THURSDAY, APRIL 8, 1897.

HEAT (AND OTHER MATTERS).

Die Principien der Wärmelehre, historisch-kritisch entwickelt. Von Prof. E. Mach. Pp. viii + 472. (Leipzig: J. A. Barth, 1896.)

PROF. MACH has conceived this treatise in much the same spirit as his "Mechanik." Both books are partly based upon his lectures: neither of them pretends to give a complete account of the subject in its details and applications. The aim is rather to describe the principal facts and the development of ideas, to explain their connection and to examine critically the principles which underlie the study of thermal phenomena.

The contents of the book may be roughly divided into three parts, of which the first two deal with heat and thermodynamics. In these the general arrangement is a compromise between the strictly historical method and that of the ordinary text-book; nowhere is any attempt made to secure the completeness and detail of a technical treatise. Subjects which have been fully discussed by other authors (such as thermo-chemistry and the dynamical theory of gases) are omitted, or only briefly referred to. In the first part the principal subjects treated of are thermometry, the conduction of heat, radiation, calorimetry and the calorimetric properties of gases. In each case there is a historical survey, followed by a critical discussion of the ideas involved in the development of the subject. The chapters on thermometry open in quite the orthodox way. We meet our old friends the three basins of water—cold, lukewarm and hot—and are warned of the danger of relying implicitly upon the uncontrolled verdict of our senses. In the next chapter (a critique of the idea of temperature) we are further warned that we have nothing to do with metaphysical ideas as to a "true" or "natural" scale of temperatures; the object of thermometry being to indicate the thermal state of a body by a number with reference to a scale which can be produced and reproduced with certainty and accuracy. Every distinct pyrometric method involves a different definition of temperature; and the temperatures measured by any one of these methods have just the same significance as numbers in an inventory. We now come to two chapters which give us a foretaste of the freedom of treatment in which the author indulges so fully in the last third of the book. In one of these he answers the questions, "What are numbers?" and "What are names?"; the other is devoted to a discussion of *Das Continuum*. We next follow the slow growth of quantitative conceptions as to the conduction of heat, beginning with the case of a bar heated at one end. First we have Amontons' incorrect assumption that the temperature increases proportionately to the distance from the cold end. Lambert has a clearer conception of the permanent state, and finds that the excess of temperature above that of the surrounding medium follows an exponential law: but the way in which he deduces the result is incorrect. Biot, making use of Newton's law of cooling, first gives a correct theoretical and experimental investigation of this case. The more general treatment of conduction is due to Fourier, whose "Théorie analytique de la Chaleur" has been of the greatest importance in the development and transformation of the methods of mathematical physics. Considered from the physical standpoint, Fourier's theory has the merit of not being based (as is the kinetic theory of gases) upon an hypothesis, but upon an assumption proved by experiment to be correct, viz. that the flow of heat is proportional to the rate of change of temperature along the line of flow. His mathematical treatment is highly original and exquisite in form. At the same time his work well illustrates the beneficial reaction of investigations in various branches of physics and mathematics. The way for Fourier had been prepared by the researches of Taylor and others on the vibrations of stretched strings and the nature of partial differential equations (the results of which are here reproduced in somewhat modernised form). In turn, the powerful methods which he devised for solving problems on the conduction and radiation of heat have proved invaluable in the study of electricity, diffusion and hydrodynamics.

Among the founders of thermodynamics, Sadi Carnot occupies an unique position—one which must be rather unintelligible to those who hold that this science owes its birth to the conception of heat as a "mode of motion." In 1798 Rumford published his "Inquiry," and came to the conclusion that heat "cannot possibly be a material substance." Soon afterwards Davy, from further experiments, had deduced that "heat . . . may be defined a peculiar motion. . . ." And long before these two experimenters there had been speculations to the same effect. Yet Carnot's "Réflexions sur la puissance motrice du feu" (1824) throughout assumes the materiality (or indestructibility) of heat. In his *Gedankenexperiment*, the reversible cycle, it is assumed that the heat lost by the working substance in one set of operations is precisely compensated by the amount absorbed in the other set. "Ce fait n'a jamais été révoqué en doute. . . . Le nier, ce serait renverser toute la théorie de la chaleur." In spite of this, of the incorrect definition of the third operation in the cycle, of the difficulty of accepting step by step his reasoning, his conclusions are correct, and his method has proved profoundly suggestive. How happy his choice of the reversible cycle was, we can only appreciate by considering the very imperfect state of knowledge at that time as to the thermal properties of bodies: by requiring that the working substance should finally be brought back to its primitive physical condition, he ensures that it shall contain the same amount of heat after the cycle as before, and thus skilfully avoids a gap which could not then be bridged. In 1834 Clapeyron recalled attention to Carnot's essay, and gave appropriate graphical and analytical expositions of his method; but he still adheres to the hypothesis of the invariability of the quantity of heat (gained and lost in the cycle), and does not advance the essential ideas beyond the stage in which Carnot left them. These ideas first fell upon good ground in our own country, and bore fruit in Thomson's remarkable paper, "On an Absolute Thermometric Scale," published in 1848.

In one respect fate did not deal kindly with Carnot. He admits (in words following those quoted above) that the foundations on which the theory of heat rests require careful examination, and that several experi-

mental facts appear nearly inexplicable in the actual state of this theory; nevertheless, if we had only the "Réflexions" to guide us, we should have to regard him as an adherent of the caloric hypothesis. Carnot died of cholera in 1832, and some forty years elapsed before the publication of his note-book showed how his views had changed since 1824. We have only space for one extract.

"On peut donc poser en thèse générale que la puissance motrice est en quantité invariable dans la nature, qu'elle n'est jamais, à proprement parler, ni produite, ni detruite. A la vérité, elle change de forme, c'est-à-dire qu'elle produit tantôt un genre de mouvement, tantôt un autre; mais elle n'est jamais anéantie."

Then follows an estimate of the number of units of heat required for "la production d'une unité de puissance motrice"! One cannot help wondering what might have happened if he had lived a few years longer, or if his views had not remained so long hidden.

As it is, the subsequent development of thermodynamics has not been the work of one person or of one country. The chapters in which Prof. Mach traces its growth, are amongst the most interesting in the book. One of his titles—"Das Mayer-Joule'sche Princip"—recalls a controversy the echoes of which have not yet died away, and indicates his position with reference to it. That position is one which many of our countrymen will not willingly accept; any more than they would accept the statement made on p. 261—"Im Grunde ist der Weg, auf dem Joule zu seiner Entdeckung gelangt, sehr ähnlich demjenigen Mayer's." But it would be unfair to allow such brief quotations to lead to the inference that the author is unfair or influenced by national bias. On the same page he draws attention to the soundness of Joule's scientific method; points out that he never befogged himself with metaphysical considerations; and that his theories were always based upon or controlled by experiment. Nor can we justly apportion the credit due to Mayer without considering the circumstances under which he thought and wrote, or without realising how imperfect (see his correspondence with Bauer and Griesinger) was his knowledge of physics. In the technical skill, the clearness and completeness of Helmholtz's paper "Ueber die Erhaltung der Kraft," we have a complete contrast to Mayer's writings. After an account of the progress which thermodynamics owes to the researches of Clausius and Lord Kelvin, we have the following comparison of the manner in which they presented their investigations to the world.

"In his exposition, Thomson is always quite frank and straightforward in dealing with the difficulties which meet him, the course that he strikes out is always the shortest and simplest, his methods are perfectly clear, and the motives which guide him in his investigations are visible to every one. In Clausius's exposition, there is always a touch of ceremony and reserve. Often one scarcely knows whether Clausius is more concerned to make a statement or to suppress it. The principles of the subject, instead of being deduced from simple experiences, are built up on specially assumed fundamental propositions; these look as though they were more reliable, but do not really offer any greater security than the experiences which might have replaced them. He has, too, a predilection for creating new names and ideas, which are not always necessary. But none of these personal and unessential peculiarities can mar the respect which we feel for Clausius's work."

Further chapters are devoted to the principal propositions in thermodynamics, the absolute scale of temperature, the principle of energy, and the relation between physical and chemical progress.

Up to this point we have nothing but praise for Prof. Mach's treatise: it will do much to revive interest in a subject which has suffered temporary eclipse by the larger developments in recent times of electrical science. The style is clear and forcible, and a due sense of proportion is shown in the arrangement of the subject-matter. We admire his mathematical skill, his critical insight, and the fairness with which he endeavours to apportion praise. The student will find him a trustworthy guide, and the teacher will recognise the frankness of a colleague who knows where the difficulties are and does not slur them over.

To some the remainder of the book will be of equal interest, as it undoubtedly is original, and after the author's own heart. But the reader who has bargained only for a historical and critical exposition of the principles of heat and thermodynamics, may be excused for feeling that he has been betrayed. For in the last twelve chapters Prof. Mach takes the bit between his teeth, and roams at will over the domains of scientific thought, philosophy, psychology, the theory of cognition, language, æsthetics, metaphysics and mysticism. To say that there is a "manifest solution of continuity" between these and what precedes, would be incorrect; but the choice and arrangement of subjects is somewhat kaleidoscopic and bewildering. In the absence of any index, reference is difficult (though here we may be confusing cause and effect). When we want to refer to an ingenious suggestion for inducing sparrows to progress by running instead of hopping, we find it in a footnote to a chapter on "Die Sprache"; while an interesting observation on the suckling and weaning of children finds place in a footnote to a chapter on "Der Begriff." This term (Begriff) is defined in a previous chapter on "Die Vergleichung als wissenschaftliches Princip," in which the author also discusses the question, *Was ist eine theoretische Idee?* Perhaps the most highly variegated chapter is that on "Der Sinn für das Wunderbare."

The proofs of the book have not been carefully read. There are misprints in the German text, and still more in the English quotations and references. The diagrams are numerous and clear, but the half-dozen full-page illustrations are not a great success. Joule is represented by a coarse reproduction of Jeens' engraving. The portrait of Clausius seems to be the best. That of Lord Kelvin is the worst; at any rate, it is as bad as it well could be. *pv.*

CELL-STRUCTURE AND REPRODUCTION.

The Cell in Development and Inheritance. By Edmund B. Wilson, Ph.D., Professor of Invertebrate Zoology, Columbia University. (Columbia University Biological Series IV.) Pp. xvi. 371. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1896.)

ORIGINALLY produced as the substance of a series of lectures of a popular character upon the problems of individual development and inheritance, the book

which Prof. Wilson has given us has taken a form which, while it can hardly longer be described as "popular," will be admitted by the more strictly scientific audience, to which it is now better adapted, to be in the highest degree fascinating. The advances which cellular biology has made, and is making at the present moment, can only be described as "leaps and bounds," and to no part of the study of the cell will this apply with greater force than to that dealing with cell-propagation. A question which seemed to our fathers, and for the matter of that to some of ourselves not so very many years ago, as of the simplest nature and capable of being described in half a dozen lines, can no longer be adequately dealt with except in a volume devoted exclusively to it, and by men who make its study the business of their lives. And although works in other languages upon the subject, such as those of O. Hertwig and Henneguy, are available for the student, it is none the less a matter for congratulation that Prof. Wilson has given us in our own speech a work which is second to none in the clear and comprehensive manner in which the facts of cell-structure and division are set forth, and the masterly way in which the principal theories which have been founded upon these facts are stated and criticised. Not the least striking feature of the book is the lavish way in which it is illustrated—a prime necessity in a work of this kind if it is to be easily read and understood. At the same time it is clear that the illustrations are carefully selected in each case with the object of presenting either a special fact or idea. And although, as might be expected from his position as a zoologist, Prof. Wilson has for the most part relied upon material furnished by the animal kingdom in illustration of his subject, he has not hesitated when occasion has offered to draw upon the important series of observations which have accumulated of late years in vegetable cytology.

The subjects dealt with are, in the first place, the general structure of the cell, the phenomena of cell-division, the special structure of germ-cells (ova and spermatozoa), together with the parts played by the several cell-structures in the process of fertilisation, the formation of germ-cells and reduction of their chromosomes. These subjects occupy some two-thirds of the entire book. Much of the remaining third is occupied by an interesting discussion on the nature and probable function or meaning of the several organised constituents of the cell; including, besides the nucleus and its various parts, the centrosome and the so-called archoplasmic structures, *i.e.* the asters and spindle and attraction-spheres. Their chemical relations and their physiological relations to one another are next passed in review, and, lastly, the most abstruse part of the subject—that, namely, which concerns the relation of cell-division to development and inheritance—is dealt with. The able manner in which Prof. Wilson has succeeded in overcoming the difficulty of presenting the various modern theories of inheritance, which are associated with the names of His, Nägeli, Darwin, Roux, de Vries, Weismann and Hertwig, in a comparatively limited space, and with admirable clearness, can only be appreciated by those who have followed the long and apparently interminable manner in which these theories have, like the Pharaoh's serpents which were popular some years ago, gradually extended their voluminous coils from a small and apparently inert mass of material, until a theory is ultimately evolved, which, in Prof. Wilson's language, "demands for the orderly distribution of the elements of the germ-plasm a pre-arrayed system of forces of absolutely inconceivable complexity." "What lies beyond our reach at present, as Driesch has very ably urged, is to explain the orderly rhythm of development—the coordinating power th guides development to its predestined end." "The same difficulty confronts us under any theory we can frame." "The controversy between preformation and epigenesis has now arrived at a stage when it has little meaning apart from the general problem of physical causality. What we know is that a specific kind of living substance, derived from the parent, tends to run through a specific cycle of changes during which it transforms itself into a body like that of which it formed a part." "But, despite all our theories, we no more know how the properties of the idioplasm involve the properties of the adult body than we know how the properties of hydrogen and oxygen involve those of water." "We cannot close our eyes to two facts: first, that we are utterly ignorant of the manner in which the idioplasm of the germ-cell can so respond to the play of physical forces upon it as to call forth an adaptive variation; and second, that the study of the cell has on the whole seemed to widen rather than to narrow the enormous gap that separates even the lowest forms of life from the inorganic world." A statement of fact which we must all have recognised, although few of us ever venture to assert it so boldly as Prof. Wilson has here done.

A characteristic feature of the book is a glossary in which obsolete terms are distinguished from those still in use, and in which also are mentioned the name of the author first using the word, and the date of its employment. This and a sufficiently comprehensive, but not too voluminous, bibliography will greatly add to the general usefulness of this admirable work.

E. A. SCHÄFER.

PRACTICAL PHYSICS.

An Intermediate Course of Practical Physics. By Arthur Schuster, Ph.D., F.R.S., Langworthy Professor of Physics, &c., Owens College, Manchester, and Charles H. Lees, D.Sc., Senior Assistant Lecturer and Demonstrator in Physics in the Owens College, Manchester. Pp. xv + 248. (London: Macmillan and Co., Ltd. New York: The Macmillan Co., 1896.)

ALL who are engaged in the teaching of physics, and all who are interested in scientific education, will take up this "Intermediate Course" with the certainty of finding much in it that is helpful and suggestive, and they will not be disappointed. It fills a distinct place of its own, between the elementary text-books of practical physics and the more advanced manuals. To some, the fact that it has been primarily written with a view to a particular examination, may be a stumbling-block; but, on close examination, there will be found in it nothing that can be fairly considered as "cram." The authors are fortunate in having had the very best help in drawing it up, namely, the criticism of successive generations of

students who have used the notes from which it is written. In this way it is possible for them to feel certain that, whatever may be the failings of their work, it will at least be intelligible to the average student.

The book opens with a preliminary chapter called "General Instructions," and the practical teacher at once becomes apparent in such paragraphs as that on the importance of *large* errors. No one can have had much experience in teaching practical physics without seeing that the anxiety of beginners to obtain correctness in the second or third place of decimals is accompanied by an extraordinary laxity in noting the tens and hundreds. In fact, it may be said that most of the inaccuracy of beginners in physical measurement is due to this cause. In the chapter on "Arithmetical Calculations," the authors rightly lay stress on contracted methods of multiplication and division. The short chapter on "Graphical Constructions" is less satisfactory than the others, and would probably be improved if some better examples of the method were employed, and if some notice were given to the convention (a most useful one) of making abscissæ represent the independent, and ordinates the dependent, variable.

The body of the book is taken up with experiments on mechanics (including measurement of density and specific gravity), heat, light, sound, and electricity. As necessarily follows from the nature of the case, there is not much that is original in the treatment of these subjects. One admirable feature, however, which runs throughout the course, is the working out of the percentage error in each experiment. In the section on heat, we notice that the calorimeter equivalent is found by pouring warm water into an empty calorimeter; more satisfactory results can generally be obtained by pouring warm water into a calorimeter containing some water at the temperature of the room, and calculating the difference between heat given out by warm water and that taken in by the cold. In this section is also to be noticed an ingenious form of heater for the determination of specific heats by the method of mixtures.

In the optical section the method of tracing rays by means of pins—first used, we believe, in the Cavendish Laboratory—is employed to a considerable extent. There is an experiment on the power of accommodation of the eye, which we have not seen before in any similar work.

The section on "sound" is concerned with the proof of the laws of vibrating strings, and an experiment on the resonance of a column of air. In the last three sections of the book, on "magnetism," "electric currents," and "electric charges," the authors seem to be less successful than in the earlier parts. But it is extremely difficult in the course of fifty pages to give a satisfactory series of experiments on these subjects, especially when, as in this case, a very large number of those pages are taken up with elementary explanations which might have been omitted by reference to any text-book, such as that of Thompson. And the form of water voltameter described is hardly, one would think, the most useful for laboratory purposes, or the most instructive from the point of view of the teacher.

In conclusion we may be permitted to suggest that, from an educational point of view, the book would gain if at the beginning of each experiment a short and clear statement of the object of that experiment were given. One of the most useful results to be obtained from a laboratory course such as this is gained when the student, knowing clearly the question which he is to address to nature, thinks out for himself how he is to proceed in his cross-examination, and compares his method with that of an experienced investigator. D. R.

OUR BOOK SHELF.

Bis an's Ende der Welt! Astronomische Causerien. By Prof. F. J. Studnička. Second enlarged edition. Pp. 212. (Prague: F. Simacek, 1896.)

THE author of this book went to Karlsbad to indulge in the special opportunities afforded by that town in the nature of its waters. During his stay there he made the acquaintance of several other "Kurgäste," by name Bausen, Bugajev, Carpenter, Parelli and Place, and his two friends from Prague, Benda and Naprstek. To pass away the time of their sojourn, these persons formed a small social circle, and, besides taking drives together, they met at stated times and discussed any subject that was uppermost in their minds. Carpenter, however, seemed, from all accounts, to be the dominating one of the party from the discussion point of view, and being of an astronomical turn of mind, the conversations generally were on this subject. His listeners were members of several different professions, so the subject had to be treated in an elementary manner, and, in consequence, the explanations had to be very clear.

The author of this book, who was one of the party, describes here the daily conversations which took place; they are mainly astronomical, although other subjects are occasionally referred to. The astronomical and physical problems dealt with are, for the most part, of a very general character, and will be found interesting reading.

A trip to Prague, after the stay in Karlsbad, gives the author a chance of referring somewhat in detail to the associations, works, and lives of Copernicus, Tycho Brahe, Kepler, Doppler, &c., all of whom were intimately connected with that town.

The book may be said to be quite suitable for the general reader, and the numerous diagrams and illustrations scattered throughout its pages will prove serviceable.

First Stage Inorganic Chemistry. By G. H. Bailey, D.Sc., Ph.D. Edited by William Briggs, M.A. Pp. 210. (London: W. B. Clive, 1897.)

IT is too often forgotten, when criticising text-books written to follow the lines laid down in syllabuses, that the books are not so much to be blamed as the syllabuses. For convenience, it is considered necessary to state the subjects of which a student who presents himself for examination will be expected to know something. The text-book is then produced, in order that the student shall be able to acquire the knowledge in as easy a way as possible. If the syllabus is badly arranged, the text-book designed to meet it will be a bad one; but if the subjects in it are placed in an educational sequence, the text-book will partake of that good quality. Probably no one is better able to judge whether a syllabus hangs together properly or not, than a competent scientific writer who tries to build a book upon it.

The book before us has been arranged to meet the requirements of the Department of Science and Art for the Elementary Stage of Inorganic Chemistry. In eighteen short chapters the author deals with the general principles of chemistry, the nature of chemical reaction, the chief non-metals and their most important compounds, physical properties of gases, chemical nomen-

clature, and chemical calculations. At the end of each chapter is a summary, and a number of questions to test the student's progress. Considerable attention is given to experiment, and the aims and purposes of the study of chemical science are brought into prominence. In fact, though the volume is one of a class of much-maligned text-books, and though it is intended for students working for examination, it is, nevertheless, a book which presents the rudiments of chemistry in a form which will make students appreciate the value of experiment as an instrument of scientific research.

Encyclopédie scientifique des Aide-Mémoire. Edited by M. Léauté. (Paris: Gauthier Villars et Fils. Masson et Cie.)

THREE new volumes have recently appeared in this very serviceable series of technical handbooks. They are as follows:—

"Les Piles Électriques." By Ch. Fabry. This volume deals with the theory of the various electric cells, the measurement of the electromotive force and resistance of such cells, the construction of ordinary electric cells, and standard cells.

"Les Machines Thermiques." By Prof. Aimé Witz. Heat engines generally, steam engines, hot-air engines, and gas engines form the main subject of this volume. The object of the book is to institute a comparison between various heat machines, so as to bring into prominence the special characters of their respective cycles. Chapters are devoted to atmospheric machines, compressed-air machines, and freezing machines. Elementary students of thermo-dynamics will find the book interesting.

"Les Gaz de l'Atmosphère," by M. H. Henriet, is an excellent little volume on the chemistry of the atmosphere. The author is chemist at the Montsouris Observatory, and the methods of analysis described by him, as well as the results of investigations into the composition of the air at different places and at different times, makes his little book very valuable to meteorologists as well as chemists.

The Dahlia: its History and Cultivation. By various Writers. Pp. 81. (London: Macmillan and Co., 1897.)

THE history of the dahlia is told in this handbook by Mr. Richard Dean; the botany is described by Mr. John Ballantyne; the propagation and exhibition of the dahlia are dealt with by Mr. Stephen Jones; and the cultivation by Mr. Robert Fife; while Mr. William Cuthbertson, the editor of "Dobbie's Horticultural Handbooks," to which series the present volume belongs, contributes an introduction. The book is interesting to the botanist as well as the florist, and it should be possessed by every one who finds delight in cultivating dahlias. Of especial value to floriculturists is a full and classified catalogue of varieties of the dahlia, and selections for various purposes. The varieties are arranged alphabetically, and the characteristics of each are described.

La Cause Première d'après les Données Expérimentales. By Émile Ferrière. Pp. 462. (Paris: Félix Alcan, 1897.)

THIS volume is the third and last of a trilogy having for their object the demonstration of the unity of substance by means of established facts, *à priori* argument being excluded. In the first volume the unity of the laws of matter and energy throughout the universe was expounded; the second volume dealt with the physical, physiological, embryological, and pathological facts concerning life and mind; the present volume aims at explaining the relations between various forms of organic life, the order of appearance of animals and plants upon the earth, and evolution problems generally. Leaving the metaphysical side of the book out of consideration, the book contains a certain amount of readable information and criticism.

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.*]

Acquired Immunity from Insect Stings.

MAY I beg to add a few lines to the very interesting correspondence and discussion regarding the immunity of man from insect-stings and snake-bites after successive inoculations. The letter of Dr. Dawson Williams, in NATURE of March 4, calls attention to a certain degree of immunity which obtains among the Norwegians from the stings of the myg, a kind of gnat (probably our midge, Anglo-Saxon mygge). His statements in regard to the degree of immunity varying in different individuals, is quite in accordance with our experience with the mosquito. His pathological description of the effects of the sting of the Norwegian myg would apply most accurately to the sting of the mosquito. We also become more or less immuned from the mosquito poison after much suffering in childhood. The swelling resulting from the mosquito sting will often close the eyes of an infant. In middle age the sting is hardly noticeable. English and Irish people, upon first coming to this country, suffer beyond measure, and often come under the care of a surgeon. It is a curious yet painful sight to see a brawny Englishman presenting the appearance of our young infants under the infliction of these pests. I have two Irish servants, who have been in this country two and seven years respectively. They both tell me that the mosquito bite, as it is called, no longer troubles them, though they were eloquent in the descriptions of their acute sufferings at the outset. More than a quarter of a century ago Dr. J. C. White, a distinguished dermatologist, of Boston, in a communication to the Boston *Medical and Surgical Journal*, November 9, 1871, discusses the subject fully in a paper entitled, "On the protection acquired by the human skin and other tissues against the action of certain poisons after repeated inoculation." He not only shows the immunity arising from the repeated stings of mosquitos, but notices a like immunity arising from the domestic pests, Pediculus, Cimex and Pulex. An American recalls his first experiences with the flea in Europe with the same horror that an Englishman remembers the welcome he received from the mosquito in America.

More than a century ago attention was called to the immunity enjoyed by natives to the sting of mosquitos. In the efforts of Great Britain to suppress the revolt in the American colonies, European troops were hired to augment their armies. Among these were the Anspach-Bayreuth troops, and this contingent was accompanied by an intelligent surgeon, Dr. Johann David Schoepll. His letters to Prof. Delius, of Erlangen, on the "Climate and Diseases of America," were published in pamphlet form in 1781. Dr. James R. Chadwick, of Boston, translated the pamphlet as being one of medico-historical interest. The following paragraph from these letters is of interest. The author says: "One fact is worthy of mention in this connection, which perhaps testifies as forcibly as anything can to the need of acclimatisation, and is moreover universally admitted to be true. In a new-comer, almost every bite of the mosquito produces a boil during the first year after his arrival, but fails to have this effect in the subsequent years."

EDWARD S. MORSE.

Salem, Massachusetts, March 22.

TO the query of Mr. Dawson Williams (NATURE, March 4, p. 415), as to whether the mosquito injects a toxin, an affirmative answer may be given. The mosquito has, instead of the two long simple salivary glands of other diptera, a complex system, three glands on each side of its thorax, two of each set unlike the third. All the six ductules from these glands unite so as to carry the secretion to the common salivary duct, and by it to the hypopharyx. The structure of the hypopharyx is the same as that of the sting of a bee, a tubular-pointed organ with a subterminal orifice. The only exit for the discharge of the complex glandular apparatus is into the wound made by the lancet-formed mouth-organs.

I have all this mechanism dissected out and preserved for

microscopic examination; and it was figured in the *American Naturalist* of September 1888. G. MACLOSKIE.

Princeton University, U.S.A., March 24.

The Affinities of "Hesperornis."

IN the autumn of 1870, I discovered, in the Cretaceous of Western Kansas, the remains of a very large swimming-bird, which in many respects is the most interesting member of the class hitherto found, living or extinct. During the following year, other specimens were obtained in the same region, and one of them—a nearly perfect skeleton—I named *Hesperornis regalis*.[1] In subsequent careful researches, extending over several years, I secured various other specimens in fine preservation, from the same horizon and the same general region, and thus was enabled to make a systematic investigation of the structure and affinities of the remarkable group of birds of which *Hesperornis* is the type. The results of this and other researches were brought together in 1880, in an illustrated monograph.[2]

In the concluding chapter on *Hesperornis*, I discussed the affinities of this genus, based upon a careful study of all the known remains. Especial attention was devoted to the skull and scapular arch, which showed struthious features, and these were duly weighed against the more apparent characters of the hind limbs, that strongly resembled those of modern diving birds, thus suggesting a near relationship to this group, of which *Colymbus* is a type. In summing up the case, I decided in favour of the ostrich features, and recorded this opinion as follows:—

"The struthious characters, seen in *Hesperornis*, should probably be regarded as evidence of real affinity; and in this case *Hesperornis* would be essentially a carnivorous, swimming ostrich" ("Odontornithes," p. 114).

This conclusion, a result of nearly ten years' exploration and study, based upon a large number of very perfect specimens, and a comparison with many recent and extinct birds, did not meet with general acceptance. Various authors, who had not seen the original specimens, or made a special study of any allied forms, seem to have accepted without hesitation the strikingly adaptive characters of the posterior limbs as the key to real affinities, and likewise put this opinion on record. The compilers of such knowledge followed suit, and before long the Ratite affinities of *Hesperornis* were seldom alluded to in scientific literature.

Several times I was much tempted to set the matter right, as far as possible, by reminding the critics that they had overlooked important points in the argument, and that new evidence brought to light, although not conclusive, tended to support my original conclusion that *Hesperornis* was essentially a swimming ostrich, while its resemblance to modern diving birds was based upon adaptive characters. On reflection, however, I concluded that such a statement would doubtless lead to useless discussion, especially on the part of those who had no new facts to offer, and, having myself more important work on hand, I remained silent, leaving to future discoveries the final decision of the question at issue.

It is an interesting fact that this decision is now on record. A quarter of a century after the discovery of *Hesperornis*, and a decade and a half after its biography was written in the "Odontornithes," its true affinities, as recorded in that volume, are now confirmed beyond dispute. In the same region where the type specimen was discovered, a remarkably perfect *Hesperornis*, with feathers in place, has been found, and these feathers are the typical plumage of an ostrich.[3]

O. C. MARSH.

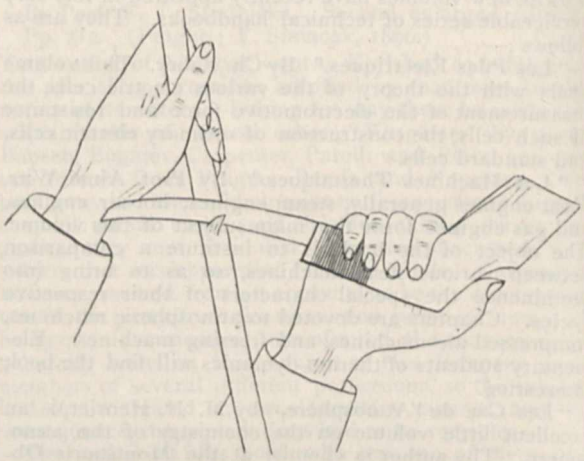
Yale University, New Haven, Conn., March 16.

The Antiquity of Certain Curved Knives.

IN the United States National Museum are a number of knives which go by the general name of "curved knives." The figure here shown is from Anderson River, Mackenzie River district, and is an exaggerated form of the implement mentioned. The essential features are a blade curving upward, so that in cutting it is moved towards the body, and not away from it as in ordinary whittling; this blade is fastened to a handle which is grasped by the four fingers, the thumb resting in a bevel at the butt end. The Canadian voyager uses this knife in making snow-shoes, canoes, and in wood-working generally.

Somewhat modified specimens come from Alaska, wherever drift wood is utilised by the natives in making household and other utensils, and from the Pacific Coast of North America. The same form is found in abundance along the eastern coast of Asia, as far south as further India. The "farrier's knife" of England is formed and used on the same principle.

I am very curious to know the antiquity of this form of knife, and to find out the earliest date when it was introduced into America. I am not familiar with any examples from southern Europe, although, anciently, this pattern may have entered into the common mechanical life of people there.



In connection with this knife, it is pleasant to know that, while a great multitude of aboriginal arts have been degraded by contact with the white race, wherever this knife has gone the savage art has been greatly improved and perfected.

The primitive and old-fashioned snow-shoe, with a rough stick bent into pear-shape for the frame, the filling being of the coarest raw hide, must be compared with the delicately made frame and fine and uniform babiche of the modern snow-shoe, to give force to this declaration.

I am making a collection of knives of this class, together with information concerning their distribution, forms and uses.

U.S. National Museum. OTIS T. MASON.

The Function of Disease in the Struggle for Existence.

PROF. A. DE QUATREFAGES ("The Human Species," p. 430), discussing the decline of the Polynesian Races, remarks:—"Two naval surgeons, MM. Bourgarel and Brulfert, have alone been able to throw some light upon this melancholy problem. The former found that tubercles were *invariably* present in the lungs of bodies submitted to post-mortem examination. The latter tells us that all Polynesians suffer from an obstinate cough, and that, in eight cases out of ten, tuberculosis follows these bronchial catarrhs. Now, phthisis does not appear in the list of diseases drawn up by the old voyagers."

As is well known, the climate of New Mexico is extremely unfavourable to the development of pulmonary tubercle, and consequently this disease seems to have been formerly absent among the native Mexicans. But I have been informed that Mexican girls serving in houses where there are consumptive invalids sometimes contract phthisis, which, in this climate, must indicate a high degree of constitutional susceptibility. *Per contra*, the Mexicans appear to survive small-pox more easily than Europeans, if not also more immune from its attacks, and this, doubtless, may be explained by the fact that they take no precautions to avoid it, and consequently allow selection by disease full play, as was suggested to me by Dr. Lyon, of Las Cruces.

[1] *American Journal of Science*, vol. iii. p. 56, January; and p. 360, May 1872.

[2] "Odontornithes: a Monograph on the Extinct Toothed Birds of North America." 4to. 34 plates, Washington, 1880.

[3] Williston, *Kansas University Quarterly*, vol. v. p. 53, July 1896.

Texas fever in cattle, due to a protozoon parasite of the blood, is endemic, and practically harmless in the south; but when southern cattle are driven northward, and mixed with northern cattle, the latter contract the disease in a form which is rapidly fatal.

The above facts are selected out of many of a similar kind that are on record. It will be generally admitted that a race or species which has long been subjected to a zymotic disease acquires by selection a relatively high degree, if not of immunity, of endurance of the disease.

It does not seem to have been sufficiently appreciated by naturalists that it may be beneficial to a species, in the struggle for existence, to *retain the susceptibility to attack while developing the power of endurance*, instead of acquiring a total immunity from attack.

When a species or race, thus subject to a mild form of a zymotic disease, meets the territory of a closely-allied species or race, it is evident from such cases as are cited above, that the disease, communicated to the newly-met race, may prove a most powerful agent for destruction, with the result of leaving a new territory open to the invaders.

It has only lately been realised how susceptible insects are to various obscure diseases due to bacteria and fungi. In fact, in my studies of the Coccidæ, I have come across numbers of parasitic fungi, which appear to be wholly undescribed and unknown. Therefore, when one insect supplants another in the mysterious way it sometimes does, it is easy to imagine the factor of communicable disease playing an important part.

The purpose of this note is simply to draw attention to the matter, and to request those of your readers who may witness the supplanting of a native animal or insect by a foreign or invading one, to particularly note whether the former is attacked by any disease. T. D. A. COCKERELL.

Mesilla, New Mexico, U.S.A., March 9.

The Caucasus.

IT might be out of place to trouble your readers with any lengthy discussion of the many difficulties and snares that beset the path of the transcriber of Caucasian place-names, and of the discrepancies to which they may easily give rise. Nor shall I ask you for space to defend, in any detail against your reviewer's strictures, my own system—or want of system—in dealing with Caucasian nomenclature. In so far as I may have deviated from the principles laid down by the Committee of the Royal Geographical Society, of which I was a member, and adopted by the British Admiralty, the Government of the United States, and other bodies, I am very ready to submit myself to expert criticism or correction.

In these notes, however, my object is not so much personal as general. It is to prevent the confusion of knowledge, and to a certain extent of tongues, which, I fear, must ensue should men of science in search of information about the Caucasus attempt to follow, without some further advice, "J. W. G.'s" summary suggestions.

In the first place, I have to point out that your critic has failed to take into account a circumstance which is, in my opinion, of great importance, and to which, in my preface, I was at pains to call particular attention. The Caucasus, as we all know, is an annexed or conquered country. Consequently its place-names are not Russian, but, in the district with which I deal, for the most part Old Turkish or Georgian. Now scientific cartographers in this country are not, I believe, prepared, wherever and whenever Russia may incorporate an Asiatic district, to substitute for the English forms of the native place-names transliterations from the forms they assume in Russian maps. Such a course has obvious disadvantages. It must obscure the meaning of many names, and give identical names different forms, according as they occur within or outside a political frontier. The question is a recurrent and a difficult one, not to be set aside lightly by an *obiter dictum*, or by an appeal to French usage. Under no circumstances, I must add, are British geographers likely to respond to your writer's implied suggestion by assimilating their system to that in use in France.

"J. W. G." and I agree, I am glad to find, in desiring to induce men of science in quest of accurate information as to the Caucasus, to seek it out from first-hand authorities. He recommends certain articles, printed in Russian, and published in Moscow and Tiflis periodicals by MM. Dinnik and Jukoff. I have good reason to believe that a knowledge of Russian is still far from universal, even among men of science. I shall therefore venture to suggest that our countrymen may gain some further assistance from the hundreds of pages devoted to the Caucasus, during the last ten years, in the *Journals* of the Alpine Club and of the Royal Geographical Society. And I would add a few words of caution to beginners. M. Dinnik's paper was written some years ago, when the New Survey was still far from complete, and his own travels did not suffice to fill in the gaps. On some matters, consequently, he may mislead—and has misled—his copyists. M. Mikhailovsky's tables of Caucasian Peaks, Passes, and Glaciers, issued in the Moscow *Zemlevyedyenie*, should also be consulted. They are more up to date, and detailed, though he, too, fails in the personal knowledge of the localities essential to graphic and accurate description. Moreover, his spelling of place-names frequently diverges from that of the preliminary sheets of the New Survey, privately communicated to me by the Surveyors, which were my authority.

It is with some surprise that I observe your critic's statement that he has failed to find in my pages any reference to the writings of either M. Dinnik or my friend M. Jukoff. The former, I must confess, has slipped out of my index. But he is referred to in his proper place in the first chapter, and elsewhere. M. Jukoff is in my index, preface, first and many other chapters. I have mentioned both frequently in the Alpine and Geographical *Journals*, and I published a translation of a paper of M. Jukoff's in the latter periodical. As to the map of M. Fournier's, which "J. W. G." cites, it is a geological map appended to a geological diploma essay printed at Marseilles last autumn. It can hardly, I think, be cited as a *geographical* authority.

DOUGLAS W. FRESHFIELD.

The Alpine Club, March 20.

WE did not intend our remarks on nomenclature to be structural, and we certainly offered no suggestions, summary or otherwise. We only pointed out some of the inconsistencies inevitable when place-names are not transliterated upon a definite system. The fact that the Caucasian place-names are derived from various languages had not been overlooked; but the rules laid down by the R. G. S. Committee, to which Mr. Freshfield refers, admit the principle in such cases of accepting the spelling of a standard national gazetteer or of official survey maps. Such a method may be philogically defective, but it is geographically convenient. Would Mr. Freshfield recommend a foreign geographer, writing about England, to abandon the recognised names in favour of the forms which may be used locally? To ignore the official spelling in many parts of the Russian Asiatic dominions would be to render the revision of place-names, to use Mr. Freshfield's term, a "recurrent" difficulty, for the people are nomadic, and names come and go like fashions. There is probably no place for which a stronger case could be made out in favour of adopting the spelling of the official maps. We did not imply that the French method should be adopted in England; what we said was that, owing to the variations adopted by Mr. Freshfield, sometimes avowedly for the sake of appearances, it was difficult to find his names in Fournier's map. We did not quote Fournier as a geographical authority. In regard to the two Russian authors to whom we referred, we remarked the absence of reference to their technical papers, instead of to those of general Western compilers, for information respecting the Caucasian glaciers. J. W. G.

The Laboratory Use of Acetylene Gas.

IT is evident from Mr. Munby's letter, in your issue for March 25, that he is unaware that atmospheric burners adjusted for acetylene gas are, and have been for some time, articles of ordinary commerce. Up to the present time no satisfactory method has been found by which large and powerful Bunsen flames can be obtained free from smoking, as the mixture of acetylene gas with a small proportion of air is very explosive, and the Bunsen tubes used must not exceed 3·16 inch diameter. Any ordinary Bunsen adjusted for 20-candle coal gas, if not exceeding the bore stated, will be found fairly satisfactory with acetylene, the gas pressure being not less than 5 inches of water; but the best results are obtained from burners rather different in proportions from the ordinary laboratory Bunsen.

Warrington. THOS. FLETCHER.

NEW WORKS ON THE CLASSIFICATION OF LEPIDOPTERA.[1]

THE satisfactory classification of *Lepidoptera* has always been regarded as one of the most difficult problems in entomology, and many authors (chiefly English and American) have recently been working at the subject, and trying to throw fresh light upon it from the supposed lines of descent of the insects, and from a critical and comparative study of their earlier stages. It is, however, somewhat to be regretted that most of the systems follow very different lines, and therefore arrive at very divergent results. This is only the consequence of the now generally recognised impossibility of arranging natural objects in a linear series which shall represent their real affinities; and in due time we may hope that some compromise may be arrived at, which will reconcile the opposing systems so far as to lead to a fairly satisfactory and uniform result.

The first book on our list professes to give a more complete and trustworthy account of our few British butterflies (a theme which we should have thought was worn almost threadbare by this time) than has heretofore appeared. However, Mr. Tutt may fairly claim to have produced a book in which the early stages of the insects are dealt with in greater detail than in almost any previous English work not devoted exclusively to larvæ, except Newman's; and he has also fully enumerated the varieties of our British species in all parts of their range, though he rarely alludes to allied continental species, even if reputed British. His account of the systematic extermination of such species as *Melitæa athalia* and *Apatura iris* (both common, quite close to London, not so very many years ago) will be read with interest and pain by every right-thinking entomologist. In some cases, his information is hardly up to date, as, for instance, with respect to the history of *Chrysophanus dispar*. Mr. Tutt's preliminary chapters are devoted to the early stages of butterflies, and to instructions on collecting, rearing, and preserving. But here, too, our author seems to write exclusively for *British* entomologists, for the continental high setting (now coming into use in England among collectors of exotic Lepidoptera) is not even mentioned.

Mr. Tutt's classification does not depart much from the Batesian system, except that he follows an ascending instead of the usual descending system, commencing with the *Hesperidæ*, and ending with the *Satyridæ*. He has adopted the American system of "superfamilies," ending in "-ides," of which he admits two, the *Hesperides* and the *Papilionides*, which he divides into families ending in "-idæ," subfamilies, ending in "-inæ," and "tribes" ending in "idi."

The second work on our list, by one of the leading American entomologists, though dealing chiefly with but a single family of North American moths, the *Notodontidæ*, includes an elaborate introduction, in which the supposed descent, the structure and affinities of the various families of *Lepidoptera* are discussed, with special reference to their early stages. The plan of Dr. Packard's researches may be gathered from the following remarks:

"Until within a few years the majority of descriptions of caterpillars have been prepared simply for the purpose of identification, or for taxonomical uses, and without reference to the philosophic or general zoological significance of these changes. The transformations of some of the European Sphingidæ have been very carefully worked out by Weismann, and also by Poulton; but it is believed that the life-histories of the lower, more generalised families usually referred to the Bombyces, especially of the Notodontidæ, Ceratocampidæ, Saturniidæ, Hemileucidæ, Cochliopodidæ, and Lasiocampidæ will bring out still more striking and valuable results, inasmuch as they, or forms near them now extinct, are believed to be closely similar to the stem forms from which many of the higher Lepidoptera have probably been evolved.

"The aim, therefore, in such studies should be:

"(1) To treat the larvæ as though they were adult, independent animals, and to work out their specific and generic as well as family characters.

"(2) To trace the origin of mimetic and protective characters, and to ascertain the time of larval life when they are assumed, involving

"(3) The history of the development of the more specialised setæ (hairs), spines, tubercles, lines, spots, and other markings.

"(4) To obtain facts regarding the ontogeny of our native species and genera which, when added to what we know of the life-histories of European, Asiatic and South American Bombyces, may lead to at least a partial comprehension of the phylogeny of the higher Lepidoptera, viz. those above the so-called Micro-Lepidoptera."

It is really the immense amount of detail which renders it so difficult to arrive at a correct classification of animals. In the case of *Lepidoptera*, it is comparatively easy to compare egg with egg, pupa with pupa, and imago with imago; but we should then only arrive at a very superficial knowledge of the species; for the caterpillars moult several times, and their structure also differs very much in these various stages, and we can only arrive at correct conclusions by comparing each of the corresponding stages; and it is frequently the earliest of these which throw most light on the affinities of the species. Thus, to take our well-known British swallow-tail butterfly as an example, the very young larva is set with fleshy tubercles, like the full-grown larvæ of *Ornithoptera*, and other exotic forms belonging to the same family.

In the special part of his work Dr. Packard has described the North American *Notodontidæ* in all their stages, and has not only given illustrations (mostly plain) of the moths themselves, but has added a series of beautifully executed coloured drawings of the larvæ of numerous species in their various stages, special attention being given to the earlier ones. Plates of neuration, and maps showing the geographical distribution of many species, are also added.

To return to the Introduction, we find sections on the mode of evolution of the bristles, spines, and tubercles of Notodontian and other caterpillars; on the incongruence between larval and adult characters; on inheritance of characters acquired by larvæ; geographical distribution; phylogeny; classification; and nomenclature of wing-veins, &c.

The enormous mass of matter (largely original) which Dr. Packard has brought together, makes it difficult to discuss his work in detail. But we may notice one or two points of special interest. His researches have led him to the conclusion that the Lepidoptera originated from some probably extinct form intermediate between the Panorpidæ and the Trichoptera; and he suggests that the earliest type of lepidopterous larva was allied to some Tineoid feeding on low herbage on land, not being a miner or sack-bearer, as these are evidently secondary adaptive forms. Some of the larvæ figured exhibit very remarkable appendages in their early stages, which disappear after the first or second moult. Among the most curious are the huge branching "antlers" on the prothoracic segments of the larvæ of different species of the

[1] "British Butterflies, being a popular handbook for young students and collectors." By J. W. Tutt, F.E.S., Editor of *The Entomologist's Record and Journal of Variation*. 8vo. Pp. 476; pls. 10, and woodcuts. (London: George Gill and Sons, 1896.)

"Monograph of the Bombycine Moths of America North of Mexico, including their Transformations and Origins of the Larval Markings and Armature." Part i. Family 1. Notodontidæ. By Alpheus S. Packard. (National Academy of Sciences, vol. vii.) 4to. Pp. 291; pls. xlix.; maps 2 (1895.)

"Die Saturniiden (Nachtpfauenaugen)." Von A. Radcliffe Grote, A.M. (Mittheilungen aus dem Roemer-Museum, Hildesheim. Nr. 6, Juni 1896.) Pp. 30; pls. iii.

genus *Heterocampa*, which remind us of the strange appendages exhibited by the perfect insects of some *Homoptera*. As regards classification, Dr. Packard refers chiefly to the writings of Dr. Chapman, Prof. Comstock, and Mr. Walter; and after some criticism, he proposes the following scheme :—

Sub-order I. Lepidoptera Laciniata, or Proto-Lepidoptera (Eriocephala).

Sub-order II. Lepidoptera Haustellata.

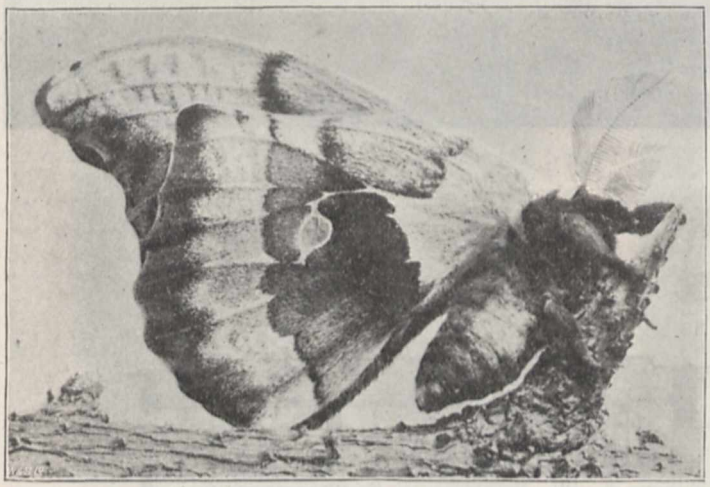
I. Palæo-Lepidoptera (Micropteryx).

II. Neolepidoptera.

Dr. Packard's phylogenetic tree of the last section, which comprises all the *Lepidoptera* except *Micropteryx* and *Eriocephala*, is suggestive.

He recognises six main stems, one of which, the *Hepialidæ*, has no offshoot; four of the others are short, culminating in the *Megalopygidæ*, *Cossidæ*, *Sesiidæ*, and *Pyralidinæ* respectively, while the sixth leads up from the *Prodoxidæ* past the *Psychidæ* and *Zygænidæ*, through the *Tineidæ*, to the *Lithosiidæ*, whence arise other branches, culminating in the *Nymphalidæ*, *Sphingidæ*, *Geometridæ*, and *Arctiidæ*.

We have said enough to indicate the immense interest and importance of this work, not only to all lepidopterists, but to all who are interested in the philosophic study of evolution. When will Governments or adequately supported Societies or Universities render it possible for similar works to Dr. Packard's to be executed and published in Europe?



Telea Polyphemus (Cramer) at rest.

Mr. A. R. Grote, who has probably described more North American Lepidoptera than any other author, has lately taken up his abode in Germany, but has not therefore abandoned his interest in entomology. In the course of last year he published a sketch of the classification of *Lepidoptera* (partly following Comstock's system), in which he recognised a "super-family Bombycides," divided into four families—Bombycidæ, Endromidæ, Agliidæ, and Saturniidæ. In the present paper he modifies his views on the plylogeny of these families, and concludes, from his own and Dr. Dyar's observations on the earlier stages of the larvæ of *Bombyx* and *Endromis*, that they are allied to the *Lachnæidæ* (*Lasiocampidæ*), which is the first family of his "super-family" Agrotides (which includes the bulk of the Bombyces and Noctuæ), which must now take the name of Bombycides, leaving the "super-family" Saturniides to include only the two families Saturniidæ (sub-families *Attacinæ*, *Saturniinæ*, and *Hemileucinæ*); and Agliidæ (sub-families *Agliinæ*, *Automerinæ*, and *Citheroniinæ*. We are puzzled by the remark that the discovery of the larva of the Australian genus *Chelepteryx* may throw light on the position of *Endromis*. Is he unaware that the full-grown larva of *Chelepteryx*, as figured by Scott, is covered with bristle-bearing warts, and is thus totally different from that of *Endromis*?

This paper also includes an analytical table of the genera of *Saturniidæ*; and several genera, founded on known species, are indicated as new. Special attention is paid to larvæ, neuration, and antennæ, in working out the phylogeny of the groups (of which a tentative table is given), and the neuration and antennæ are illustrated with woodcuts. A special feature of interest is formed by the three photographic plates—one representing cocoons, and the others, taken from the living insects, representing the positions of several of the moths in repose. One of these is reproduced on this page. The paper concludes with a revised synonymic list of the North American Saturniides.

THE ZÜRICH FEDERAL POLYTECHNIC SCHOOL.

A RECENT number of the *Revue Générale des Sciences* contains a very interesting account of the Federal Polytechnic School at Zürich. Switzerland possesses one other such institution, namely, that at Lausanne.

The Federal Polytechnic School at Zürich is the only institution in that country, connected with higher education, which depends on the Confederation directly. As a natural result the school is much richer, and has been able to develop more rapidly. The students are all day scholars, and are divided into two classes: the *reguliers*, that is, those who go through a fixed course, and the *auditeurs*, those who work chiefly in the advanced division. The school opened in 1855 with 228 students. This number has increased every year, and in 1895 reached the total of 757. The courses of instruction are arranged under the seven following heads: (1) architecture, (2) civil engineering, (3) industrial mechanics, (4) industrial chemistry, (5) agriculture, (6) pedagogy, and (7) an optional course, in harmony with the six other divisions, which includes history, literature, modern languages, political economy, statistics, philosophy, fine art, and military tactics.

While endeavouring to preserve the character of a higher technical school, the theoretical instruction is also carried on as far as possible. The school has from the Confederation an annual subsidy of eight hundred thousand to nine hundred thousand francs, besides numerous other subsidies and revenues. With this income of over one million francs, not only are general expenses covered, but a number of additions can annually be bought. No money has, moreover, been spared on the erection of the laboratories, which are very numerous and spacious.

Fig. 1 represents the chemical school. It contains photographic, microphotographic, and pharmaceutical laboratories. The chemical analytical laboratory contains 166 single places, or 83 double; the double places, consisting of two tables back to back, are given to the more advanced students. Adjoining this laboratory are two balance-rooms, a dark-room, a room for electrolysis, one for analyses of gases, two for work of more advanced students, and another for physical chemistry. The laboratories for industrial and analytical chemistry are also divided into similar rooms.

The astronomical observatory is shown in Fig. 2, the principal feature of the illustration being the

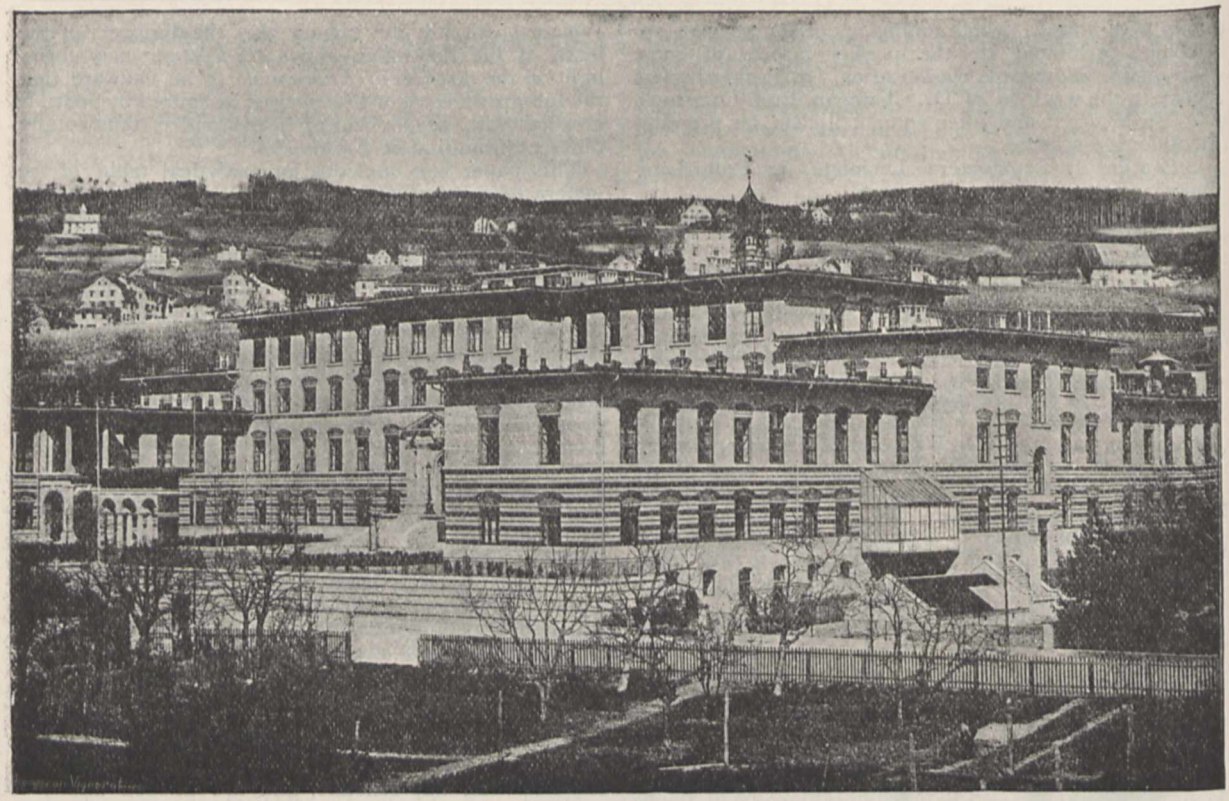


FIG. 1.

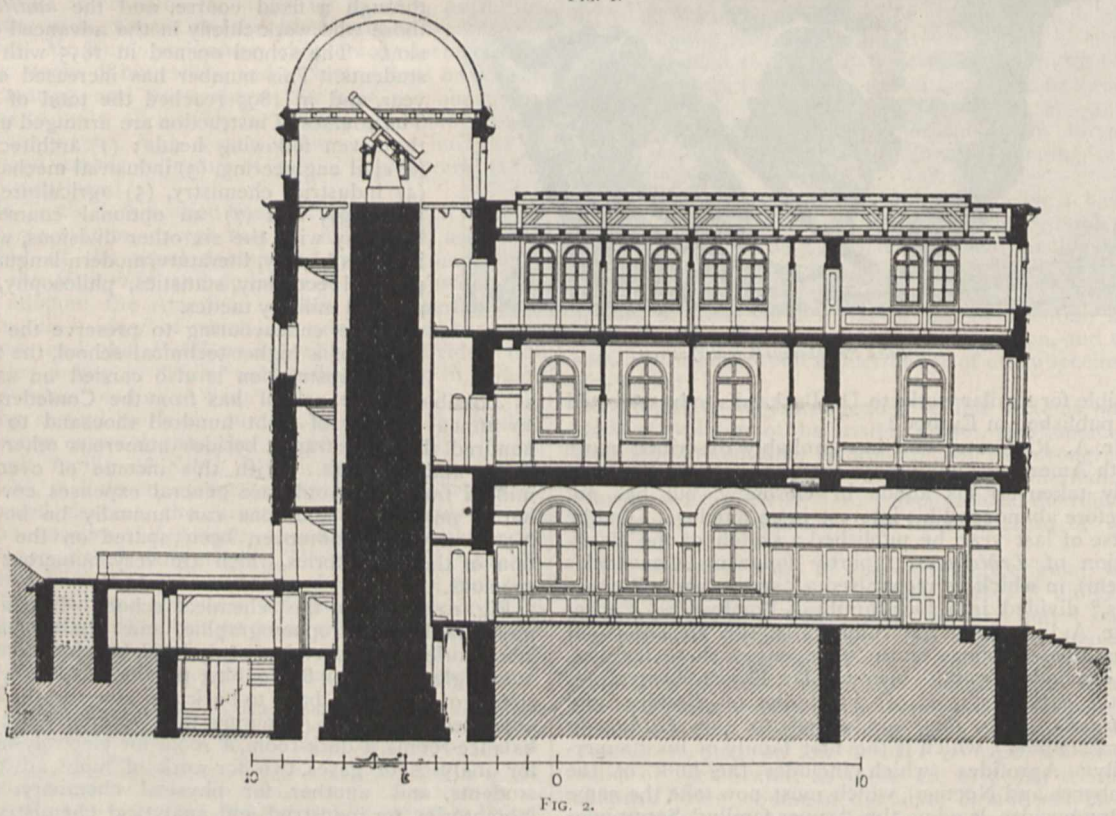


FIG. 2.

mmense concrete pillar on which the equatorial rests. In addition to the laboratories already mentioned, there is an institute for physics, for photography, a workshop for modelling in clay and plaster, in connection with the course on architecture; a workshop for working on metal and wood, in connection with the mechanical

division; and, also, laboratories for pharmaceutical purposes and agricultural chemistry.

From this sketch it will be gathered that the courses of instruction are not only well provided for as regards laboratory equipment, but are thoroughly suited to the requirements of the students in every subject included in the syllabus.

SCIAGRAPHS OF BRITISH BATRACHIANS AND REPTILES.[1]

ON May 5 last, Mr. G. A. Boulenger, F.R.S., reading a paper before the Zoological Society of London, on "Some little-known Batrachians from the Caucasus,"

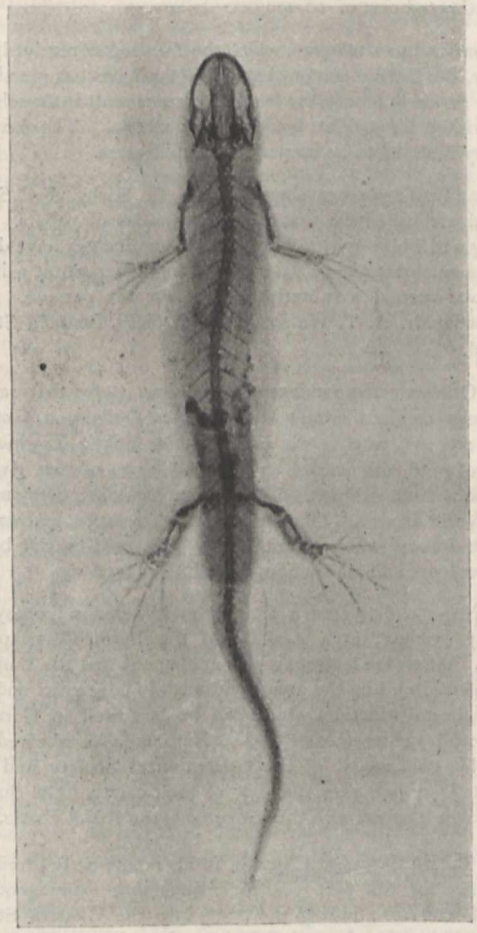


Fig. 1.

announced (*cf. P.Z.S.*, 1896, p. 552) the first outcome of the application of the Röntgen rays to herpetological investigation, having by their aid settled the systematic position of a unique batrachian without injury to the specimen. The event aroused in the minds of Messrs. Green and Gardiner a determination to repeat the experiment on a larger scale, with the result now before us—viz. a series of sciagraphs of all the British Batrachians and Reptiles, including the rare Smooth Snake (*Coronella austriaca*).

Two or three of the plates are indefinite, perhaps as the result of light printing, but the majority, for clearness and sharpness of definition, mark a very considerable advance upon anything of the kind yet published, and enable us the better to judge of the possibilities of the method as an aid to zoological and anatomical study. The plate of the Crested Newt (Fig. 1), which we reproduce, is especially noteworthy in this respect, and for the clearness with which the ossific nuclei of the carpus and tarsus are recorded. In the case of bones which, like these, are well isolated, and of those which are rod-like and dense, the method leaves little to be desired for purposes of general study and orientation of parts. Where thin flat bones exist, however, detail is not recorded; and as concerning the cranium, to which this remark especially applies, the appearances

Fig. 2.

presented by some of the plates suggest delimitation of brain structure rather than anything that is osteological. Be this as it may, it is important to observe that marked indications of the soft parts occur in some of the prints—most conspicuously in the case of the large intestine, especially when fully laden with egesta largely composed of the elytra of beetles ingested as food. The area of overlap of the segments of the limbs and of not a few of the individual limb muscles is also rendered evident.

Detail is greatest in the figure of the Natterjack Toad, which we also reproduce (Fig. 2). Its lungs (like those of the frog of which a sciagraph by Messrs. Reid and Kuenen

[1] "Sciagraphs of British Batrachians and Reptiles." Thirteen plates mounted, with portfolio. By J. Green and J. H. Gardiner. (Wallington, Surrey, 1897.) With an introduction by G. A. Boulenger, F.R.S.

appeared in NATURE, vol. liii. p. 419) were unequally inflated. Not only can the texture of both of them be satisfactorily made out, but on the right side there is a uniformly tinted hemi-cardiac-shadow, indicative of the greatly thickened right lobe of the liver. Indications of the base of the stomach are also to be made out, and on both sides of the body there are feeble shadows at places coincident with the oviducts.

Messrs. Green and Gardiner have also favoured us with an advanced print of a sciagraph of a *Pelodytes*, which is in some respects sharper than those which they have placed on the market. They are continuing the work, and have recently exhibited before the Linnean and Malacological Societies sciagraphs of molluscs no less successful than those here under review—for they have obtained from the entire *Nautilus* a pictorial record of the muscle scars and lines of origin of the septa (a reprint of which is shortly to appear in the Proceedings of the Malacological Society), and from an entire Chiton of the plate-margins, which lie beneath the body-wall and are of primary taxonomic importance.

Mr. Green is one of our most accomplished zoological lithographers. Recent plates of his, which have appeared in the British Museum Catalogue of Snakes, and in the Proceedings of the Zoological and Malacological Societies, lead us to hope that in some departments of the work he may outrival his foreign contemporaries; and with the Röntgen rays he and his colleague have been no less successful. Their portfolio is elegantly got-up; and its value is materially enhanced by an accompanying introduction, dealing with geographical distribution and structure, from the pen of the distinguished herpetologist whose work incited them to action. We shall watch with intense interest the development of their enterprise, which has already produced results of the greatest service to the student of animal life.

NOTES

THE names of those who attended Prof. Sylvester's funeral, copied from the *Times*, were by inadvertence inserted at the end of Major MacMahon's article, instead of beneath his signature.

M. RADAU has been elected a member of the Section of Astronomy of the Paris Academy of Sciences, in succession to the late M. Tisserand.

SIR JOHN EVANS, K.C.B., Treasurer of the Royal Society, has been elected a Corresponding Member of the Academy of Sciences of Bologna, in succession to the late Right Hon. T. H. Huxley.

PROF. ALBERT VON KÖLLIKER, the eminent professor of anatomy in the University of Würzburg, has had the title of "Excellency" conferred upon him.

DR. LAUDER BRUNTON, F.R.S., will give one of the general addresses at the forthcoming International Medical Congress in Moscow.

PROF. E. RAY LANKESTER, F.R.S., will preside over the meeting of the Museums Association, to be held at Oxford on July 7–9 of this year.

THE ninth meeting of the International Congress of Hygiene and Demography, which was to have been held at Madrid in October of the present year, has been postponed till April 1898.

DR. H. E. ARMSTRONG, F.R.S., has been elected a member of the Athenæum Club, under the rule which empowers the annual election by the Committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

A FINE bronze statue of the late Sir Richard Owen has just been placed in the Natural History Museum, South Kensington, facing the statue of Darwin. The funds for the statue were raised by public subscription.

WE regret to have to record the death of Dr. G. A. Kenngott, for many years professor of mineralogy in the University of Zürich, and director of the mineralogical museum there.

A REUTER'S telegram from Ottawa says that the Canadian Government intends to begin immediately the works for enlarging and deepening the canal system in the Dominion, securing a uniform depth of 14 feet from Lake Superior to Montreal, at an estimated cost of 10,000,000 dollars.

ACCORDING to a telegram which the *Lancet* has received from Bombay, the Yersin serum treatment of plague has practically failed. So far the mortality has been 50 per cent. in the selected cases within forty-eight hours of the attack. The hospital mortality is stated to be 60 per cent. in all cases.

IT is now fifty years since Dr. H. C. Sorby, F.R.S., of Sheffield, published the first of his long series of papers. The Literary and Philosophical Society of his native city have determined to celebrate the occasion by having his portrait painted, and have opened a subscription list for the purpose. The treasurer is Mr. A. T. Watson, Assay Offices, Leopold Street, Sheffield.

THE Ottawa correspondent of the *Times* states that reports have been received from Mr. William Ogilvie, a Government Surveyor, who is wintering on the Yukon, in which he speaks of gold discoveries on the tributaries of that river of almost incredible richness. Mr. Ogilvie has taken every means to verify the reports. On one stream three men had washed out 1200 dollars' worth in eight days. The gold-bearing belt is 300 miles long, and well within British territory.

DR. NANSEN delivered a lecture on his Arctic journey, on Saturday evening, at a meeting of the Berlin Geographical Society. After the lecture, it was announced that the Emperor had conferred on him the great gold medal for science and art, "the highest distinction which can be bestowed in Germany for peaceful achievements." Dr. Nansen also received the Humboldt gold medal of the Geographical Society, and was nominated an honorary member of the Society. On Sunday Dr. Nansen lunched with the Emperor at the Royal Castle.

THE British Consul at Chicago, in his report on the trade in his district for the past year, mentions that many goods of German make are finding their way into the Western States, and are taking the place of British goods. Amongst these are chemicals, quinine, ammonia, caustic soda, plate-glass, fuller's earth, Portland cement, cutlery, needles, surgical instruments, paints, and oils.

Science makes a strong protest against some vexatious provisions in the new Tariff Bill now before Congress. The Bill imposes a tax of 45 per cent. *ad valorem* on scientific apparatus "imported especially for colleges and other institutions"; it imposes a tax of 25 per cent. on books imported for public libraries, on books "printed in languages other than English," on books "printed more than twenty years," and on books "devoted to original scientific research"; and it imposes a tax of 25 per cent. on works of art. This simple statement shows that men of science in the United States have abundant cause for complaint against the Bill.

THE Cairo correspondent of the *Times* reports that Prof. Forbes, the electrician, who has just returned from Wady Halfa, expresses a highly favourable opinion about utilising the power of the cataracts for generating electricity, and considers the general circumstances of Egypt exceptionally well adapted for its use as motive power. He thinks that the cataract power would be available all the year round for working the railway, cotton ginning mills, sugar factories, irrigation machines, &c., also that it could be supplied over distances of several hundred miles at a cost much below that of coal. Prof. Forbes is now on his way to England. He will return to Egypt in September next, to make a complete survey and present the Government with a project for utilising the electricity to be generated at the Nile cataracts.

THE rapidity with which Röntgen photographs can now be taken was exemplified by a series of pictures recently shown by Dr. John Macintyre at the Glasgow Philosophical Society. Dr. Macintyre passed through a kinematograph a film thirty-five feet long, having upon it radiographs of a limb of a frog, and he was thus able to show distinctly to a large audience the movements of the bones in the limb. To obtain the photographs the kinematograph was covered with lead, in which there was the usual aperture. This aperture was covered with black paper. The tube was then put in the best condition, the mercury interrupter being used with a 10-inch spark coil. The movements of the limb of the frog were controlled by a mechanical arrangement.

A SHORT time ago, one of our correspondents ("S. J. R.," NATURE, vol. liv. p. 621) described the injurious effects of the X-rays on his hands. He is not the only one, however, that has suffered in this way: several other operators, who have been experimenting with these rays for any length of time, have had either to bear the consequences, or give up for a short time this line of work. An interesting summary and discussion of many of the well-recorded cases of dermatitis due to the X-rays, forms an article in the *Bulletin* of the Johns Hopkins Hospital. The writer, Mr. T. C. Gilchrist, after reviewing the several cases, finds that the X-rays are even more powerful than have been generally thought, and hat the deleterious effects may in some cases be quite serious; the cutaneous manifestations are not, however, the most severe of the lesions, but they are surpassed in severity by those of the deeper tissues, and particularly of periosteum and bones. The discovery of this deeper and more profound effect calls for a new explanation to account for the cutaneous lesions. It seems probable that, according to the writer, these injurious effects may be due to the platinum particles piercing the bulb, and then attacking the tissues. On clinical grounds, he states, there is considerable support for this, at first sight, improbable theory. If the lesion extends at all deeply, it leads to the formation of ulcers, which are extremely intractable, and they may be due to irritating particles still present in the tissues. Mr. Gilchrist advises X-ray operators and experimenters, who develop any special idiosyncrasy, to abstain from their use if they find that the slightest deleterious results follow an exposure to them.

A NUMBER of valuable works on botany and other branches of natural history, from the library of the late Mr. Freeman C. S. Roper, were sold by auction last week, the 668 lots realising a total of 1308*l.* 15*s.* Among the more important lots mentioned in the *Times*, with the prices obtained, are the following:—Mr. C. Cooke, "Illustrations of British Fungi," 1881-91, eight volumes, 17*l.* 5*s.*; "The Grete Herbal," printed at Southwarke by P. Treveris, 1526, extremely rare, a sound copy, 39*l.*; a set of the Ray Society publications from the commencement in 1845-1893, 28*l.*; P. A. Saccardo, "Sylloge Fungorum," 1882-96, 27*l.*; the *Journal of Botany* from its commencement in 1863 to 1896, 21*l.*; J. Sowerby, "English Botany," 1790-1863, with the Rev. M. J. Berkeley's appendix volume on British Algæ, 36*l.*; another of the same work, but the third edition, 1863-92, 15*l.* 10*s.*; "Bryologia Europæa," a work on mosses by Bruch, Schimper, and Gümbel, 1836-64, 18*l.* 5*s.*; *Transactions* of the Zoological Society, 1835-95, 43*l.* 10*s.*

THE *Daily Chronicle* announces that the preliminary arrangements are now completed for laying across the English Channel two additional telephone cables. The first cable will be laid shortly by the English cable ship *Monarch*, the second being laid by the French Government, for whom it has been constructed in France. The cables will leave the English side of the Channel about three miles to the west of Dover. There are two circuits in each wire; so that, with the cable already laid, there will be six wires available for public use instead of two, as at present, which are in constant use. When the additional cables are duly installed, it is stated that facilities for international telephoning will be given to the large commercial centres in both England and France, instead of confining them to London and Paris only, as at present. When the two new cables are laid, there will be in all about thirty-four wires across the English Channel between St. Margaret's, Dover, on the east, and Beachy Head on the west.

FOUR hundred years ago the Atlantic was crossed for the first time by Cabot, and a little later Vasco da Gama started on his first voyage to India round the Cape of Good Hope. As the fourth centenary of these epoch-making expeditions will shortly be celebrated in Bristol, Canada and Portugal, an article upon them, by Mr. Edward Salmon, in the current number of the *Fortnightly Review*, appears at the right psychological moment. It is generally believed that Sebastian Cabot was the captain of the English ship which first touched the new continent, but attention is called to Mr. Henry Harrisse's work on "John and Sebastian Cabot," in which it is shown that Sebastian was an impostor who took credit for what his father, John Cabot, did. Furthermore, according to accepted opinion, Cabot struck land at the easternmost point of Cape Breton, but Mr. Harrisse concludes that the first point reached was Cape Chudleigh. John Cabot left Bristol for the voyage west in May 1497, with one small vessel and a crew of eighteen men; Vasco da Gama lef Lisbon, after elaborate preparations, on July 8 in the same year, in charge of three vessels. He arrived at Mozambique in March 1498, and went from there to Melinde. Leaving Melinde he proceeded across the Indian Ocean, and in three weeks arrived in India, whether off Calicut or Cananor is doubtful. A few other interesting points on the voyages of Cabot and Vasco da Gama will be found in Mr. Salmon's opportune article.

THE latest issue of the *Izvestia* of the Russian Geographical Society (xxxii. 4) contains a very well-written account, by P. K. Kozloff, of the last portion of Roborovsky's Tibet expedition. While the main body of the expedition was returning from the Nan-shan Mountains, *viâ* Hami, to the Russian post of Zaisan, Kozloff made three very interesting side-journeys across East Tian Shan, and in the adjoining deserts. During one of those journeys he crossed the Kobbe sand desert, which was once visited by Prjevalsky, and lies in the Dzungarian depression, between East Tian Shan and the Altai. The wild camel, the wild horse (*Equus Przewalskii*), and the kulang still live in numbers in the Kobbe desert. As to man, only a few Kirghiz shepherds visit it. From these shepherds, as well as from the inhabitants of the Urungu valley, Kozloff heard about the wild men (*Kyz-kiyik*) who are said to live in that desert; and although the Russian explorer does not much trust to the rich fancy of the nomads, he nevertheless faithfully reproduces what

he has learned about the *Kyz-kiyiks* for the use of future explorers. The information runs as follows:—"The size of these men is not smaller than the habitual man's size. Their body is all covered with a short hair of the same colour as in the young camel, black hair falling on the shoulders, and dark eyes; body short and thin, legs relatively long. The *Kyz-kiyik* feeds on roots of plants growing along the streamlets in the sands; moves about in pairs; looks severe, harsh; emits sounds when he is dissatisfied with something, or as a calling signal. When he is pursued, he shouts loudly, and in his shout one hears a whistling sound. The wild man runs very swiftly and walks rapidly, setting his feet wide apart. The Kirghizes whom I spoke to said they had taken *Kyz-kiyiks* alive. The Kirghizes kept them for two or three days in their tents, and tried to feed them with meat and cakes, but they ate nothing; when forced to eat, crossed their hands on the breast, and twinkled with the eyes. They could not bear a steady look, turned the head aside, and on their own will made their hair stand on end. When they were set free, they took at once to the sands, and were joined each time by a comrade, who concealed himself, in the meantime, somewhere in the neighbourhood." The Kirghizes added that it would not be difficult to catch one of them in the winter, but not in summer, as they never have been seen in summer, probably because they conceal themselves in some inaccessible place.

THE opinion that distinct toxins require distinct anti-toxins would appear to require some modification. Dr. Calmette has shown that anti-venomous serum protects against scorpion poison; Roux and Calmette have shown that rabbits vaccinated against rabies, acquire remarkable powers of resisting the action of cobra venom. Again, animals vaccinated against tetanus and anthrax respectively, not only elaborate anti-tetanic and anti-anthrax serum, but such serums have also been found to be in some cases capable of counteracting the effects of cobra venom. Calmette has also shown that anti-diphtheria, anti-tetanus, anti-anthrax, and anti-cholera serums possess decided immunising powers with regard to the vegetable toxin of abrine. Dr. Memmo, working in the Hygienic Institute of the University of Rome, has observed that a distinct, although slight, curative action is produced by anti-diphtheria serum in cases of tetanus. Some extremely interesting investigations by Dr. Marriotti-Bianchi, dealing with the action of normal serums from various sources on different bacterial toxins, also tend to confirm the above observations. Bianchi has also been able to reproduce all the phenomena, claimed by Pfeiffer, to be specific in respect to the behaviour of cholera vibrios in anti-cholera serum, by placing these vibrios in normal serum derived from dogs and cats respectively. It would appear that not only may various anti-toxins modify one and the same toxin, but normal serums may also produce in some cases protection against toxins. This latter point has been specially dwelt upon by Bianchi in his memoir.

A PAPER by Mr. Walcot Gibson, published in the *Transactions* of the Federated Institute of Mining Engineers, will prove useful to all who wish to obtain a clear general notion of the geological structure of the continent of Africa. Written primarily from an economic point of view, a large portion of the paper is naturally devoted to South Africa, for which territory the author pleads the urgent necessity of a thorough geological survey. For the same reason, all beds later than the Karoo receive rather summary treatment, which the pure geologist will regret. The accompanying map, on the scale of about 400 miles to the inch, is very valuable: on it the author has indicated his views on the general correlation of beds throughout the continent. The frequent blanks and queries show how much has yet to be learned of the structure of Africa; but the continual discovery of new facts tends to rapidly throw a map out of date. Ever since the preparation of this map, two important additions to our knowledge of African geology have been recorded in the *Geological Magazine*. Dr. Gregory has recorded (from the specimens collected by the Lort-Phillips expedition) the occurrence of Lower Jurassic (Bathonian) rocks, with an Indian fauna, in Somali-land, and has pointed out the bearing of this on the important question of the ancient union of India and Africa. More recently Mr. Draper has found nummulitic limestone on the coast of Gaza-land, and Mr. R. B. Newton, who has identified the nummulites, also records the presence of Upper Cretaceous fossils in the same area.

IN *Das Wetter* for February, Dr. W. Meinhardus, of Potsdam, discusses the possibility of predicting the general character of the weather for some time in advance, based upon the researches of Prof. O. Pettersson, of Stockholm, as to certain relations found to exist between hydrographical and meteorological phenomena. One of the questions dealt with by Prof. Pettersson, is whether the Gulf Stream, or its northern extension, brings the same amount of warmth yearly, or whether variations occur from year to year, and whether any connection exists between its variations and climatic conditions. With this object, he plotted the monthly means of air and sea temperatures for Norwegian stations for twenty years, and found the interesting result that the sea-surface temperature curves for the months December to April, and July to September, exhibit a similar course. A break in the continuity occurs in October and November, and again in May and June, which points to a decided change in the ocean currents at those seasons. The same characteristic is found to exist in the air-temperature in the inland parts of Sweden. From this correspondence of the air with the sea-temperature, and the continuity of the latter through whole groups of months, he concludes that it may be possible to foretell the general character of the weather for a long period in advance. If, for instance, certain conditions are found to exist in the sea-surface temperatures in December, an opinion may be formed of the coming winter and spring. Of course such predictions are quite distinct from those relating to current weather changes, which at present cannot be foretold for more than a day or so in advance. Dr. Meinhardus has extended this inquiry so as to include various stations in Germany, and has plotted the temperature means for thirty-five years. The results confirm those obtained by Prof. Pettersson in a very satisfactory manner. The probability of similar temperature changes in November and December at Christiansund, and in Hamburg, in the following quarter of the year, amounted to 85 per cent., while at inland stations a somewhat less, but still high percentage obtained.

THE address to the South London Entomological and Natural History Society, referred to in last week's NATURE (p. 515), was delivered by Mr. Richard South, the retiring president of the Society.

AN instructive paper on the geology of the Alps, recently read by Prof. T. G. Bonney before the Geologists' Association, appears in the March number of the Association's *Proceedings*. The title of the paper is "An Outline of the Petrology and Physical History of the Alps."

THE first number of a new journal, the *Zeitschrift für Criminal-Anthropologie*, has just appeared. The contents include articles on Lombroso and criminal anthropology of to-day, crime and mind disease, the handwriting of criminals, and a report on the proceedings of the fourth international congress of criminal anthropology, held last August at Geneva. There are also notes on current literature, and reviews of books which come within the scope of the journal. The general editor is Dr. Walter Wenge, and the publisher is A. Priber, Berlin.

JUDGING from the very interesting paper on "The First Crossing of Spitsbergen," in the April number of the *Geographical Journal*, Sir W. Martin Conway's forthcoming book will be an attractive as well as instructive contribution to geographical and geological literature. The general results of the expedition, of which Sir Martin Conway was the leader, have already been described in these columns (vol. liv. p. 437, 1896), and some idea will have been gained of their value from many points of view, particularly on account of the flood of light they throw upon vexed problems of glacial geology. Many remarkably fine illustrations of glaciers and moraines, and a large sketch map of part of Spitsbergen, accompany Sir Martin Conway's paper.

A MEMOIR, by Mr. Alexander McAdie, on the "Equipment and Work of an Aero-physical Observatory," has been published as No. 1077 of the Smithsonian Miscellaneous Collections. The memoir was awarded honourable mention and a bronze medal, in the Hodgkins Fund Prize Competition. The subjects discussed are the known properties of atmospheric air considered in their relationships to research in every department of natural science, and the importance of a study of the atmosphere considered in view of these relationships. Mr. McAdie also points out the proper direction of future research in connection with the imperfections of our knowledge of atmospheric air, and the conditions of that knowledge with other sciences.

FOR the past eleven years Prof, H. G. Seeley, F.R.S., has, through the medium of the London Geological Field Class, done much to impart a practical knowledge of the physical geography and geology of the Thames district. Nature must be looked in the face if her character is to be understood; and it is to give students an opportunity of thus viewing her directly, while her physiognomy is read, that the Class was founded. The teaching is given by Prof. Seeley during excursions made on Saturday afternoons, between the beginning of May and the middle of July. The twelfth annual course will commence on May 1, with an excursion to Leith Hill. Particulars of this and other excursions may be obtained from the honorary secretary, Mr. R. Herbert Bentley, 43 Gloucester Road, Brownswood Park, South Hornsey, N. All London students of the elements of geology should take advantage of the systematic course of teaching in the open country offered by the London Geological Field Class.

MR. S. G. NEWTH, of the Royal College of Science, has invented a little instrument for use in the detection of potassium compounds by the flame test, in the place of the indigo prism. Owing to the fact that indigo transmits the red rays given by lithium, strontium, calcium and barium compounds, as well as the red of potassium, salts of those metals, when heated in a Bunsen, while the flame is examined with an indigo prism, are mistaken for those of potassium. Mr. Newth's instrument, however, not only absorbs the green and yellow portions of the spectrum, but also the red, very nearly as far down as the potassium line, and quite beyond the red lines of lithium, strontium, calcium and barium. It is therefore opaque to the red light given by these metals, while being transparent to the red light of potassium; and it thus allows of the certain detection of potassium in the presence of any of these metals, or of sodium. A patent has been applied for, and the instrument will shortly be put on the market.

NEW editions have been received of the following works:—Bourne's Insurance Directory, by William Schooling (London: Effingham Wilson). This trustworthy and valuable statement of the positions of insurance companies, and their comparative advantages, should be seen by all who are interested in assurance or actuarial affairs.—"Appearance and Reality: a Metaphysical Essay," by Dr. F. H. Bradley. Second edition. (London: Swan Sonnenschein and Co.). The author describes his work as "a more or less desultory handling of perhaps the chief questions in metaphysics. . . . This volume is meant to be a critical discussion of first principles, and its object is to stimulate inquiry and doubt."—"Les Femmes dans la Science," by A. Rebière. Second enlarged and revised edition. (Paris: Libraire Nony and Co.). The first edition of this book was reviewed in NATURE of July 19, 1894 (vol. l. p. 279). Many new names have been added, and some, perhaps, have been inserted without sufficient discrimination; while the information about several of the ladies whose names adorn the pages is often very meagre. The book now includes the names of women who may be termed scientific amateurs, *collaboratrices*, and *protectrices*, as well as of genuine workers. Notwithstanding this, the volume is an interesting monument to the genius of women; and the portraits and autograph letters add to its attractiveness.

THE valuable work carried on under the direction of Prof. S. A. Forbes, upon the Illinois River and its dependent waters, has often been noted in these columns. The general object of the biological experiment station of the University of Illinois is to study the forms of life, both animal and vegetable, in all of their stages, of a great river system, as represented in carefully selected localities. How well this object has been attained may be seen from the Biennial Report just received, together with various bulletins of the Illinois State Laboratory of Natural History containing accounts of zoological investigations made at the station. The publications amount in all to some three hundred pages of text, with sixty plates. In one of the papers Dr. C. A. Kofoid describes in detail the methods and apparatus used in "plankton" observations at the station. This term is applied to all plants and animals floating free in water, and incapable by their own efforts of materially changing their position. Prof. Frank Smith has devoted particular attention to a study of oligochæte worms (earthworms and their allies) found in and about the Illinois River and other waters near Havana. The collections made comprise about thirty species, several of which are new. A full report upon the Oligochæta is in preparation. In a valuable contribution, Mr. C. A. Hart gives an account of observations of the insect fauna of the Illinois River and adjoining waters; his paper fills one hundred and twenty-five pages, and, as an example of work done during the first year of the station's establishment, it is very creditable. Mr. Adolph Hempel describes new species of Rotifera and Protozoa. About ninety species of Rotifera and eighty species of Protozoa have been collected upon the Illinois River. Among the Rotifera there are three presumably hitherto undescribed species of the genus Brachionus. From the papers we have named, it will be evident that the Biological Experiment Station of the University of Illinois has more than justified its existence. If evidence is needed in support of the scheme for the establishment of fresh-water biological stations in Great Britain, it will be found in the papers to which reference has been made.

THE reaction of ferric chloride, potassium chlorate and hydrochloric acid, has been carefully investigated by Messrs. Noyes and Wason, whose results are published in the current number of the *Zeitschrift für physikalische Chemie*. The change is of special interest, because it is the first satisfactory case of a reaction of the third order, in which three different substances are concerned. Hood had previously stated that in presence of excess of acid the reaction is of the second order, its velocity being proportional to the product of the concentrations of the ferrous chloride and of the potassium chlorate. When the concentration of the hydrochloric acid is varied it is seen, however, as the authors show, that the reaction is really of the third order, and that its velocity is proportional to

the product of the concentrations of all three substances. Without making assumptions, the truth of which cannot at present be verified, it is impossible to represent the reaction by means of a chemical equation, in which the change takes place between three molecules only. Like many other reactions, it is of a lower order than would be the case if the order were determined by the number of molecules represent ed by the chemical equation as taking part in it. The cause of this simplicity remains at present unknown. The influence of temperature on the velocity of change is well represented by Van 't Hoff's well-known equation ("Études," p. 115). An increase of temperature from 0° to 10° C. increases the velocity 2·7 times; all other reactions, so far studied, are influenced to much the same extent, the effect of a rise of temperature of 10° being to increase the velocity from 2 to 3·6 times; the average number is 2·8.

THE additions to the Zoological Society's Gardens during the past week include two Californian Quails (*Callipepla californica*, ♂ ♀) from California, presented by Mr. T. M. Howells; a Black-headed Lemur (*Lemur brunneus*), a Madagascar Boa (*Boa madagascariensis*) from Madagascar, a Canarian Pigeon (*Columba laurivora*) from the Canary Islands, deposited; two Black-necked Storks (*Xenorhynchus australis*) from Malacca, two Larger Tree Ducks (*Dendrocygna major*) from India, a Ruddy Sheldrake (*Tadorna casarca*, ♂), four Tufted Ducks (*Fuligula cristata*), European, purchased.

OUR ASTRONOMICAL COLUMN.

MR. ISAAC ROBERTS ON LONG-EXPOSURE PHOTOGRAPHS.—In the current number of *Knowledge*, Mr. Isaac Roberts describes a beautiful photograph of Orion, taken by him with an exposure of seven hours thirty-five minutes, the photograph "depicting very probably the maximum of extent and detail that can be shown by aid of photographic methods." This statement, coming from one so versed in celestial photography, cannot be considered lightly, but must be carefully weighed before judgment be given. The reasons which Dr. Roberts gives for this statement are as follows: (1) The film of the negative is, in consequence of prolonged exposure to the latent sky luminosity, darkened on development to a degree that would obscure faint nebulosity and faint stars. (2) Longer exposures of the plates would not reveal additional details of nebulosity, nor more faint star images. Dr. Roberts goes on to say that, although he has taken all precautions to protect the plates from extraneous light, to photograph only on clear evenings, &c., yet the longer the exposure the darker the film becomes in the development of the images. The sequence, he states further, has been observed for many years on all very sensitive films which have had long exposure, and the results have been practically invariable. An important point, favouring Dr. Roberts' statement, is that the unexposed margins of the films do not undergo this process of being darkened, but remain perfectly clear. The point raised by him is one well worth consideration in these days of long exposures; and although the evidence he brings together is strong, yet we hope he has not proved his case.

VANADIUM IN SCANDINAVIAN RUTILE.—For producing the spectrum of titanium, Prof. B. Hasselberg used titanic acid in the form of rutile in the electric arc, finding that it was more suitable than commercial titanium. This rutile came from Krageröe, in Norway, its other chief component, besides titanic acid, being oxide of iron, in a quantity of about 1 or 2 per cent. The spectrum obtained from this substance, after the elimination of known impurities, was thought at first to be pure titanium, but it was found "that among the fainter and faintest lines of my titanium spectrum there are several that doubtless belong to *vanadium*." A re-examination of a large piece of the latter, and subsequent comparison photographs of vanadium and rutile, exhibited many striking similarities. Another kind of rutile was put to the same test. This was Swedish rutile from Käringbricka, in Westmanland, which contained chromium in addition. A comparison photograph of the spectra showed hat the same series of coincidences was found as in the case of the Norwegian rutile, as Prof. Hasselberg shows in the table of his results, given in the *Astrophysical Journal* for March (No. 3). Further spectroscopic experiments suggested that the Swedish variety contained a greater amount of vanadium than the Norwegian; but whether the difference is sufficient to be recognised, or determined quantitatively chemically, remains uncertain.

COLUMBIA UNIVERSITY OBSERVATORY'S PUBLICATIONS.—In the two numbers (10 and 11) of the Contributions of this Observatory, Prof. Harold Jacoby presents two communications on (1) the reduction of stellar photographs with special reference to the Astro-photographic Catalogue plates, and (2) on the permanence of the Rutherfurd photographic plates. The first paper has been written at the request of Dr. Gill, who asked him to put together the formulæ which seemed best for the reduction of the Astro-photographic Catalogue plates. Prof. Jacoby acknowledges the work of others on the subject, and the method he gives is suitable for the reduction of any photographic plates, whether the programme of the Permanent Committee has been adopted or not. The only restrictions are that the centre of the plate must be more than 15° from the pole, and that the plate does not cover more than two square degrees. A description of the method would be too long to give here, so we will confine ourselves to the statement that Prof. Jacoby's formulæ greatly facilitate the computation as a whole. As an illustration of the method of reduction, he gives a fully worked-out example of a plate taken at Paris in 1891, and discussed by M. Prosper Henry. The second communication, dealing with the permanence of the Rutherfurd plates, gives the results of a comparison of the old measures of the Pleiades and those quite recently completed. The object of the investigation was to test the durability of the photographic film, and see whether any deformation, either contraction or expansion, had occurred in the interval since the first measurement, made nearly a quarter of a century ago. The question is one of great importance, since some of Rutherfurd's photographs are still unmeasured; it has, further, a great bearing on the plates of the astro-photographic chart of the heavens. The result of the investigation can be best illustrated by extracting from the final table the figures representing the differences between the old and new measures as obtained from three separate plates. These are as follows:—

Rutherfurd Measures minus New Measures.

Star.	Plate 16.		Plate 18.		Plate 22.	
	Angle.	Dist.	Angle.	Dist.	Angle.	Dist.
	″	″	″	″	″	″
A 34	0·00	−0·12	−0·24	−0·21	+0·07	+0·26
18 *m*	− ·06	− ·06	+ ·12	+ ·05	− ·08	− ·34
A 12	− ·01	− ·18	+ ·40	+ ·14	+ ·16	− ·10
A 22	− ·04	+ ·27	− ·06	− ·08	− ·06	+ ·19
A 24	− ·02	+ ·16	·00	+ ·30	− ·13	+ ·10
A 28	+ ·08	− ·10	+ ·18	− ·13	− ·12	− ·13
A 30	− ·02	− ·01	− ·45	+ ·08	+ ·17	− ·01
A 39	+ ·41	+ ·03	+ ·14	− ·18	+ ·39	+ ·02

The conclusions that can be drawn from the whole discussion are that the positions of the individual stars on the plates may be practically determined from either set of measures, the mean error amounting to about 0″·1. Thus the new measures will furnish practically identical results with those that would have been obtained if the plates had been measured twenty years earlier.

A GIFT TO THE PARIS ACADEMY OF SCIENCES.

THE Paris correspondent of the *Times*, writing under date April 5, makes the following announcement:—

M. Berthelot read this afternoon, at the Academy of Sciences, the following letter addressed to him in French by Mr. H. Wilde,

president of the Manchester Literary and Philosophical Society, announcing to the Academy the gift of 5500*l.* to be set apart for an annual prize of 4000f. I send you the original letter, without undertaking, considering its special and technical character, to translate it :—

Diverses considérations m'engagent actuellement à me mettre en communication avec l'Académie dans le but de stimuler de nouvelles investigations dans les sciences physico-chimiques, et de faire disparaître quelques-uns des obstacles qui entravent leurs progrès. L'un de ces obstacles qui appelle la sérieuse attention des penseurs philosophes est l'invasion d'une autorité dogmatique dans une science scolastique, pour soutenir des erreurs démontrées et des méthodes erronées d'observation et d'expérience. Il sera suffisant pour l'objet que j'ai actuellement en vue de citer le système périodique des éléments chimiques comme un exemple de l'abus d'autorité dans une branche de la science où vous occupez un rang si distingué. J'ai à vous exprimer mes regrets que vos vues au sujet de la prétendue loi périodique ne soient venues que récemment à ma connaissance ; sans cela je m'y serais référé dans mes travaus généraux sur les relations numériques des poids atomiques. Quoique vous ayez clairement indiqué, monsieur, dans vos "Origines de l'Alchimie," les sophismes et les contradictions inhérents à ce système, et que vous ayez également montré que la prédiction de l'existence et des propriétés des éléments inconnus n'a aucune relation nécessaire avec la prétendue loi périodique, cependant ce système a depuis été imposé aux personnes qui s'occupent de science par les sociétés scientifiques et les corps enseignants comme une vérité natureile d'une autorité indiscutable.

Je n'ai pas besoin de vous rappeler que l'état actuel de la chimie théorique en raison de la connaissance formelle de ce dogme est réellement déplorable. Les savants qui aspirent à se distinguer dans la chimie et dans la physique estiment qu'il est nécessaire de donner des preuves de leur croyance personnelle, en tâchant de montrer la correlation de leurs propres travaux sur des points particuliers avec le système périodique, et ils évitent toute référence aux proportions multiples des poids atomiques, comme à une dangereuse hérésie. Beaucoup de ces néophytes, de même que certains auteurs de manuels, ne peuvent se fair une idée, ou ignorent la signification de l'idée de la périodicité telle qu'elle est définie par De Chancourtois, Newlands et Mendeleief dans leurs mémoires respectifs. Ils appliquent l'expression impropre de loi périodique à la progression de propriétés antérieurement commes observables dans les familles naturelles des éléments, à la correlation avec les poids atomiques de propriétés physiques et chimiques établies depuis longtemps, à la progression bien connue des propriétés physiques dans les séries homologues des composés organiques. Par suite, le danger pour les progrès futurs de la chimie théorique est que, lorsque l'idée illusoire d'une spiro-périodicité des propriétés analogues des éléments sera universellement abandonnée, le nom impropre de loi périodique est exposé à prendre dans la science un caractère narasite de la même facon que cette autre expression impropre, "esprit lunatique," avec ses dérivés, subsiste encore dans la civilisation moderne comme une survivance de la physiologie mentale barbare des âges passés.

Heureusement pour l'avenir de la philosophie chimique que l'esprit de Dumas vit encore dans les esprits de la plupart des chimistes français, qui ne reconnaissent aucune autre autorité que la vérité de la nature telle qu'elle se présente à l'entendement, et qu'ils sont par là exempts de l'illusion de la prétendue loi périodique. En reconnaissance des nombreux profits que j'ai retirés de la science française, tant pure qu'appliquée, j'ai l'honneur d'offrir à l'Académie la somme de 5500*l.* (137,500f.) pour être placée en rente française, et l'intérêt provenant de cette somme devra être appliqué à la fondation d'un prix de 4000f. à décerner tous les ans à l'auteur d'une découverte ou d'un ouvrage quelconque en astronomie, physique, chimie, minéralogie, géologie, et mécanique, qui, au jugement de l'Académie, sera jugé le plus méritant. L'attribution de ce prix sera internationale et pourra être retrospective.

Alderley Edge, Cheshire, 15 Mars, 1897.

The gift has given great satisfaction at the Academy, and is as much to the honour of the donor as to that of the distinguished secretary of that Academy, whose work is referred to in such terms of gratitude.

THE THEORY OF OSMOTIC PRESSURE.[1]

AS osmotic theory is now attracting general attention in this country, it seems desirable that all the positions that are maintained in regard to it should be clearly set forth. The excuse for offering the following remarks is that for some time I have paid attention to the subject in its relations to general molecular theory, both in the thermal and the electrical aspects. I fail to recognise how the validity of the thermodynamic basis of the law of osmotic pressure can be shaken ; and though the idea of ionic dissociation in solutions is an additional hypothesis which must be judged separately by the extent of its agreement with the facts, it appears to me that in some form—possibly not at all in the chemical imagery with which it is at present often associated—it holds the field. It is difficult, in fact, to see how the hypothesis that the same chemical element can have different valencies in different series of compounds, which is now usually accepted, is fundamentally any whit less parodoxical than the hypothesis of ionic dissociation ; anything that throws light on the one must also illuminate the other.

In his recent note on this subject, Lord Kelvin[2] appears to allow, within certain limits, the cogency of the argument which bases the law of osmotic pressures on Henry's empirical law of solubility for gases ; an argument which has recently been carefully re-stated by Lord Rayleigh, having previously been employed, as he remarks, in forms more or less explicit, by van 't Hoff, Nernst, and other investigators. The connection thus established, however, hardly amounts to a physical demonstration, because it only deduces one empirical relation from another. Yet it seems desirable to draw attention to the fact, which I have not seen anywhere remarked, that this method had been employed by von Helmholtz in 1883, some time before van 't Hoff announced his theory of the correlation between osmotic and gaseous pressures ; and that the principles given by him in an investigation of the work-equivalent of gaseous solution, made in connection with the theory of galvanic polarisation,[3] involve in fact an implicit prediction of the osmotic law. This circumstance, that the law of osmotic pressure as regards dissolved gases is tacitly involved in von Helmholtz's equations, does not, of course, confer on him a position in the actual development of the subject.

But the theory of osmotic pressure can, I think, be placed on a purely abstract basis, independently of the law of solubility of gases, which would then assume the form of a deduction from it. The broad principles on which this is to be done have been in fact laid down, in a precise but very general manner, and without special applications, by Willard Gibbs as early as 1875, in his fundamental development of the laws of mechanical availability of energy.[4] The following position is, I believe, sound. Each molecule of the dissolved substance forms for itself a *nidus* in the solvent ; that is, it sensibly influences the molecules around it up to a certain minute distance, so as to form a loosely-connected complex, in the sense not of chemical union but of physical influence. The laws of this mutual molecular influence are unknown, possibly unknowable ; but provided the solution is so dilute that each such complex is, for very much the greater part of the time, out of range of the influence of the other complexes (as, for instance, are the separate molecules of a free gas), then the principles of thermodynamics necessitate the osmotic laws. It does not matter whether the nucleus of the complex is a single molecule, or a group of molecules, or the entity that is called an ion ; the pressure phenomena are determined merely by the number of complexes per unit volume.

To determine the osmotic forces, we must know the change in *available* energy that is involved in dilution of the solution by further transpiration of the pure solvent into it. In finding that change, the laws of mutual action between molecules of the dissolved substance are not required ; for there is actually no action between them, and as soon as the solution becomes so concentrated that such mutual action between the complexes comes in, the theory is no longer exact. Nor are the laws of mutual action between the molecules of the dissolved substance and

[1] Read before the Cambridge Philosophical Society, January 25, by J. Larmor, F.R.S.

[2] *Proc.* R.S. Edin., January ; NATURE, January 21, p. 272.

[3] H. von Helmholtz, "Zur Thermodynamik Chemischer Vorgänge, iii." in Collected Papers, vol. iii. pp. 105–114, especially his equation (4) and the theory of diffusion at the end. [The theory had already been given explicitly in 1876 by Willard Gibbs, *loc. cit. infra*, p. 227.]

[4] *Trans.* Connecticut Academy, November 1875, p. 138 : "Effect of a Diaphragm Equilibrium of Osmotic Forces)."

those of the solvent required, because the effect of transpiration of more of the solvent into the solution is not in any way to alter the individual complexes. The change in available energy of the system, on dilution, thus solely arises from the expansion of the complexes into a larger volume; and it can be traced into exact correlation with the change of available energy that occurs in the expansion of a gas. This argument meets the objection that a true theory should involve a knowledge of the molecular actions between the various molecules. It would seem that with just the same cogency it might be argued that a real investigation of the connection of the alteration of the freezing-point of a liquid by pressure, and its change of volume on freezing, should involve a knowledge of the individual molecular actions in the liquid; and so it would, had we not the means of evading molecular considerations that is afforded by Lord Kelvin's great principle of availability, which is for this very reason at the basis of all physical theory.

There is, however, one point to be remembered, namely, that the theoretical osmotic pressure is a limiting value which may not be reached by an actual arrangement, unless we can be certain that it works reversibly, and so without heating effects.

The remark has been made by Lord Kelvin, that the connection between Henry's law and the osmotic law must break down when the solution of the gas is accompanied by change in its state of molecular aggregation. It is also probable, from the fundamental ideas as to dissociation and aggregation, that such change would usually be partial, and not uniform over all the dissolved molecules; so that it is not to be expected that Henry's law would, in such circumstances, hold good. The point in which the argument, as set forth in precise form by Lord Rayleigh (NATURE, *loc. cit.* p. 254), becomes then inapplicable, is that the gas expelled from solution by the osmotic process must be considered as emerging in the actual state of aggregation differing from that of its free condition, and its return to the latter state involves further change of available energy.

If the considerations above stated, which will be most suitably developed in detail in another connection, are valid, it follows that Prof. Poynting's recent suggestion (*Phil. Mag.*, October 1896), with a view to evading the necessity of the ionic dissociation hypothesis, cannot avail, as it would not lead to the desired value for the osmotic pressure; that pressure depends on the number of molecular complexes involving the dissolved substance, that exist in the dilute solution, but not on their individual degrees of complexity.

THE OSTRICH.[1]

THE ostrich, *Struthio camelus*, has been observed with interest from very early times; it has frequently been the subject of remark by African travellers; and it has been domesticated and farmed in the Cape Colony for some thirty years. Yet it is remarkable how little is known about it in scientific circles, and how many misconceptions still prevail as to its nature and habits.

This article is founded on personal observations made during nine years of uninterrupted ostrich-farming in the Karroo of the Cape Colony, and during travels about the country generally. In large ostrich camps, some of which are a couple of miles in diameter, numbers of birds of both sexes run in what is practically a wild state, seldom interfered with in any way, except when rounded up to be plucked or to be fed in a drought. The habits of birds thus farmed differ in no way from those of native wild birds, except perhaps that monogamy is more difficult.

NUMBER OF SPECIES

All the differences on which the arguments for classifying the ostrich into three species are founded, are commonly present among the ostriches of the Cape Colony—that is, of South Africa generally; for a great many of the Cape ostriches are the progeny of birds brought down from "The Interior"—the Kalahari Desert, Damaraland, and beyond. There is, I think, little doubt that all South African ostriches are of one species; individual variations, accentuated by local differences of food and climate, are quite sufficient to account for all supposed varieties. I do not think that, on the evidence which I have been able to gather, there is any justification for maintaining that there is more than one species of ostrich.

[1] Abridged from a long article, by S. C. Cronwright Schreiner, in the March number of *The Zoologist*.

THE EGG OF THE OSTRICH.

The ostrich hen lays every other day, and the egg weighs about three pounds; it is a tasty and nutritious food however prepared, very rich, and excellent for making pastry and cakes. It is generally computed to be equal to two dozen fowls' eggs; but this must be on account of its superior richness, for, from personal experiment, the empty shell of a fairly large one exactly held the contents of eighteen fowls' eggs. It takes about forty minutes to boil an ostrich egg hard. The period of incubation is about six weeks.

LEAPING AND SWIMMING.

The old idea that an ostrich can only leap over a very low fence, or across but the narrowest sluit (gully), is incorrect. The birds will, when startled (never deliberately), sometimes go over a six-strand wire fence nearly five feet high, putting one foot on one of the middle wires, and striding over with the other. They will go over a stone wall in the same manner, if too high for them to step upon; and I have seen a cock take a standing jump on to the top of a wall five feet high, beyond which were his chicks.

Even as a chick the ostrich is a powerful swimmer. I have known several birds swim some distance down the Great Fish River when it was running fairly strong, and have heard, on what seems trustworthy evidence, of a cock that was carried a long way down the same river when it was running nearly level with its precipitous banks in the stormy season; he was some hours in the water before he could get out, but emerged unhurt.

HOW IT FEEDS, AND WHAT IT WILL SWALLOW.

The ostrich feeds in a peculiar manner. It tosses the food into a sack in the upper part of the neck, and then swallows it. I have seen a bird toss fully a quart of mealies (Indian corn) into this sack before swallowing; and it is no uncommon thing to see two "swallows" travelling down the neck at the same time with a clear interval between them; or to see one of them (if of large and loose food, *e.g.* grain) slide back into the sack after being swallowed, if the bird lowers its head to continue feeding before the food has travelled some considerable distance down the neck. The food travels slowly, and performs a complete circuit of the neck before reaching the crop. Crushed bones are greedily eaten; if too large a piece should stick in the neck, it is a simple matter to cut it out and sew the wound up again. The wound, as a rule, heals quickly, and causes but little inconvenience. As is well known, ostriches will swallow almost anything small enough to pass down the neck. An ostrich's crop always contains a large quantity of smooth stones, many of them brightly coloured.

HOW THE OSTRICH RUNS.

Considerable misconception prevails as to the manner in which the ostrich runs. It seems to be still generally held that, when running, it spreads out its wings, and, aided by them, skims lightly over the ground. This is not correct.

When a bird really settles itself to run it holds its head lower than usual, and a little forward, with a deep loop in the neck. The neck vibrates sinuously, but the head remains steady, thus enabling the bird, even at top speed, to look around with unshaken glance in any direction. The wings lie along the sides about on a level with, or a little higher than, the back, and are held loosely just free of the plunging "thigh." There is no attempt to hold them extended, or to derive any assistance from them as organs of flight.

When an ostrich, after a long run, is very tired, its wings sometimes droop; this is due to exhaustion; they are never, by a running bird exerting itself to the utmost, held out away from the sides to lighten its weight or to increase its pace. But the wings appear to be of great service in turning, enabling the bird to double abruptly even when going at top speed.

THE NEST.

As the breeding season approaches, a cock and hen will pair, and, having selected a site congenial to their inclinations,

proceed to make a nest. I believe that in all cases, in the first instance, one cock and one hen, having paired, select the site and make the nest.

The nest is simply a hollow depression, more or less deep according to the nature of the soil. It is made by the pair together. The cock goes down on to his breast, scraping or kicking the sand out backwards with his feet, cutting the earth with his long and powerful nails. The hen stands by, often fluttering and clicking her wings, and helps by picking up the sand with her beak, and dropping it irregularly near the edge of the growing depression.

LAYING AND SITTING.

When satisfied with their work (and they are easily satisfied, often too easily) the hen begins to lay an egg in the nest, every other day. During the laying period the nest is often unattended, and is not slept on at night. A nest in which only one hen is laying contains on the average about fifteen eggs; but she often begins to sit before she has laid her full complement. Sometimes she will lay four or five after beginning to sit, though not often so many; sometimes only one or two; while sometimes she will lay her full complement. The hen generally begins the sitting; she will occasionally sit for one or two days and nights before the cock takes his turn. When sitting assumes its regular course, the hen sits from 8 or 9 a.m. to about 4 p.m., and the cock from 4 p.m. to about 8 or 9 a.m. The bird whose turn it is to be on the nest keeps its seat until the other arrives to relieve it, when they at once change places.

It is quite incorrect to say that the cock alone sits, or that during the day the eggs are left to the heat of the sun. The cock and hen sit alternately, regularly and steadily, night and day, during the whole period of incubation.

PROTECTIVE COLOURATION.

The colour of each is admirably adapted to the time spent on the nest, and furnish interesting examples of protective colouration. It is scarcely possible to conceive a more effective disguise than the sober brownish grey of the hen for day sitting, and the black of the cock for night. When on the nest, the ostrich lays its head, neck, and tail flat along the ground; its naked "thighs" are covered by the wings, the plumes lying close together on the earth almost hidden against the bird's body. Thus only the low, long-curved body projects above the surrounding level. The cock, at night, is, of course, almost perfectly hidden; while the hen, at day-time, closely resembles a stone, bush, ant-heap, or any little inequality of the veld. One is surprised to see how close such a large bird can lie to the ground, and how even an ostrich-farmer may almost walk over a sitting hen in full daylight without seeing her. The cock is simply indistinguishable at night, except to a practised eye, and then only at a few yards distance.

IS THE OSTRICH POLYGAMOUS?

Every authority that I have consulted holds that the ostrich is polygamous, but the evidence against polygamy is very strong: a pair make the nest; the hen lays all her eggs (a full sitting) in that nest; the hatching of the eggs and the care of the chicks are shared equally by cock and hen; the cock loses his sexual vigour and ceases his attentions to the hen, soon after beginning to sit; and one hen to a nest yields the best results.

I do not, however, think it can be maintained that the monogamy of the ostrich is proved absolutely, but I decidedly think that the arguments in its favour are much stronger than those in support of polygamy.

CURIOUS AND EXCEPTIONAL RELATIONS.

Finally, it must be allowed that, while all the facts at my command point strongly to the conclusion that the ostrich is not only often monogamous, but that monogamy is the only condition perfectly favourable to the successful hatching and rearing of young; and that all the arguments in favour of polygamy break down on examination: yet the fact remains that there are a large number of curious and exceptional circumstances connected with the nidification, sexual relations, and parental habits of ostriches that I am not yet exactly able to account for, either on the supposition of fully organised monogamy or polygamy.

NATIONAL MEMORIAL TO JENNER.

THE meeting held on Wednesday, in last week, gave coherence to the scheme for raising a national memorial to Edward Jenner, in celebration of the centenary of the discovery of vaccination. "It was surely high time," said the Duke of Westminster, who presided over the meeting, "that this his native land should rise to the occasion, and at last, after 101 years have passed since the first successful vaccination, take active and effective steps to carefully preserve his great legacy to the world, and to do more—to give every facility for the promotion of science in the direction of the prevention of diseases that afflict mankind." Lord Herschell, in moving the first resolution—"That the present is an appropriate time to inaugurate a work of national utility in honour of Edward Jenner," pointed out that Jenner was the first to illustrate a principle which seemed destined to play an important part in the history of preventive medicine. Surely this alone is a high tribute to Jenner and the value of his discovery. His name is held in reverence by the highest men of science and the most civilised countries in the world. Some of these countries have already commemorated his centenary. Are Englishmen to be behindhand in testifying their admiration of the man, and their sense of the benefits he has conferred on humanity? The resolution was seconded by Prof. Michael Foster, who gave instances of the extension of the Jennerian principle to other diseases by Pasteur and other observers. Sir Alfred Lyall, in supporting the resolution, referred especially to the blessings which vaccination had already conferred upon the people of India. The resolution was then carried unanimously.

Lord Lister moved the next resolution:—"That a subscription be set on foot with a view of promoting, in connection with the British Institute of Preventive Medicine, but in a manner distinguished by Jenner's name, researches on the lines which he initiated." In speaking to the resolution (reports the *British Medical Journal*), Lord Lister referred to a mistake in his address to the British Association at Liverpool. The statement was to the effect that smallpox was unknown in the German army as a result of the revaccination of all recruits. If he had stated that fatal smallpox was absolutely unknown in the German army, it would have been the literal truth. A recent instance of the application of the principle discovered by Jenner was Dr. Koch's discovery that by using the bile of an animal which had died of rinderpest to inoculate a healthy animal, that animal was rendered immune to the pestilence for some months at least, time could alone decide for how long. This was an exact parallel to the discovery of Jenner, and the simplicity of the method was such that it places in the hands of any farmer the possibility of protecting the whole of his herd on the appearance of the first case. Another example was the work now being done in India with regard to plague. Two such examples, both taken from a period so recent, and so brief, were sufficient to prove the practical importance of work of this kind. And it was such work which the British Institute of Preventive Medicine was doing. That Institute had been the first in this country to supply the diphtheria antitoxic serum, the use of which had effected so remarkable a reduction in the mortality of the disease in those cases in which it could be employed early. The Institute had never ceased to improve the serum, until that which was issued now had six times the curative power of that first employed. The Institute also prepared tuberculin, which was capable of rendering such important services to the public health by facilitating the early diagnosis of tuberculosis in cattle; and mallein, which rendered similar services in the case of glanders. The Institute might claim, therefore, to be a work of utility, and it was a national institution, for it had upon its governing body representatives of public bodies in all three kingdoms. Thanks to the generosity of their Chairman, the Institute was in possession of a site upon which, owing also in part to his generosity, it had now nearly completed the erection of a suitable building for carrying on its work. But its income was only some 700*l.* a year; the scope of its work was thus cramped, its officers, who gave their services in the true spirit of scientific devotion, were inadequately remunerated, and, unless a large measure of public support was accorded, the full benefits which the Institute was capable of rendering to the country could not be realised. If the response to the movement inaugurated by that meeting was as liberal as it should be, the Council of the Institute were prepared to agree that its name should be changed to that of the "Jenner Institute." If the response were less generous, they might still hope that the sum received would be sufficient to

found a Jenner professorship of bacteriology, and in addition, or as an alternative, of a Jenner scholarship.

The resolution having been briefly seconded by Lord Davey, and supported by Mr. Brudenell Carter, was put to the meeting and carried unanimously.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. H. M. Vernon, of Merton College, has been elected Radcliffe Travelling Fellow for the year 1897. Mr. Vernon took a first class in the Natural Science School in 1891.

EX-MAYOR WILLIAM R. GRACE, of New York City, and his wife and daughter have given two million dollars to establish in that city a school of manual training for women and girls.

THE first Huxley medal and prize of 10*l.*, open to students of the Charing Cross Hospital Medical School at the end of their second winter session, has been awarded to Mr. Arthur Gentry Pitts. The awards were founded last year, in memory of the late Prof. Huxley—a former student of the school.

IT has been decided that the memorial to the late Rev. William Rogers shall take the form of a physical laboratory, to be erected and fitted up in connection with the Charterhouse Schools, which were inaugurated by the Prince Consort, and were the first schools with which Mr. Rogers was connected on his entry into parochial work in London.

THE state of chemical industries in Germany, France and England, and the position of chemistry in higher education, forms the subject of an article, by M. M. A. Haller, in the *Revue Générale des Sciences* for March 30. Referring to the efforts which are made in this country to obtain a fuller recognition of the value of chemistry to manufactures, the author says: "Industriels et Professeurs prennent part à cette campagne, sans que les pouvoirs publics s'émeuvent." It is this lack of interest shown in scientific matters by State authorities that astonishes men of science on the continent.

BY the will of the late Mr. John Crerar, of Chicago, who died October 19, 1889, the residue of his estate, after the payment of numerous bequests, both private and public, was given for the creation and endowment of a free public library, to be called the John Crerar Library, and to be situated in the city of Chicago. Having sympathetically reviewed the library section of John Crerar's monumental will, and carefully considered the library facilities and needs of the city, the directors unanimously decided to establish a free public reference library of scientific literature. This library was opened on April 1. Its special field is that of the natural, the physical, and the social sciences, with their applications, the adopted classification being into general works, social sciences, physical sciences, natural sciences, applied sciences. The directors propose, however, to make the library exceptionally rich in scientific periodicals, American and foreign. The total endowment is estimated to be over 2,500,000 dollars, and the income should be sufficient ultimately to allow the making of a good collection within the proposed limits. At present the library has 15,000 volumes ready for use, and nearly 7000 more in process of preparation. The number of periodicals in the reading-room is 800, with 400 others to be added. By the end of 1898 it is expected that there will be 40,000 volumes on the shelves.

THE following are among recent announcements:—Dr. A. F. Dixon, senior demonstrator of anatomy at the School of Medicine of Dublin University, to be professor of anatomy at the University College of South Wales and Monmouthshire, Cardiff, in succession to Prof. A. W. Hughes, now professor of anatomy in King's College, London; Dr. Classen, of the Polytechnic Institute at Aachen, to be professor of chemistry in the University at Kiel; Dr. A. Palladin to be professor of plant anatomy and physiology at the University of Warsaw; Dr. de Vries to be professor of geometry in the University of Utrecht; Prof. von Kries, who had been offered the chair of physiology in Berlin in succession to Dr. du Bois Reymond, has decided to remain in Freiburg; Dr. Ernst Gaupp to be associate professor of embryology at Freiburg; Dr. Wernicke to be associate professor of hygiene at Marburg; Dr. Karl Bohlin, of Upsala, to be director of the Stockholm Observatory; Dr. James Clark to be professor of agriculture at the Yorkshire College, Leeds, in succession to Prof. James Muir; Dr. Karl Fütterer to be associate professor of mineralogy and geology in the Polytechnic Institute at Karlsruhe; Mr. Louis M. Dennis to be professor of analytical chemistry in Cornell University; Mr. Henry S. Jacoby to be professor of civil engineering; Mr John Henry Barr to be professor of machine design; and Mr. Joseph E. Trevor to be professor of physical chemistry in the same University (Cornell); Dr. Karl Kaiser to be associate professor of physiology in the University of Heidelberg.

THE *Journal* of the Society of Arts gives the following particulars with reference to the fourth meeting of the Congrès International de l'Enseignement Technique, to be held this year in London. The previous meetings of the Congress were—in 1886 at Bordeaux, in 1889 at Paris, and in 1895 at Bordeaux. The meeting will be held at the invitation of the Society of Arts, and of the Worshipful Companies of Drapers, Fishmongers, Goldsmiths, Merchant Taylors, and Clothworkers. The Congress will be opened at 11 o'clock, on June 15, by an address from the President, the Duke of Devonshire, K.G., and from the President of the last Congress, M. le President Léo Saignat. The meetings will be held on Tuesday, Wednesday, Thursday, and Friday. The subjects for discussion at the Congress will include:—Technical Education: (1) Advanced Instruction. Polytechnics, Universities, Colleges. (2) Secondary Instruction. Higher Technical Schools; Secondary and Intermediate Schools; Evening Schools. Commercial Education: (1) Advanced Instruction. Colleges; High Schools and Institute of Commerce. (2) Secondary Instruction. Commercial Schools; High Schools; Classes for Adults. It is not proposed to deal with elementary technical or commercial education. The education of both sexes will be included. The proceedings of the Congress will be reported in English. Papers intended for the Congress may be in French, German, or English, and speakers may make use of any of these languages. All communications relating to the business of the Congress should be addressed to the Secretary, Society of Arts, John Street, Adelphi, London, W.C.

CHILDREN are always interested in natural history, and with a little help and encouragement they become keen collectors and quick observers. Prof. W. A. Herdman relates, in the tenth annual report of the Liverpool Marine Biology Committee, how the aquarium at Port Erin is used as an educational influence. "For example," he says, "if a boy brings us a light-coloured shanny, caught in a shallow exposed pool, we can place the little fish in a deep vessel in semi-darkness under a table, or cover it with some brown sea-weed, the result being that when the boy comes next day to look for his specimen, he has been known to exclaim, 'Hullo! where is my shanny? There is only a black one here.' It is then easy, by putting the fish into a shallow white dish in the bright sunlight, in a short time to turn the black shanny into what he recognises as the light-coloured one he caught. You can then tell him of the beautiful pigment cells of the skin, and show them to him under a microscope in a small living fish, in a watch-glass full of sea-water. You can show him a speckled shrimp hiding in sand and a mottled shrimp in gravel, and the little prawn *Virbius*, which may be almost any colour according as you change its surroundings from green to red or to dark brown sea-weeds. You explain the difference in pigmentation on the upper and lower sides of a flat fish, you remind him of the chamæleon, tell of Lord Lister's observations on the change of colour in the skin of the frog, and—most beautiful experiment of all—show him the 'blushing' of the newly-born cuttle-fish. From this there opens up a wide range of physiology, of the influence of light and the controlling action of nerves, not to mention natural selection and evolution in general. This is only one of many examples that might be taken. Almost any of the common marine animals, if carefully watched as to structure and habits, show us interesting cases of adaptation to their surroundings and mode of life."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 4.—"Second Report on a Series of Specimens of the Deposits of the Nile Delta, obtained by Boring Operations undertaken by the Royal Society." By John W. Judd, C.B., LL.D., F.R.S., Professor of Geology in the Royal College of Science. Communicated by desire of the Delta Committee. Received February 11.

The last report on the borings undertaken in the Delta of the Nile under the auspices of the Royal Society was communicated to the Society by the direction of the Delta Committee on November 12, 1885, and published in No. 240 of the *Proceedings*. This report dealt with the materials obtained from the three borings made at Kasr-el-Nil, at Kafr-ez-Zayat, and at Tantah, which reached depths of 45 feet, 84 feet, and 73 feet respectively. Although these borings made known to us the character of the delta deposits at greater depths than the explorations made by Mr. Leonard Horner and M. Linant de Bellefonds, yet none of them succeeded in reaching the solid rock on which these deposits lie, and in which the Nile Valley was originally excavated. It was therefore decided by the Delta Committee to make still more strenuous efforts to attain this result.

In their attempts to carry out this important work, the Delta Committee have received the most valuable aid from the Secretary of State for War, the Inspector-General of Fortifications, and the officers of the detachment of the Royal Engineers attached to the Army of Occupation in Egypt.

Zagazig having been chosen as a suitable site for the next attempt to penetrate the delta deposits, a boring with a 5-inch tube was carried down to 97 feet, with a 4-inch tube to 190 feet 6 inches, and with a 3-inch tube to 345 feet.

From the surface to a depth of 115 feet the strata passed through in the Zagazig boring closely resembled those already reported upon as occurring in the three earlier borings of Kasr-el-Nil, Kafr-ez-Zayat, and Tantah, and consisted of alternations of desert-sand and Nile-mud.

At the depth of 115 feet a very noteworthy change was found to occur in the characters of the beds passed through, a mass of coarse sand and shingle being met with, and this continued to the depth of 151 feet. At the latter depth a band of yellow clay 2 feet thick was passed through, and under it sand and shingle beds prevailed till the lowest depth reached, 345 feet. In some of these shingle beds the fragments, which were usually well rounded—often, indeed, perfect pebbles—were very coarse, the fragments being of all sizes up to that of a hen's egg.

It is interesting to note that a boring made at Rosetta in the summer of 1885 by Mr. T. E. Cornish, C.M.G., Director of the Alexandria Waterworks, gave a section very similar to that at Zagazig. This boring was carried down by a 5-inch tube. Various beds of sand and mud, the latter containing in some places impure lignite, occurred down to the depth of 143 feet 8 inches from the surface, but at this latter depth a mass of "coarse sand and pebbles" was found, which was followed down for about 10 feet.

It will thus be seen that in the case of the Zagazig boring we find at the depth of 115 feet 8 inches (89 feet below sea level) a sudden change from the blown sand and alluvial mud of the Nile delta to masses of shingle and sand, and that the same change is found to take place at the Rosetta boring at a depth of 143 feet 8 inches (134 feet 4 inches below sea level). That these shingle beds were deposited under totally different conditions to those which prevailed while the delta deposits were laid down, and that they were in fact the product of ordinary fluviatile action, can scarcely be doubted, and the determination of the geological age of the great gravelly deposit which is now shown to underlie the modern delta deposits, and to attain depths which certainly in places exceed 230 feet, becomes a problem of the greatest importance and interest.

That the surface of these old gravelly deposits is a very uneven one is indicated by the difference of depth at which it is found at Rosetta and Zagazig respectively. It is possible, indeed, that this gravelly floor may in places rise through the whole of the Nile deposits, and form the present surface of the country. The late Sir Samuel Baker, in a letter addressed to the Delta Committee on February 20, 1886, called attention to the existence of the so-called "turtle-backs," which he regards as interesting proofs of "the pre-existence of desert, before the Nile deposit had converted the lower level into delta."

In spite of the most careful search, not a single organism has been found which lived when the shingle beds were deposited, and which would serve to throw light on the geological period to which they must be assigned. As, however, it was of considerable interest to determine the source of the various pebbles making up the deposit, which we may conveniently speak of as the "Sub-delta formation," I placed myself in communication with Dr. Karl von Zittel, of Munich, who possesses such a unique knowledge of the rocks and fossils of North-eastern Africa. In his obliging communication, he has indicated the probable source of the pebbles which I forwarded to him, and writes as follows:—

"The quartz and chalcedony pebbles, from depths of 120, 160, 245, and 270 feet, are almost absolutely pure examples of those rocks. The sandstones (for example, those from the depth of 120 feet) rather recall, in their general appearance, the Tertiary Sandstone of Gebel Achmar, near Cairo, than the older (Cretaceous) Nubian Sandstone of Upper Egypt. The quartz and chalcedony pebbles, before referred to, might also be derived from the Gebel Achmar Sandstone. The absence of limestone pebbles is striking; it would appear that only the harder rocks have been preserved in the gravels of the Delta, the softer ones having been possibly worn away."

With respect to the igneous rocks found as pebbles in these shingle beds, Dr. von Zittel suggests, from their macroscopic appearance, that they may be derived "from the side valleys of the Arabian Desert." Of metamorphic rocks, quartzites, which are evidently altered sandstones, were found somewhat frequently. Many pebbles of sandstone, sometimes showing stratification and fault-structures, but destitute of organic remains, were obtained at various depths.

Pebbles of flinty limestone from various depths contain recognisable Foraminifera, and one is crowded with specimens recognised by von Zittel as "belonging to the Textularidæ, Rotalidæ, and Globigerinæ." Of these there are other specimens from a depth of 270 feet. Dr. von Zittel states:—"I hold it as probable that these pebbles come from the Eocene of the Nile valley. Flinty layers and concretions are extremely common in the Egyptian Eocene (as, for example, in Central and Upper Egypt). The absence of sections of *Nummulites* and *Alveolina* is particularly noticeable."

At the depth of 121 feet, a pebble of a somewhat different class of rock was obtained. This rock may have come from a Cretaceous deposit, and not from the Eocene, like the others.

Of the general sources from which these pebbles were derived, Dr. von Zittel writes as follows:—

"On the whole, it appears to me conceivable that these gravels under the delta originated at a time when the Nile had already formed its present valley, but not to so great a depth as at present. The majority of the rolled rock-fragments would seem not to have been derived from points extremely distant from those in which they are at present found."

There can scarcely be the smallest doubt that in this Sub-delta formation we have a series of deposits, which were formed under totally different conditions from those which prevail in North-eastern Africa at the present time. The land must have been at an elevation at least from 100 to 300 feet higher than at present; and the Lower Nile, instead of forming an alluvial flat, as at present, must have deposited coarse sands and gravels. It is upon the very uneven surface of this Sub-delta deposit that the alluvial mud and sands of the delta have been deposited, as the surface gradually subsided below the level of the Mediterranean.

The interesting problem of the geological age of this Sub-delta deposit remains to be solved, but it may be hoped that the explorations now being carried on by the Geological Survey of Egypt, under Captain H. G. Lyons, R.E., will furnish new and important evidence bearing on this important question.

It is to be regretted that the borings carried out by the Royal Society have not set at rest the doubts which have long existed as to the depth at which the solid rock-floor lies below the surface of the delta. But while this has not yet been accomplished, it is satisfactory to have been able to show that the supposed insignificant thickness of the alluvial deposits is altogether a mistake; while the existence of an underlying formation, laid down under conditions totally different to those which prevail at present, has been demonstrated.

Communications have lately passed between the English War Department, the Egyptian Public Works Department, and the Royal Society, which lead us to hope that borings, to be shortly undertaken for economic purposes, may, either with or without aid from this Society, supply the means of reaching greater depths than that obtained at Zagazig, and possibly of reaching the old floor of solid rocks on which the Sub-delta deposits rest.

Geological Society, March 24.—Dr. Henry Hicks, F.R.S., President, in the chair.—The following communications were read:—Notes on some volcanic and other rocks which occur near the Baluchistan-Afghan Frontier, between Chaman and Persia, by Lieut.-General C. A. McMahon and Captain A. H. McMahon. In the first part of this paper Captain McMahon

described briefly the physical geography of th Baluchistan deserts, which extend along the south of the Helmund River, between Quetta and Persia. Taking first the plains and their drainage-system, he showed how the wide alluvial plains of Shorawak and Chagai were probably in earlier times one large lake. North and west of these plains, as far as Persia, lie vast deserts of sand, which in places were gradually encroaching upon and burying the mountain-ranges which rise up like islands in the desert. He showed how the sand had intercepted all the drainage from the mountains and prevented it from making its way, as it would otherwise have done, into the Helmund River and the God-i-Zirreh Lake. Turning next to the mountains, Captain McMahon described a well-defined line of fault, which he traced for a distance of about 120 miles from north of Chaman, along the Khwaja Amran and Sarlat mountain-ranges to Nushki. East of this fault all the rocks appeared to be sedimentary; while those to the west were all, with few exceptions, volcanic and igneous. The mountain-ranges in the desert described appeared to be all volcanic, and reference was made to the Koh-i-Taftan, 12,600 feet high, lying south-west of them, which is still an active volcano. The curious, grotesquely-shaped peaks of the Koh-i-Sultan range were then briefly described, and especially that named Neza-i-Sultan—a gigantic natural pillar of volcanic agglomerate many hundreds of feet high. After thus describing the general character of the country, Captain McMahon pointed out the very remarkable force and activity with which certain natural agents were at present at work there—namely, water, wind, sand, and extremes of heat and cold. In the second part of the paper General McMahon described the microscopical characters of the rocks, which consist of lavas, ashes, pumice, igneous intrusive, and sedimentary rocks. In the discussion which followed, the President remarked, concerning the corrosion of basic minerals by silica, that silica might be truly a corrosive mineral, but hitherto the idea had been that the basic mineral had decomposed *in situ*, and that the silica had filled up the hollows and cracks resulting from this decomposition. Mr. Griesbach considered the paper a valuable contribution to our knowledge of Baluchistan. But, having spent some years in that part of Asia himself, he wished to point out that there is abundant evidence to show that the Pliocene deposits which are seen in Shorawak and the neighbouring Registan have not been laid down in a lake-basin, but are chiefly of a fluviatile nature. Dr. Blanford referred to the great prevalence of Tertiary and Cretaceous rocks throughout the wide area extending from the Indus to Mesopotamia. The volcanic rocks of Eastern Baluchistan, like the Deccan traps of India, appear to be of Cretaceous and Lower Eocene age; but the igneous formations near the Baluchistan and Persian frontier must be, in part at all events, of far more recent origin, some of the cones of loose materials seen by the speaker between Bampur and Bam, having undergone no change through denudation. The Rev. Edwin Hill said the pinnacle shown resembled a magnified earth pillar. Was the water which disappeared in the sand ultimately evaporated? Prof. Milne made special reference to the fault which Captain McMahon had described, and compared it with a fault which in 1891 had been formed in Japan. Mr. Cadell said that the remarkable peaks described by the author, which were said to be of agglomerate, might be explained on the supposition that these were the necks of old volcanoes, the upper parts of which, together with the surrounding strata, had been denuded away. Prof. Judd called attention to the great steep-sided masses of volcanic agglomerate which rise up in the midst of the town of Le Puy in Central France, and are crowned by the cathedral and the church of St. Michel. These seem comparable, though of smaller dimensions, to the great columnar masses described by Captain McMahon. There is no doubt that the masses of Le Puy are relics left by denudation of a mass of volcanic agglomerate that once filled the whole valley. The reason why these masses have escaped removal by denudation is probably not because they are "volcanic rocks," but because these materials have been consolidated by the action of siliceous, calcareous, or chalybeate springs. Dr. H. Woodward and Mr. W. W. Watts also spoke, and the authors replied.—On the association of *Sigillaria* and *Glossopteris* in South Africa, by A. C. Seward. In this paper the author described in detail several specimens of fossil plants submitted to him by Mr. David Draper, of Johannesburg. His conclusions as to the geological age of the plant-bearing beds differed from those arrived at by Mr. Draper from stratigraphical evidence; the plants pointed to an horizon which may be referred to what is now termed the Permo-Carboniferous age. The difficulty of distinguishing between various forms of *Glossopteris*-leaves was discussed at some length; and the opinion expressed that it is practically impossible to separate the Indian, Australian, and African forms of *G. Browniana*, *G. indica*, and others. The chief interest as regards the plants centred round the specimens of *Sigillaria*; these were fairly well preserved impressions, and were referred to the well-known species, *S. Brardi*. In addition to various forms of the genus *Glossopteris* and the specimens of *Sigillaria*, the following plants were recorded:—*Noeggerathiopsis Hislopi*, *Gangamopteris cyclopteroides*, *Phyllotheca*, *Conites* sp., *Cardiocarpus* sp., and *Sphenopteris* sp.—Notes on the occurrence of *Sigillaria*, *Glossopteris*, and other plant-remains in the Triassic rocks of South Africa, by David Draper. The author gave a brief description of the geology of four localities, within a comparatively short distance from Johannesburg, from which several fossil plants have recently been obtained. He considered the plant-bearing beds to belong to the Lower Stormberg Series of Dunn, and to the horizon known as the Molteno Beds. The most important locality described in these notes was that of Vereeniging, thirty miles south of Johannesburg, where the author found several specimens of *Sigillaria* associated with *Glossopteris* and other plants in iron-stained sandstones. The significance of this discovery of *Sigillaria* was briefly discussed. —In the discussion on the two preceding papers, Dr. Blanford said that it was a source of much gratification to those who, despite the views of many European palæontologists, had maintained for years on geological evidence that the *Glossopteris* fauna was Palæozoic, to find their contention confirmed by recent botanical discoveries. Mr. Griesbach pointed out that the fossil plants exhibited, showing true Carboniferous types associated with *Glossopteris*, constituted another and valuable contribution to our knowledge of these beds, which were known as Gondwanas in India; and they confirmed in a striking manner the fact, already accepted in India and Australia, that the lowest beds of this group of strata belonged to the later Carboniferous and Permian systems. Prof. Seeley stated that when he visited Aliwal North in 1889, Mr. Alfred Brown showed him many plants which he had obtained in white sandstone. They included *Glossopteris* and Lepidodendroid plants, together with a variety of ferns, which might be new. There was no opportunity of visiting the locality; but Aliwal North was near the top of the Karoo Series, and he though that Mr. Brown's plants might be from beds yielding *Euskelesaurus*, which he would place above the Indwe coal. There were indications of coal near the base of the Karoo and in the middle, but the workable beds which he had seen were towards the top; although their flora was not the same as in the beds worked by Mr. Brown, which resembled the types now exhibited. He should like to see better evidence of the age of the beds before admitting them as Permo-Carboniferous, because the whole of the South African vertebrata of the Karoo appeared to be below the beds which are found near Aliwal North. The Lower Karoo comprised the zone of *Pareiasaurus*. Then came the zone of *Dicynodon*. Above that is the zone of *Ptychognathus*. And at the top is the zone of the Theriodont reptiles, which he placed below the Cape coal. He had regarded all these beds as Permian. Mr. Stonier observed that in New South Wales *Glossopteris* was characteristic of the more important of the productive Coal-Measures. Feistmantel had described the Palæozoic plants; but there was a difficulty, as stated by Mr. Seward, in distinguishing forms; and in 1894 Mr. R. Etheridge, jun., pointed out that the whole question of generic name, specific characters, &c., of *Glosssopteris* had become almost hopelessly involved. *Gangamopteris* and *Glossopteris* were associated at Lochinvar and Newcastle (N.S.W.).

EDINBURGH.

Royal Society, March 15.—Lord Kelvin in the chair.—Dr. James Kerr Love, Glasgow, read a paper on deaf mutism and its prevention. He divided deaf mutism into two classes—the one caused by disease, the other due to heredity or congenital causes. Dealing with congenital deafness, a tree was shown of a family, called the Ayrshire family, where about forty deaf mutes resulted during five generations. Dr. Love's conclusions with regard to the transmission of deafness were that congenital deafness was hereditary either in the direct line, or it might be the expression of a tendency which was seen only in the collateral branches of a family. The anatomical lesions upon which deafness depended, were not one but many. The intermarriage of the deaf, therefore, only perpetuated without

accentuating the tendency. In Great Britain, the tendency to have deaf progeny was about the same, whether one or both parents were congenitally deaf. Adventitious or acquired deafness ending in mutism, was not usually hereditary. The hearing brothers and sisters of a congenitally deaf mute, were as liable when they married to have deaf progeny as the deaf themselves. Consanguinity of the parents emphasised family defects in the children, and in this way many cases of congenital deafness arose. Dr. Love asserted the right of the State to control the marriage of those who belonged to badly tainted families, and were likely to transmit deafness.—Mr. W. R. Laing communicated a note on an analysis of human gastric juice, which he had procured from a fistulous opening of the stomach. His analysis proved the presence of free hydrochloric acids.—Dr. John Murray gave the first of two papers on the structure and origin of coral reefs. He recapitulated his old theory as opposed to Darwin's, and showed that evidence since procured supported his view. A still greater number of submerged volcanic cones, which were the foundations of coral atolls, had been discovered in the coral seas. Some were rising by the accumulation of shells and various dead calcareous animals. Others were being worn down by tidal action in the same way as certain parts of the ocean bed is kept clear of mud. These facts helped his theory. The second paper will deal with the growth of the corals, and more especially with their food.—Mr. J. Erskine Murray laid before the Society a new form of constant volume air thermometer, which shows the total pressure directly, and may be graduated in degrees of temperature. The feature of the instrument is an arrangement whereby the pressure of the atmosphere is eliminated by the adjustment of an auxiliary reservoir of mercury. The total pressure of the air, and hence its temperature, is measured directly by the height of a column of mercury. To the bent stem of the air bulb a barometer tube with a vacuum at the top is connected, and the stem is continued in flexible form to the mercury reservoir. The barometer tube is graduated in absolute degrees of temperature by fixing one point—the pressure for the temperature of melting ice—and dividing the tube mechanically. To make an observation of temperature the mercury is adjusted to a mark fixed on the bulb-stem, by raising or lowering the mercury reservoir, and the pressure of the enclosed air is given by the height of the mercury in the barometer tube over the mark in the stem of the air bulb. By closing a stop-cock between the pressure gauge and the reservoir, the bulb and the gauge may be completely cut off from external pressure.

PARIS.

Academy of Sciences, March 29.—M. A. Chatin in the chair.—Second note on asynchronous motors, by M. A. Potier.—On the transformations of the sugars and on levulic acid, by MM. Berthelot and André. A thermochemical study of the various modes in which glucose is decomposed by yeast, alkalies, and acids. All three reactions are exothermic, and evolve approximately equal amounts of heat.—On the fatty materials found in the Egyptian tombs at Abydos, by M. C. Friedel. The presence of partially hydrolysed glycerides of palmitic and stearic acids was proved, showing that the original grease probably consisted of beef or mutton fat.—On the transformation of the diamond into graphite in the Crookes' tube, by M. Henri Moissan. By the molecular bombardment in a high vacuum, Crookes showed in 1879 that the face of the diamond became covered with a blackish deposit. By its behaviour towards oxidising agents this deposit is now shown to consist of graphite, proving that the diamond must attain on its surface a temperature approaching that of the electric arc.—On the Insemineæ without ovules, forming the subdivision of the Inovulæ or Loranthineæ, by M. Ph. van Tieghem. A further note on the classification of the Insemineæ.—On the transformation of algebraic equations, by M. Brioschi.—Remarks by M. Henri Moissan on the presentation of his work on the electric furnace.—The Academy nominated the Committees to act as judges for the prizes awarded in 1897, bearing the names of Jecker, La Caze (Chemistry), Delesse, Desmazières, Montagne, Thore, Savigny, Gama-Machado, Montyon, and Bréant.—Emission of liquid water by vegetables: new method for this study, by M. Maxime Cornu. The method described is based upon the use of an electrical counter for automatically recording the number of drops of water exuded from a given surface.—On associated congruences, by M. C. Guichard.—On the singularities of partial differential equations, by M. Jules Beudon.—On interpolation, by M. Émile Borel.—On the successive differentials of a function of several independent variables, by M. E. Goursat.—On a complete apparatus for researches relating to electro-magnetic waves, by M. Jagadis Chunder Bose. The apparatus described, although occupying but a relatively small space, suffices to show the reflexion, refraction, diffraction, double refraction, rectilinear, circular, and magnetic polarisation of electro-magnetic waves.—Mutual actions of the electrodes and kathode rays in rarefied gases, by M. H. Deslandres.—On the propagation of strains in metals submitted to stresses, by M. Mengin. A description of experiments performed on aluminium, nickel-steel, Delta metal, and brass.—On the chlorobromides of tin, by M. A. Besson. These substances are formed by the action of hydrogen bromide upon stannic chloride, and by the action of bromine upon anhydrous stannous chloride in carbon tetrachloride solution, the latter method giving the best yield. The chlorobromides were separated by fractional distillation under reduced pressure, $SnCl_3Br$, $SnCl_2Br_2$, and $SnClBr_3$ being isolated.—On the conditions under which sulphur and hydrogen directly combine, by M. H. Pélabon. Hydrogen and sulphur combine slowly to form sulphuretted hydrogen at temperatures between 215° and 350°, and the reaction is a limited one, although hydrogen sulphide is not decomposed under 350°.—Action of bromine and hydrobromic acid upon ethyl acetate, by M. Boleslas Epstein. The results obtained in this experiment differ in some respects from those previously published by M. Crafts, the products being ethyl bromide, monobromacetic acid, and hydrobromic acid; the latter in considerable quantity. Experiments with ethyl monobromopropionate gave analogous results.—On the formation of native iron carbonate, by M. L. De Launay. The view is put forward that agglomerated iron carbonate has not been, as is generally held, deposited as carbonate from water, but that, like calamine and cerussite, it has been produced by the action of limestone upon the salts arising from the destruction of iron sulphides. It is pointed out, in confirmation of this view, that whilst massive sulphide of iron is always found in schists, the carbonate occurs with limestone.—Clasmatosis in the Lamellibranchs, by M. Joannes Chatin.—On the organisation and relationships of the *Pleurotomaria*, by MM. E. L. Bouvier and H. Fischer.—The refractory period and synchronisation of nervous oscillations, by MM. André Broca and Charles Richet.—Demonstration of the existence of vaso-sensitive nerve regulators of the arterial pressure, by M. C. Delezenne.—Action of the bile and the biliary salts upon the nervous system, by M. Adolph Bickel. The application of bile or of a solution of the biliary salts to the brain of certain animals (cat, dog, rabbit, rat, and guinea-pig) causes cerebral phenomena which vary with the animal, but generally characterised by convulsions and loss of consciousness, accompanied by salivation.—*Pseudocommis Vitis* (Debray) in the tubercles of the potato, by M. E. Roze.—Observations on some properties of the oxydase of wines, by M. Bouffard. Sulphurous acid acts directly upon the oxydase, and completely destroys its oxidising properties. Its use as a preventive of the decolorisation of wines (*la casse*) is specific.—On rye, by M. Balland. The results of proximate analyses are given.—Radiography of a man and a woman, by M. F. Garrigou.—Note relating to an experiment of cone set in rotation on water, by M. Aug. Coret.—Note on electric tourniquets, by M. Galamand.

AMSTERDAM.

Royal Academy of Sciences, February 27.—Prof. van de Sande Bakhuyzen in the chair.—Prof. Franchimont on the nitro group of the nitramines. According to the author, both the acid and the neutral nitramines contain the same group. When in the acid nitramines the hydrogen atom is replaced by metals, the metal may, under certain circumstances, pass from the nitrogen to the oxygen.—Mr. Hamburger, on the influence of carbonic acid upon the volume of the red and the white blood corpuscles. Continuing his investigations (*vide Proc.* November meeting, 1896), Mr. Hamburger observed that not only CO_2, but also other acids, as HCl and H_2SO_4, when added to blood in very small quantities (0·04 per cent.), caused a swelling of those cells, and that an equally small amount of KOH brought about a shrinking. An explanation of these phenomena was given by the author.—Mr. Verbeek gave a survey of the sedimentary formations and the eruptive rocks occurring in Java. The author also made some communications concerning the useful minerals of Java, viz. ores, coal, and petroleum; the last-mentioned substance seems to be present in large quantities in the neo-tertiary strata, not only of Java, but also of Sumatra and Borneo.—Prof. van der Waals, on special points in the melting-

curve. The author demonstrated (1) that the real melting temperature, *i.e.* that temperature at which solid and liquid have the same composition, is the highest temperature at which the solid can ever occur under that pressure; (2) that at that temperature a break in the melting-curve can occur only when the liquid contains no other molecules than complex ones of the composition of the solid.—Prof. Franchimont presented a paper by Dr. van Romburgh, of Buitenzorg, on the action of fuming sulphuric acid upon methylethylaniline and of chromic anhydride upon 2·4 dinitromethylethylaniline.—Prof. Kamerlingh Onnes presented, on behalf of Dr. W. van Bemmelen, of Utrecht, a paper entitled "Values of the terrestrial magnetic declination for the period of 1500–1700, and its secular variation during the period 1500–1850."—Mr. Jan de Vries presented, on behalf of Dr. G. de Vries, of Haarlem, a paper entitled "The motion equations of cyclones." After a discussion of the motion equations in cylinder coordinates, the hypotheses are made that the radian and the tangential velocities are independent of the height above the ground, and that the motion near the centre is symmetrical with respect to the axis of the clycone.—Prof. Haga presented, on behalf of Mr. D. G. Tiddens, of Gröningen, a paper entitled "Observations on Fomm's experiments on the wave-length of the X-rays." On repeating Fomm's experiments (*Wied. Ann.*, 1896) on the wave-length of the X-rays, it appeared that the maxima which the X-rays produce upon a photographic plate after passing through two narrow slits, do not obey the laws of diffraction; for each edge of the slit produces one maximum, while it depends upon the width of the slit, whether the two maxima coincide or even overlap each other, whereby, *e.g.* the left maximum is caused by the edge of the right slit. Consequently no conclusion can be drawn from these experiments as regards the wave-length.

DIARY OF SOCIETIES.

THURSDAY, APRIL 8.

ROYAL SOCIETY, at 4.30.—The Production of X-rays of different Penetrative Values: A. A. C. Swinton.—Photographic Spectra of Stars to the 3½ Magnitude: F. McClean, F.R.S.—Condensation of Water Vapour in the presence of Dust-free Air and other Gases: C. T. R. Wilson.—(1) Double (Antidrome) Conduction in the Central Nervous System; (2) Further Note on the Sensory Nerves of Muscles: Prof. Sherrington, F.R.S.—On the Breaking-up of Fat in the Alimentary Canal under Normal Circumstances and in the Absence of the Pancreas: Prof. V. Harley.—On the Application of Harmonic Analysis to the Dynamical Theory of the Tides, Part I.: S. S. Hough.—On Boomerangs: G. T. Walker.—Kathode and Lenard Rays: J. A. McClelland.

ROYAL INSTITUTION, at 3.—Roman Britain: Prof. W. Boyd Dawkins, F.R.S.

MATHEMATICAL SOCIETY, at 8.—On the Potentials of Rings: A. L. Dixon.—An Extension of a certain Theorem: Rev. F. H. Jackson.—On the Deformation of a Closed Polygon, so that a certain Function remains constant: F. S. Macaulay.—Ueber verzweigte Potentiale im Raum: Prof. A. Sommerfeld.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Recent Developments in Electric Traction Appliances: H. A. Baylor.

INSTITUTION OF NAVAL ARCHITECTS, at 12.—On the Fighting Value of certain of the Older Ironclads if re-armed: Captain the Right Hon. Lord Charles Beresford, C.B., R.N.—The Application of the Compound Steam Turbine to the Purpose of Marine Propulsion: Hon. Charles Parsons.—On the Use of the Mean Water-Line in designing the Lines of Ships: A. G. Ramage.——At 7.—The Accelerity Diagram of the Steam-Engine: J. Macfarlane Gray.—Note on the Geometry of Stability: J. Macfarlane Gray.—Acetylene, and its Probable Future Afloat: Prof. Vivian B. Lewes.

CAMERA CLUB, at 8.15.—The Phonograph: Mr. Stroh and F. C. B. Cole.

FRIDAY, APRIL 9

ROYAL INSTITUTION, at 9.—The Limits of Audition: Lord Rayleigh, F.R.S.

PHYSICAL SOCIETY, at 5.—A Nickel Stress Telephone: T. A. Garrett and W. Lucas.—On Alternating Currents in Concentric Conductors: W. A. Price.—On the Effect of Capacity on Stationary Electrical Waves in Wires: W. B. Morton.

ROYAL ASTRONOMICAL SOCIETY, at 8.—A New Quadruple Stellar System: R. T. A. Innes.—On the Straightness of Spider Lines: H. H. Turner.—Observations of the Minor Planet (8) *Flora*: John Tebbutt.—The Orbit of Sirius: S. W. Burnham.—Micrometrical Measures of the Double Stars in the Great Nebula and Cluster surrounding *η Carinæ*: T. J. J. See.—On some Original Observations of the Comet of 1652: E. B. Knobel.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Poole Harbour: Harold Berridge.

INSTITUTION OF NAVAL ARCHITECTS, at 12.—Nickel Steel as an Improved Material for Boiler Shell-Plates and Forgings: William Beardmore.—Application of Electrical Transmission of Power in Marine Engineering and Shipbuilding: Herr F. von Kodolitsch.

MALACOLOGICAL SOCIETY, at 8.

SATURDAY, APRIL 10.

ROYAL INSTITUTION, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh, F.R.S.

ROYAL BOTANIC SOCIETY, at 4.

GEOLOGISTS' ASSOCIATION (Baker Street Station), at 1.37.—Excursion to Aylesbury, Hartwell, and Stone. Directors: A. M. Davies and Percy Emary.

ESSEX FIELD CLUB (at Theydon, &c.).—Fresh-water Algæ: their Structure, Distribution, and Relationships: E. D. Marquand.

MONDAY, APRIL 12.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Fourth Centenary of the Voyage of John Cabota, 1497: Sir Clements R. Markham, K.C.B., F.R.S., President.

SANITARY INSTITUTE, at 8.—Sanitary Appliances: Dr. George Reid.

VICTORIA INSTITUTE, at 4.30.—The Scope of Mind: Dr. A. T. Schofield.

CAMERA CLUB, at 8.15.—Some Recent Investigations in X-Ray Work: Campbell Swinton.

TUESDAY, APRIL 13.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Some Points in connection with the Anthropology of the Kafirs of the Hindu Kush: Sir George S. Robertson, K.C.S.I.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Paper to be discussed: The Blackwall Tunnel: David Hay and Maurice Fitzmaurice.

ROYAL HORTICULTURAL SOCIETY, at 1.—Artificial Manures.

PHARMACEUTICAL SOCIETY, at 8.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Colour Measurement in Photography: C. F. Townsend.

ROYAL VICTORIA HALL, at 8.30.—Modes of Mountain Making: F. W. Rudler.

THURSDAY, APRIL 15.

LINNEAN SOCIETY, at 8.—On some New Irish Crustacea: A. O. Walker.—On Desmids from Singapore: W. and G. S. West.——Exhibition: Plants collected during Two Years' Residence in Franz Josef Land: H. Fisher.

GEOLOGISTS' ASSOCIATION (Charing Cross, S.E.R.), at 4.30.—Long Excursion to Walmer, St. Margaret's, Dover, Folkestone, and Romney Marsh. Directors: George Dowker, W. F. Gwinnell, Dr. A. W. Rowe, and C. Davies Sherborn.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—First Principles of Mechanical and Engineering Drawing: H. Holt-Butterfill (Chapman).—Rough Notes and Memoranda relating to the Natural History of the Bermudas: J. L. Hurdis (Porter).—Ferrets: N. Everitt (Black).—Wild Bird Protection and Nesting Boxes: J. R. B. Masefield (Leeds, Taylor).—Stones for Building and Decoration: G. P. Merrill, 2nd edition (New York, Wiley; London, Chapman).

PAMPHLETS.—Equipment and Work of an Aero-Physical Observatory: A. McAdie (Washington).—On the Forms of Plane Quartic Curves: R. Gentry (New York, Drummond).

SERIALS.—National Review, April (Arnold).—Humanitarian, April (Hutchinson).—Contemporary Review, April (Isbister).—Fortnightly Review, April (Chapman).—Astrophysical Journal, March (Chicago).—Scribner's Magazine, April (Low).—Journal of the Royal Agricultural Society of England, Vol. viii. Part 1, No. 29 (Murray).—Bibliography of South African Geology: H. P. Saunders, Parts 1 and 2 (Cape Town).

CONTENTS.