartzose	Copper	Lead
Gold	15·2	74·3	5·0	5·4
Silver	0·1	22·2	34·7	42·9

A similar calculation of the copper production of the United States, made by Mr. W. H. Weed, shows that of the copper produced 27 per cent. occurs in native ores, 6 per cent. in oxide ores, and 67 per cent. in sulphide ores. Mr. L. C. Gratton reports that the tin deposits (dykes of pegmatite carrying cassiterite) of North and South Carolina are probably of considerable economic importance; and Mr. F. L. Hess gives a concise statement of what is known with regard to tin deposits throughout the rest of the world. In the Birmingham district, Alabama, an important result of the work of the survey has been the extension of the red hæmatite ore beyond its supposed southern limit.

The fuel resources of the United States received more attention last year than at any previous time during the existence of the survey. About 3000 square miles of coal-bearing territory have been mapped, and work in the oil and gas fields has been continued. The American cement industry formed the subject of an extensive investigation by Mr. E. C. Eckel, and much valuable information is given regarding the slate, granite, and clay industries. Descriptions are also given of a molybdenite deposit in eastern Maine, and of the vanadium and uranium ore deposits in south-eastern Utah.

Bulletin No. 255, on the fluorspar deposits of southern Illinois, by Mr. H. Foster Bain, embodies the results obtained in a detailed study of the fluorspar deposits in Pope and Hardin counties, the area covered being at present one of the most important producers of fluorspar in the United States. The deposits were discovered in 1830 but were not mined until 1870. The mineral occurs in veins along faulting fissures, and is associated with calcite, galena, and zinc-blende. In 1903 the district produced 11,413 tons of fluorspar, valued at 11,544*l*. The best grade of fluorspar, with less than 1 per cent. of silica, is used in the enamelling, chemical, and glass trades. The second grade is used in open-hearth steel making to give fluidity to the slag. About 20,000 tons are used annually in this work. The lowest grade is used in foundry work.

The zinc and lead deposits of north-western Illinois are dealt with in Bulletin No. 246 by Mr. H. Foster Bain. The region contains large reserves of zinc ore of good quality. The main ore-bearing rock is a thick massive dolomite, known as the galena limestone. Owing to the predominance of solution over disintegration, it presents on weathered surfaces a very characteristic carious surface (Fig. 1).

FIG. 2.—Vanport Limestone Quarries at Newcastle, Pennsylvania.

Bulletin No. 249, on limestones of south-western Pennsylvania, by Mr. F. G. Clapp, is of great economic interest in view of the recent extension of the portland cement industry. It points out promising localities for the erection of cement plants in the coal areas of Pennsylvania. As a rule, these Carboniferous limestones are not suited for building stone, but many of them, when burned, form lime of excellent quality for agricultural, building, and fluxing purposes. The Vanport limestone, the most persistent, thickest, purest, and most massive limestone in the series, is extensively quarried for furnace flux at Newcastle (Fig. 2).

In Bulletin No. 238 Messrs. G. I. Adams, E. Haworth, and W. R. Crane give detailed information concerning the geology of the Iola Quadrangle, Kansas, a rapidly developing petroleum and natural gas field. At the end of 1903 there were 1596 producing wells in Kansas, and of these 549 were at Chanute (Fig. 3) and 339 at Humboldt in the area under consideration. Natural gas is abundant in the vicinity, and is largely used in zinc smelting. Indeed, more than half the zinc made in the United States is smelted by Kansas gas, and more than half of this is produced at works within the Iola quadrangle.

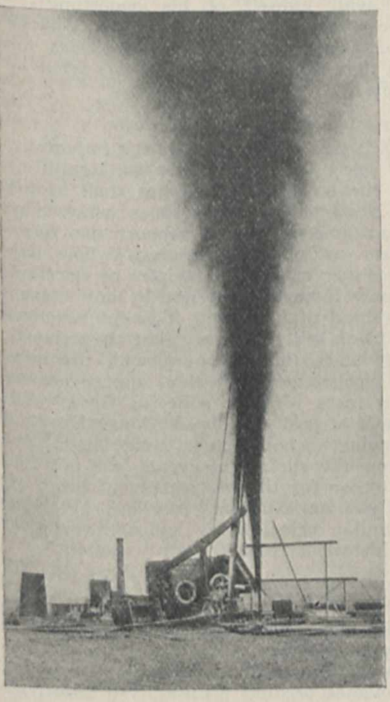

FIG. 3.—Golden Oil Company's Well No. 2, near Chanute, Kansas.

Bulletin No. 264, by Messrs. M. L. Fuller, E. F. Lines, and A. C. Veatch, gives a record of deep-well drilling for 1904, and is the first of a proposed series of annual publications. The report embodies the records of a large number of wells, for many of which sets of samples are preserved.

THE APPLICATION OF SCIENTIFIC METHODS TO THE STUDY OF HISTORY.[1]

THE remarkable change which during the last fifty years has passed over most subjects of study owing to the growing dominance of the scientific spirit has not left history unaffected. The leading historians of the present day are essentially men of science. They are diligent in their pursuit of truth and skilled in the special methods of research which their subject demands. They are strikingly impartial in their judgments, constantly on their guard against the prepossessions so liable in matters of past politics to bias opinion. They are ever on the alert to discover unifying principles, general laws, large uniformities, without which no body of historic facts, however accurately ascertained and however impassionately selected, can justify the claim of history to be regarded as a science, or can make history worthy of the serious attention of intelligent men.

All the writers enumerated at the foot of this column deal in some shape or form with this transference of history from the domain of literature to the domain of science. None states the fact of the transference more clearly than does Prof. Bury, who says (p. 16):—"I may remind you that history is not a branch of literature. The facts of history, like the facts of geology or astronomy, can supply material for literary art . . . but to clothe the story of a human society in a literary dress is no more the part of a historian as a historian, than it is the part of an astronomer as an astronomer to present in an artistic shape the story of the stars"; and again (pp. 7 and 42) he emphatically asserts that "History is a science, no less and no more." But though this statement is perhaps more explicit than any other in the works before us, yet the idea which it expresses is common to all.

It is not enough, however, to assert that a subject, long regarded as a branch of literature, is really a science. It is necessary to define its scope, to expound its method, and to show its relation to other sciences. This our authors do in varying degrees of fulness, and it would be a profitable, and I think not uninteresting, task to take them one by one and to analyse their views. But in an article like the present it is not possible to undertake this detailed examination, and I must content myself with giving a summary statement of the way in which scientific method has been applied to history, and of some of the results which have been attained.

It is a curious and remarkable fact that the earliest of the above-named exponents of the science of history, Droysen and Froude, were called upon to cast their first clear utterances upon the subject into the form of a severe castigation of a too zealous champion of their own view, H. T. Buckle. Buckle had become possessed of the great idea commonly associated with the name of Comte, viz. that "all phenomena without exception are governed by invariable laws with which no volitions natural or supernatural interfere," and in his "History of Civilisation" (1858–61) he had endeavoured with wonderful ingenuity and vast learning, not so much to elevate history to the rank of a science as to reduce it to the level of a *physical* science, with laws of the same rigidity and of the same universal applicability as the laws of motion or the laws of chemical affinity. This was going further than either the most advanced historians or the least exclusive philosophers would allow, and a keen controversy ensued, out of which at length emerged into general recognition the important fact that history differs from the natural sciences in at least two respects, first, that, with regard to its method, it is a science, not of observation or of experiment, but of criticism; secondly, that with respect to its generalisations, since they deal with a realm, not of matter, but of mind, in which motive and not force is supreme—a realm of consciousness and freedom—they can never have that fixity and universality which are connoted by the term "law."

On the other hand, historical phenomena are not permanent, but evanescent. Events happen once, and then fade beyond recall into the past. Observations made at the moment of their happening can never be repeated, and historians are dependent for all their knowledge of bygone events upon such records as may chance to have been made and to have been preserved. These records are the only present and concrete facts with which historians come into contact. These are the basal material of their science. But they are valuable and important, not at all for their own sake, but only for what they reveal. They reveal past facts, yet even these not directly, but past facts as seen through the refracting medium of the human mind. And when the historian has eliminated, so far as he can, the personal factors for his records and has extracted such pure and unadulterated fact as remains, even then he has not come to the end of his research. Far beyond and beneath all events there lie the thoughts, the acts of will, the emotions of which they were the realisations and manifestations—ultimate facts of the human spirit wholly beyond the observation even of those in whose midst the events transpired. It is these for which in the last resort he seeks. Thus, as has been remarked, history is a science, not of observation, still less of experiment: it is a science of criticism.

On the other hand, with regard to generalisation and law, the fundamental truth to be recognised is that history never repeats itself. The phenomena of history are not

[1] (1) "Erhebung der Geschichte zum Rang einer Wissenschaft." By J. G. Droysen. (1862.)
(2) "The Science of History." By J. A. Froude. (1864.)
(3) "Grundriss der Historik" By J. G. Droysen. (1867.)
(4) "The Science of History." By Principal John Caird. (1886.)
(5) "Introduction aux Études Historiques." By Langlois and Seignobos. (1897.)
(6) An Inaugural Lecture. By Prof. J. B. Bury. (1903.)
(7) "A Plea for the Historical Teaching of History." By Prof. C. H. Firth. (1904.)
(8) "The Methodical Study of Man" By Dr. Percy Gardner. (1904.)

stationary like those of the experimental sciences which can be called up at will at any moment; they are in constant movement. Moreover, their movements are not cyclical, like the movements of the planets; they are progressive in an infinite series. Every event which occurs adds something to the environment of every subsequent event and is a factor in its causation; so that the mere fact that a thing has happened once presents an insuperable barrier to its ever happening again. We of the present day, for instance, are divided by an impenetrable wall of new ideas, new discoveries, new conditions from our predecessors of but the last generation. Not even the most deliberate and carefully planned attempts to revert to earlier orders of things—social, religious, political—can possibly result in anything but hopeless failure. History can never be *made* to repeat itself.

That being the case, it is obvious that whatever may be the general principles which historians may deduce from their study of historic phenomena, they will be very different from the rigid and invariable laws of natural science which enable the expert not only to explain the past, but also to predict the future. History, in fact, has closer analogies with the mental and moral sciences than with the natural sciences. It is to the human race almost exactly what memory is to the individual man. No individual man ever finds himself twice in precisely the same situation, nor can anyone discover unvarying sequences of cause and effect in the relations between himself and his fellows; yet, notwithstanding this, every man in his mature life is very largely guided and governed by his experiences as recorded by his memory and by the principles of conduct which his judgment has deduced from them. As with the individual so with the race; but subject to this important difference, that the race lacks that personality, that continuity of self-consciousness, which marks the individual. It has no natural memory, and in order that it may not lose the vast accumulated wealth of the experiences of the past a memory has to be created for it. That race-memory is history. Through history mankind attains to self-consciousness. As Droysen puts it:—"Die Geschichte ist das γνῶθι σαυτὸν der Menschheit, ihr Gewissen." By means of this self-knowledge humanity is able to become to a degree otherwise wholly impossible the master of its fate; it is able to control its destiny, and to move deliberately forward on the pathway of progress.

Now if history is to perform adequately its high function, and to serve the purpose of a universal memory to man, it is plain that it must no longer be left in the hands of the literary artist to be built up of anecdotes, be they told never so brilliantly, or in the hands of the party-politician to be constructed of half truths, be they never so honestly held to be the whole truth. History must be elaborated by the strictest methods of science, even though it is concerned with facts which are beyond the reach of observation and with principles which are not reducible to the satisfying simplicity of law. To state the matter in the briefest outline, which is all that is possible here, scientific method must be applied to history, first, in the discovery of facts; secondly, in the selective classification of facts; and thirdly, in the drawing of inferences from facts.

(1) *The Discovery of Facts.*

In history, the discovery of fact resolves itself mainly into the criticism of documents. So important are documents in historical research that MM. Langlois and Seignobos go so far as to say, in the opening paragraph of their book, "L'histoire se fait avec des documents," and "Pas de documents, pas d'histoire." There *are*, however, other sources of information, for example, oral tradition in the case of contemporary or recent events; archæological, architectural, and monumental remains in the case of more remote eras. Nevertheless, it is correct to say that documents are the primary source of historical knowledge. Concerning documents, the first thing which has to be determined by criticism is their origin—that is to say, their authorship, the date and place of their composition, and their genuineness. Many things have to be taken into account in the determination of these important matters, *e.g.* handwriting and writing materials, vocabulary, internal evidence of knowledge displayed and opinions expressed. When, so far as is possible, the origin of a document has been fixed and its genuineness proved, the problem of the accuracy of its statements has to be entered into. Such questions have to be asked as:—Had the writer opportunities of knowing what he wrote about? Had he sufficient ability to avail himself of his opportunities? Had he any prejudices to distort his judgment? Had he any reason to conceal or pervert the truth? Does his testimony agree with that of other witnesses? Is what he says inherently credible?

(2) *Selection and Classification of Facts.*

The fact that a fact is a fact does not make it important. The historian has to select the facts which are significant from vast masses of the insignificant. What shall be his principle of choice? Shall he select anecdotes which may amuse his readers, or incidents which support the views of some party or sect to which he belongs? The day when he could adopt either of these principles of selection is gone. But even now historians do not by any means agree as to the exact kind of facts that it is the function of history to record. Nor is it necessary that they should agree; no two people store their memory with precisely the same kind of recollections. Seeley and Freeman limited themselves to facts of past politics; Green and Macaulay recorded facts of past social conditions; Droysen and Döllinger, following Schopenhauer and Hegel respectively, looked below the surface of events, the one for the acts of will, the other for the movements of ideas of which events were the manifestation. Any one of these principles, or any similar principle, is sufficient to give a scientific unity to historical research.

(3) *The Drawing of Inferences from Facts.*

Although, as already seen, historical inferences can never have the characteristics of physical laws, and although the completest philosophy of history could never enable the historian to predict revolutions with that unerring certainty with which the astronomer predicts eclipses, yet historical inferences may be thoroughly scientific, and the philosophy of history of the greatest practical value. Given the permanent and unchanging facts of human nature, and known the peculiar circumstances of any particular event, that event can be explained; and though it is true that these circumstances can never by any possibility recur again, yet others will certainly occur sufficiently similar to make the explanations discovered in the one case valuable guides to conduct in the others. Social and political progress and the development of civilisation depend very largely on the adequate learning by the human race of the lessons of experience remembered by means of history.

If in our days kings are benevolent, churches are tolerant, armies are obedient, and policemen are civil; if colonies are well governed; if taxation is equitable; if Ministers of State are honest—all this is due no little to the recorded and thus remembered fates of tyrants, persecutors, rebels, and the rest. Similarly if the admitted imperfections of the present are to be removed, and if progress is to continue, history, rich with its lessons of the past, must remain the light and guide of the future. But it must be not the history of superstition and prejudice and romance, not the boon companion of astrology and alchemy, but the history of exact knowledge and calm judgment, the recognised members of the hierarchy of the sciences.

F. J. C. HEARNSHAW.

PUBLIC SCHOOLS SCIENCE MASTERS' CONFERENCE.

THE annual meeting and conference of the Public Schools Science Masters' Association was held on Saturday, January 20, at Westminster School. Owing to ill-health, which had forced him to go abroad, the president, Sir Oliver Lodge, was unable to be present, and the Rev. E. C. Sherwood (Westminster), chairman of committee, presided at the business meeting, his place being afterwards taken by the retiring president, Sir Michael Foster, K.C.B. The honorary secretary, Mr. W. A. Shenstone (Clifton), relinquished his post, and the Rev. E. C. Sherwood (Westminster) and Mr. Hugh de Havilland

(Eton) were elected to serve in a joint capacity. Mr. J. Talbot (Harrow) was re-appointed treasurer, and the Rev. the Hon. Canon Lyttelton, headmaster of Eton, was unanimously elected president for the year 1907.

Sir Michael Foster, in opening the conference, excused himself from giving an address on the ground that for some time his mind had been filled with very inferior things (Sir Michael referred to the contest for the representation of London University in Parliament). The first paper was read by the Rev. W. Madeley (Woodbridge); its aim was to invite discussions upon the possibility of introducing a comprehensive syllabus of scientific teaching within the time limits of a classical curriculum. Mr. Madeley characterised the fact that there was no compulsory science on the classical sides of public schools as a deplorable anachronism. He pointed out, too, that philosophy was introduced into the classical honours papers at Oxford, and that classical scholars were expected now to know what was meant by the "struggle for existence," "survival of the fittest," "the Glacial epoch," and "the laws of motion," as shown by questions set in examination papers. He suggested that two hours alone per week could be spared in which classical boys could do science, and outlined a general course of what he termed natural philosophy, which he thought would broaden the outlook of the boys and do more for their general education than a training in some special branch of science. Among the items in his syllabus were gravitation, the solar system, the conservation of energy, the indestructibility of matter, the laws of chemical change and combination, Darwinism and evolution.

Sir Michael Foster, in the discussion which followed, said that he sympathised with the wish of Mr. Madeley, who had given them a problem to solve and mentioned the time in which it had to be done. He went on to say that the whole use of science was dependent upon the habit of mind that was acquired, and this, which meant openness, alertness, and power of observing many things, could not be gained by surveying the whole world of science, but by attendance to details. When these had been mastered broader views and generalisations could more easily be grasped.

Mr. W. D. Eggar (Eton) advocated that the two hours should be devoted to laboratory study, and that a very small bit of science should be thoroughly taken up. No lectures should be given, as the boys could read up notions for themselves. Mr. D. Berridge (Malvern) thought that if classical masters prepared a number of foreign phrases for the science boys to learn, so that those met with in the newspapers could be understood, they would be as well equipped from the literary point of view as Mr. Madeley's boys would be in science by the course which he had outlined. Mr. Berridge agreed that the division of the lower school into classical and modern sides militated against the taking of science on the former of these. He suggested that headmasters should try the experiment of making, say, the five subjects of the old London matriculation compulsory for all boys until they were sixteen years of age and ready to specialise. Mr. W. A. Shenstone (Clifton) asked why boys might not have the special and the general training as well, and advocated, in addition to the two hours' work at a particular branch in the laboratory, the attendance of the boys once a fortnight at general lectures, such as those lay addresses given at Clifton on Sunday evenings. Many speakers emphasised the ignorance of the classical boy and man. Mr. Cumming (Rugby) said that the only instrument that they understood when they left school was the pen.

Mr. J. Talbot (Harrow) read the second paper, on the present state of the Army examinations, and began by alluding to the changes which have recently taken place, not only in the standard and arrangement of subjects, but also in their very nature. As he considered that the changes were permanent, he went on to trace the reason for them. For this we must go to South Africa, for the recent war has altered the whole principles underlying the tactics and training of the Army. As Colonel Henderson has pointed out, the discipline used to be entirely mechanical, killing all individuality, and forbidding either officer or man to move without direct order; now, as he says, soldiers must be like a pack of well trained hounds, not running in regular order, but without stragglers, each using his instincts and intelligence, and following up the general aim with relentless perseverance.

Under the old conditions, Mr. Talbot said, brains were not essential in an officer, and any type of entrance examination would do, and did. Now, however, if each officer is to employ the trained initiative which is essential in the new order of things and produce it in his men, it is obvious that his own training as a boy becomes all important. While Woolwich and Sandhurst supply the purely technical training, the science masters have to supply the mind they train, and this must be well developed, inured to hard work, and, above all things, supple.

We are now in a position, continued Mr. Talbot, to understand the division of the examination into two parts. The qualifying examination, or its equivalent, the leaving certificate, is intended to ensure that the boy has a sound general education, the competitive, that he has brains, and unless the standard of the examination is fairly high it is difficult to discriminate between brains and cram.

One of the chief qualifications of the officer is the power of initiative; he is always meeting fresh problems, the solution of which, right or wrong, must be found quickly, and on its correctness the lives of his men and possibly of a whole army may depend. No method of teaching which Mr. Talbot had found makes more demand on a boy's power of drawing conclusions and acting on them than the practical work in the laboratories. For this reason science should be compulsory in the qualifying examination, though not in the competitive one as it at present stands. Certain things militate against the adoption by candidates of science—the want of laboratory accommodation, the fact that the alternative subject, Latin, can be taught to all the boys at once, and that there are two examinations. In larger schools Mr. Talbot fancied that science is doing well in the struggle for existence. In conclusion, science masters were told that they could no longer grumble at a reactionary War Office; they must see to it that it is not able to talk of antiquated teachers. It would be a bad thing for the schools if there ever arose a military Osborne to supersede the science masters.

Sir Michael Foster bore out what Mr. Talbot had to say about the two halves of the examination. The committee on military education had had to face the fact that many an officer could not spell, and had no knowledge of accounts. The qualifying examination was to ensure that the candidate should at least be able to write a letter, and the competitive to prove that he had brains, and, being able to use them in some directions, might be likely to do the same in others. Subsequent speakers made it clear that many boys at the public schools took science in the qualifying examination if not in the other. The discussion turned afterwards on the difficulties of, and objections to, the practical examinations in science, especially when no examiner came to conduct them. As an alternative, it was suggested that the production of note-books kept in the laboratory to show that the candidate had been through a proper course of training should be accepted in lieu of practical tests, and should determine whether the owner should be allowed to sit at the theoretical examination.

An exhibition of scientific apparatus by various makers and members of the association was arranged in the laboratories of Westminster School in connection with the meeting. Two novelties were shown by Messrs. Brown and Son; the first was a combination of the conical condenser from their "Desideratum" still with a hot water oven, the hot water from the top of the condenser being used to feed the jacket of the oven. The other was a new suction and blast apparatus dependent upon water pressure, which worked almost instantaneously. Among the exhibits of the science masters themselves was a very neat method of rocking a flask or other vessel by placing under one edge of the circular base of the stand supporting it an india-rubber tube through which a current of water is passed. The Rev. E. C. Sherwood exhibited this, and also some exceedingly useful clamps designed by Mr. Barnes. Though adapted for almost any work, those shown were used by Mr. Sherwood on retort stands, and are wonderfully ingenious and effective. A spring prevents the clamp from sliding rapidly down the rod when the screw is released; the tightening of the latter not only fixes it on the rod, but holds the arm perfectly immovable in any position, three contacts being made. The arm will support any weight that will not actually break it. On some clamps a micrometer screw allows the arm to be moved while supporting the full weight that it can carry. Those who have struggled with the old type of retort stand clamp which wobbles in all possible directions will welcome tne new invention should it be put upon the market.

WILFRED MARK WEBB.

THE THIRD TANGANYIKA EXPEDITION.[1]

I LEFT London for Cape Town on March 24, 1904, proceeding thence to Chinde, and up the Zambesi and Shiré Rivers, to Blantyre and Zomba, in British Central Africa. In Zomba I reported myself to Sir Alfred Sharpe, and from him received much advice and assistance before leaving shortly for the Upper Shiré and Lake Nyasa. In the region of this lake I stayed, roughly, three weeks—one week on the gunboat anchored at the south end, one week ascending the lake, and a week in Karonga—before starting to cross the plateau to Tanganyika.

I collected, as far as possible in the short time, specimens to illustrate the flora of the lake—dried specimens, algæ scraped from rocks, &c., and tow-nettings containing diatoms and other of the more minute organisms. I made no systematic attempt to collect fish, but brought a few specimens, in addition to some leeches, crabs, a species of prawn (of interest as none had been hitherto recorded from the lake), and a sponge.

Karonga was left on July 5, and after an unavoidable delay on account of illness among my men, I arrived at Niamkolo, at the south end of Tanganyika, on July 27. I made this spot my headquarters for more than two months, though during the period I stayed a week at Kituta. I purchased at once a large dug-out canoe and hired a crew, so that I was able from the first to fish, dredge, and take tow-nettings. Meanwhile, I made arrangements with the owner of a large dau in Ujiji to hire his vessel, and this was dispatched to the south end of the lake to pick me up. I sailed on board the dau on September 23, and for the rest of my time on the lake cruised about, visiting as far as possible the most interesting and likely places on the lake shore. I camped on land whenever circumstances permitted, but my stays varied, according as I found much or little of value to me. Although I made some attempts, I found it almost impossible to dredge satisfactorily in deep water by means of the dau, so I was reduced to dredging from the canoe, in which case, of course, we had not sufficient power to dredge at any depth. On one occasion, by the kindness of the captain, I was permitted to make an attempt from the German gunboat, but unfortunately I lost the dredge and a large part of the rope, by the snapping of the rope under the strain.

I collected fish on every possible occasion, but though we tried various methods of catching them, the majority were obtained direct from the native fishermen. The largest fish I saw was a Siluroid (probably Clarias), 155 cm. in length, and weighing 30·6 kilograms. Tow-nettings were taken systematically at various times before and after dark, in various places and at various seasons. These consisted, as a rule, principally of phyto-plankton, but there were also prawns, copepods, ostracods, and insect larvæ taken in this fashion. The quantity of material obtained by tow-netting became markedly less during the rainy season. The larger representatives of the flora were also collected, but show, on the whole, little difference from the corresponding water-weeds of Nyasa. Scrapings from the rocks and submerged stems of plants produced various of the smaller algæ, while a few fungi were brought from the rotting wood of the canoe.

Five or six species of prawns were collected, in addition to those already known from the lake, some among the rocks at the water's edge, others by dredging in a few fathoms. Some two or three species of crabs were obtained, and at least two species of Argulus. These latter were perhaps most common from the mouth-cavity, gill-bars, and surface of the body of various large Siluroids, but they were also frequently present upon large specimens of Lates, and occasionally on other scaly fishes. Two forms of true parasitic copepods were found—one on the gills of a Siluroid, and the other attached at the junction of the pelvic fins of a Polypterus. Of worms, a few Oligochætes were collected and a considerable number of leeches.

In addition to these were some Turbellaria, and various endo-parasites—Cestoda, Trematoda, and Nematoda—principally from the gut of fishes. Among the Polyzoa is, at any rate, one form with horseshoe-shaped lophophore, which has not yet been described from Tanganyika. There is probably little of interest in the molluscs collected, as my work was confined to the comparatively shallow water. I was struck by the irregularity in the appearance of the Tanganyika medusa, or rather the uncertainty of finding it at any particular time or place. It is doubtless, like all such forms, driven to and fro by wind and currents, but it is curious that one may be a month or more on the lake without seeing a single specimen. I have brought back a few in formalin, for museum purposes, and others preserved with a view to the histology. Some quantity of sponge was collected, encrusting in every case submerged rocks or shells.

Apart from actual collecting, some observations of physical interest were made. Attempts were made, both on Nyasa and Tanganyika, to observe the seiche alterations in water-level, and at the south end of Tanganyika the actual level of the water was marked, with the view of affording some basis of comparison for the use of future investigators. A good many readings of the water temperature have been taken, which should prove interesting, as I believe nothing has ever been recorded from these lakes before. The temperature in general seems very high, the lowest obtained on the lake being only 73°·3, and the highest recorded 81°·0. At a depth of 76 fathoms (length of the sounding-line) the temperature appears fairly constant, for readings taken on various occasions, and at different spots, only vary between 74°·1 and 74°·8.

The total length of time spent on and around Tanganyika was about eight months. Dismissing the dau at Usumbura, at the north end of the lake, I began on March 18, 1905, the journey overland to the western shore of the Victoria Nyanza. This took rather longer than was expected, owing to the bad weather and the famine-stricken nature of the country, but Bukoba, a German station on Nyanza, was reached on April 16. During a stay of ten days waiting for the steamer, and during a short stay in Entebbe, the British capital, I was able to do some collecting in this lake also. As far as possible, representatives of the water flora were obtained, for the sake of comparison with the plants collected on Nyasa and Tanganyika. A few tow-nettings were taken, and, in addition to the smaller plants and animals thus obtained, there were also collected a few molluscs, some Argulus, and certain endo-parasites. More interesting was the finding of a species of prawn and a sponge, as no sponge had been recorded from the lake before.

[1] From a report by Mr. W. A. Cunnington, Christ's College, Cambridge.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE council of King's College, London, has received a donation of 500*l*. from the Drapers' Company for the further equipment of the physics laboratory, especially for the promotion of research.

PROF. W. W. WATTS, F.R.S., assistant professor of geology and professor of geography at the Birmingham University, has been appointed professor of geology at the Royal College of Science, South Kensington, vacant by the retirement of Prof. J. W. Judd, C.B., F.R.S. In view of the changes in organisation that may be found desirable in the Royal College of Science and the Royal School of Mines after the consideration of the report of the departmental committee on the college, the appointment has been made a temporary one.

THE council of the Armstrong College of Durham University in Newcastle has resolved to found a chair of electrical engineering, and has voted a sum of 260*l.* toward the equipment of electrical engineering laboratories. At the end of the current session two fellowships of 125*l.* a year will be offered for competition, on condition that the holders should spend their time in the prosecution of definite research or in the pursuance of a definite line of advanced study. Mr. H. Morris-Airey, lecturer and demonstrator in physics in the University of Manchester, has been appointed lecturer in physics at the college in succession to Mr. R. J. Patterson.

THE movement for extending higher education in the Potteries has received (says the *Lancet*) a great impetus from the offer by the Duke of Sutherland of Trentham Hall to the Staffordshire County Council for higher educational purposes. For some time a scheme to establish a university college for North Staffordshire has been energetically brought forward, and promises of help have been received from the North Staffordshire Institute of Mining and Mechanical Engineers, from a joint committee of china and earthenware manufacturers, and from various other sources. The scheme commended itself so much to the county council that it offered to contribute 12,500*l.* to the building fund, and to undertake the maintenance of the college. The hall is considered to be in every way admirably adapted for the purposes of a university college.

THE following gifts in aid of higher education have been announced in *Science*. The Pennsylvania College for Women in Pittsburg has succeeded in raising 38,000*l.* to pay off a mortgage resting upon its property, and to make a beginning in securing an endowment. After the mortgage has been paid, the college will possess as the nucleus of an endowment fund the sum of 25,000*l.* Mr. Andrew Carnegie has promised to contribute 10,000*l.* toward the endowment fund of Bates College when 20,000*l.* shall have been raised for the same purpose by friends of the college. The University of Pennsylvania received last month an anonymous gift of 10,000*l.* Lake Forest University has received 12,000l., and the University of Wisconsin a bequest of 2000*l.* by the will of the late Mrs. Fannie Parker Lewis, for the establishment of scholarships for needy young women students.

SIR PHILIP MAGNUS, the new Member of Parliament for the University of London, after the formal announcement of the result, proposed a vote of thanks to the Vice-Chancellor for the manner in which, as returning officer, he had conducted the election. During the course of his remarks, Sir Philip Magnus said that during the last two years he has served on a departmental committee presided over by Mr. Haldane to inquire into the working of the Royal College of Science and Royal School of Mines, in relation to other educational institutions. The report of the committee is settled, and Sir Philip Magnus said he was disclosing no secrets when he announced that, if effect is given to the recommendations, London will before long possess an institution, closely connected with the University, for the higher scientific training, and for the application of science to engineering in all its branches, which will compare favourably with any similar school in Europe or America.

AT the meeting of the Sociological Society on January 22, Prof. R. M. Wenley, of the University of Michigan, read a paper on sociology as an academic subject. Sociology, although taught in all the great universities of the United States, is academically in an experimental stage. Like other new subjects, it has received much criticism as being unsuitable for inclusion in the university curriculum. It is said to lack disciplinary value, and it is urged, moreover, that students come to it without the necessary basis in previous knowledge. Prof. Wenley attaches little importance to the first objection, but admits that the second is of real weight. Answering the question, What ought sociology to be as an academic subject? Dr. Wenley suggested that at Cambridge it might well form a part of the moral science tripos; at the Scottish universities, it might be attached to the *practical* training of the theological faculty; in London the opportunities for ethnological, linguistic, and economic research are in need of its complementary aid. Wherever ethics, psychology, economics, anthropology, or the various forms of ethnology have a place, sociology is needed as a coordinate discipline. The paper concluded by urging that sociology must be a science conducted by scientifically trained, competent experts, and not merely a pottering-round so-called problems of local or even national origin by well meaning enthusiasts.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 14, 1905.—"On the Distribution of Chlorides in Nerve Cells and Fibres." By Prof. A. B. **Macallum** and Miss M. L. **Menten.** Communicated by Prof. W. D. Halliburton, F.R.S.

At the present day, when numerous observers are seeking the explanation of certain nerve-phenomena on an electrolytic basis, it is imperative that accurate knowledge of the electrolytes present should be first obtained. Prof. Macallum has carried out previous work in this direction, and has discovered methods for detecting the inorganic salts microchemically. He has, among other things, found that nerve cells are destitute of potassium. This element, at any rate, is not revealed by tests which show its presence in other tissues, though it is possible, as Prof. J. S. Macdonald has pointed out, that it may be present in a "masked" form, from which it is liberated by injury. Another reaction at which Macallum has worked is the well known reduction stain with silver nitrate. The staining has been attributed by some histologists to the formation and subsequent reduction in sunlight of a silver-proteid compound. But this cannot be the case, because proteids freed from inorganic salts do not give the reaction. The test is shown to be entirely due to inorganic chlorides, and thus forms a method of great delicacy for the detection and localisation of chlorine in the tissues.

The present paper deals with the distribution of chlorine in the nerve-units. The chlorides present are probably numerous, but sodium chloride is the most abundant. By the ordinary method, nerve fibres exhibit the well known crosses of Ranvier. One limb of the cross is due to the presence of chlorides in the cementing substance which forms a ring at the junction of the neurilemmal elements. The other is due to staining of the axis cylinder itself; this usually exhibits itself, not as a continuous dark stain, but as a series of transverse striæ known as Frommann's lines. It is, however, shown that the same appearance can be produced by suitable modifications of manipulation at any portion of an axis cylinder, and that its greater intensity at the nodes is simply due to the fact that at these spots the reagent can penetrate more readily; the sheath of the fibre presents considerable impediment to the passage of the reagent inwards and of chlorides outwards.

The next question that arises is whether Frommann's lines indicate a definite preexisting arrangement of the chlorides in layers, or whether the appearance is an accident explicable on a physical basis. It is quite conclusively shown that the latter explanation is the correct one. The appearance can be most successfully imitated in capillary tubes filled with chromate-holding gelatin or white of egg, and is merely the result of physical processes, as Boehm and Liesegang were the first to point out.

Nerve cells also contain chlorides, but the intensity of the reaction is less, and is usually limited to the peripheral portions of the cell, principally because of the difficulty the reagent has of penetration. The nucleus, however, like other nuclei, is apparently free from chlorides.

The distribution of electrolytes such as sodium chloride in the colloid material of an axis cylinder would not permit ions carrying an electrical charge to travel unimpeded, and in consequence the change of potential transmitted would progress with diminished velocity. This diminution would bring into line as parallel phenomena the nerve impulse and the electrical current of action. It must, however, be freely admitted that caution should be shown in drawing conclusions of this kind where so much is still unknown.

Geological Society, January 4.—Dr. J. E. Marr, F.R.S., president, in the chair.—The highest Silurian rocks of the Ludlow district: Miss G. L. **Elles** and Miss I. L. **Slater.** The authors give a classification of the beds, and a brief outline description of the main subdivisions is first given, as they appear when followed from Ludlow southward to Overton, eastward to Caynham Camp, westward to Downton-on-the-Rock, and northward to Bromfield, and also near Onibury and Norton. The main tectonic features of the district appear to be due to the superposition of Armorican movements in rocks with a Caledonian trend, held by some rigid mass to the north, presumably the Longmynd massif.—The Carboniferous rocks at Rush (County Dublin): Dr. C. A. **Matley,** with an account of the faunal succession and correlation: Dr. A. **Vaughan.** Rocks of the Carboniferous Limestone series are exposed along five miles of coast near Rush, Loughshinny, and Skerries, in County Dublin. The present paper deals only with the beds near Rush, in the southern portion of this tract, where about 2500 feet of the series are exposed, without allowing for gaps in the succession. The upward sequence is (on the whole) from south to north, and the range is from the Upper Zaphrentis- to the Upper Dibunophyllum-zone.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 25.

ROYAL SOCIETY, at 4.30.—Experiments on the Chemical Behaviour of Argon and Helium: Dr. W. T. Cooke.—The Vapour Pressure in Equilibrium with Substances holding Varying Amounts of Moisture. Parts I. and II.: Prof. F. T. Trouton, F.R.S., and Miss B. Poole.—Note on Heusler's Magnetic Alloy of Manganese, Aluminium and Copper: Prof. A. Gray, F.R.S.—On the Overstraining of Iron by Tension and Compression: Dr. J. Muir.—On the Effect of High Temperature on Radium Emanation: W. Makower.—Observations and Photographs of Black and Grey Soap Films: H. Stansfield.—Galvanic Cells Produced by the Action of Light. The Chemical Statics and Dynamics of Reversible and Irreversible Systems under the Influence of Light. Second Communication: Dr. M. Wilderman.—Artificial Double Refraction due to Æolotropic Distribution, with Application to Colloidal Solution and Magnetic Fields: T. H. Havelock.—An Electrical Measuring Machine for Engineering Gauges and other Bodies: Dr. P. E. Shaw.—The Relation between the Osmotic Pressure and the Vapour Pressure of a Solution: W. Spens.—The Elliptic Integral in Electromagnetic Theory: Prof. A. G. Greenhill, F.R.S.—On the Simple Group of Order 25920: Prof. W. Burnside, F.R.S.—On Metallic Reflection and the Influence of the Layer of Transition: Prof. R. C. Maclaurin.

SOCIETY OF ARTS, at 8.—High Speed Electric Machinery, with Special Reference to Steam Turbine Machines: Prof. S. P. Thompson, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Technical Considerations in Electric Railway Engineering: F. W. Carter.

FRIDAY, JANUARY 26.

PHYSICAL SOCIETY, at 5.—The Isothermal Distillation of Nitrogen and Oxygen and of Argon and Oxygen: I. K. Inglis.—On the use of Chilled Cast Iron for Permanent Magnets: A. Campbell.—Experiments on the Propagation of Longitudinal Waves of Magnetic Flux along Iron Wires and Rods: Prof. T. R. Lyle and J. M. Baldwin.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Prince of Wales Pier, Falmouth: T. R. Grigson.—Ferro-Concrete Pier at Purfleet: H. O. H. Etheridge.

SATURDAY, JANUARY 27.

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—Methods of Fire-making, Ancient and Modern—A Lecture and Demonstration: Miller Christy.

MONDAY, JANUARY 29.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geographical Functions of Certain Water Plants in Chile: Prof. G. F. Scott Elliot.

SOCIETY OF ARTS, at 8.—Modern Warships: Sir William White, K.C.B., F.R.S.

INSTITUTE OF ACTUARIES, at 5.—The Variations in Masculinity under Different Conditions: J. N. Lewis and Dr. C. J. Lewis.

TUESDAY, JANUARY 30.

ROYAL INSTITUTION, at 5.—Impressions of Travel in China and the Far East: Prof. E. H. Parker.

SOCIETY OF ARTS, at 8.—The Chemistry of Artists' Colours in Relation o their Composition and Permanency: Prof. J. M. Thomson, F.R.S.

FARADAY SOCIETY, at 8.—The Electric Furnace: its Origin, Transformations and Applications. Part III.: Adolphe Minet.—Demonstration of a New Electrolytic Tube Furnace: Dr. J. A. Harker.—Note on the Production of Ozone by Electrolysis of Alkali Fluorides: E. B. R. Prideaux.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Railway-Gauges of India: F. R. Upcott.

WEDNESDAY, JANUARY 31.

ROYAL GEOGRAPHICAL SOCIETY (Research Department), at 5.—Suggestions as to an Inquiry into the Resources of the British Empire: Prof. G. F. Scott Elliot.

THURSDAY, FEBRUARY 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Filtration of Crystalloids and Colloids through Gelatin, with Special Reference to the Behaviour of Hæmolysins: J. A. Craw.—Chemical Action of *Bacillus lactis aerogenes* (Escherich) on Glucose and Mannitol. Production of 2:3-Butyleneglycol and Acetylmethylcarbinol: Dr. A. Harden and G. S. Walpole.—On Voges and Proskauer's Reaction for Certain Bacteria: Dr. A. Harden.—The Quantitative Estimation of Small Quantities of Nickel in Organic Substances: H. W. Armit and Dr. A. Harden.—The Alcoholic Ferment of Yeast Juice: Dr. A. Harden and W. J. Young.—On the Function of Silica in the Nutrition of Cereals. Part I.: A. D. Hall and C. G. T. Morison.

CHEMICAL SOCIETY, at 8.30.—Hydroxylamine-αβ-disulphonates (Structural Isomerides of Hydroxyamino-sulphates or Hydroxylamine-ββ-disulphonates): T. Haga.—Studies in the Camphane Series. Part XXI. Benzenediazo-ψ-Semicarbazino-camphor and its Derivatives: M. O. Forster.—The Relation between Absorption Spectra and Chemical Constitution. Part I. The Chemical Reactivity of the Carbonyl Group: A. W. Stewart and E. C. C. Baly.—(1) The Relation between Absorption Spectra and Chemical Constitution. Part II. The Quinones and α-Diketones; (2) The Relation between Absorption Spectra and Chemical Constitution. Part III. The Nitranilines and the Nitrophenols: E. C. C. Baly and A. W. Stewart.—The Action of Light on Benzylidenephenylhydrazine: F. D. Chattaway.—The Union of Chlorine and Hydrogen: D. L. Chapman and C. H. Burgess.—Note on the Molecular Weight of Adrenaline: G. Barger and A. J. Ewins.—The Critical Temperature and Value of ML/O of Some Carbon Compounds: J. Campbell Brown.

ROYAL INSTITUTION, at 5.—The Significance of the Future in the Theory of Evolution: Benjamin Kidd.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Destructor Byeproducts: F. L. Watson.

LINNEAN SOCIETY, at 8.—The Percy Sladen Trust Expedition to the Indian Ocean in H.M.S. *Sealark*: J. Stanley Gardiner.

SOCIETY OF ARTS, at 8.—Howard Lecture: High Speed Electric Machinery, with Special Reference to Steam-Turbine Machines: Prof. S. P. Thompson, F.R.S.

CONTENTS.