THURSDAY, APRIL 16, 1908.

THE CHEMISTRY OF THE HIGHER FUNGI.

Chemie der höheren Pilze, eine Monographie. By Dr. Julius Zellner. Pp. vi+257. (Leipzig: W. Engelmann, 1907.) Price 9 marks.

THE detection, isolation, and characterisation of the definite compounds resulting from the vital processes of living organisms is a branch of organic chemistry which is slowly developing and of which the progress is necessarily dependent upon the development of pure chemistry. In fact, it may be said that in some respects this department of biochemistry is in advance of the pure science, because the living organism has already furnished chemists with immense numbers of compounds which are quite definite, but of which the chemical constitution is at present unknown. Indeed, it may be stated in much wider terms that there is probably no such thing as an "indefinite" chemical compound in the whole animal or vegetable world. There is no doubt that many, perhaps the majority, of the organic compounds present in animals or plants are of very high molecular weights and of great atomic complexity, and there is also no doubt that many of the products which have been isolated and studied are complex mixtures or combinations of such complexes. But to speak of such products as "indefinite" is simply tantamount to the admission that our modern methods of research are inadequate, and that our knowledge of biochemistry must develop concurrently with the development of new methods for dealing with these highly complex molecules.

The ultimate aim and object of scientific chemical work in this field is presumably to follow the development of the various compounds in the living organism—to detect the genetic relationships between the molecules for the purpose of learning how nature works in the vital laboratory. As a prelude to this knowledge it is necessary to get, in the first place, an inventory, as complete as possible, of the compounds actually known to exist in, or to be produced by, the animal or plant. With respect to plant chemistry it may be said that practically all the works dealing with this subject have hitherto been of the nature of such catalogues or inventories. Here and there, as the result of these studies, genetic relationships have been detected, but this field of research is urgently in need of systematic cultivation. As a subject it bristles with practical difficulties, and for the achievement of successful results the investigator should combine the qualifications of an expert chemist with those of the expert botanist. It is not surprising that, in the circumstances, the biostatical aspect of plant chemistry should have progressed so much more rapidly than the biodynamical aspect.

Dr. Zellner's monograph may be regarded as another contribution to plant chemistry from the biostatical side. It deals with a particularly interesting group, and will be found invaluable to students and workers in this field. By the "higher fungi" the author means all those orders generally classed as fungi with the exclusion of bacteria, moulds, and yeasts. The line of demarcation, as Dr. Zellner points out, is perhaps not, strictly speaking, a scientific one, but for practical purposes it is both justifiable and convenient, as bacteriology and fermentation have been developed into large and important branches of science, and their literature is amply provided for.

In treatment the present work follows the chemical rather than the botanical classification, the chapters, of which there are twenty-two, bearing the titles of the chemical families, beginning with the mineral constituents, and passing on to the hydrocarbons, fats, lecithins, alcohols, acids, amino-acids, purine group, bases, carbohydrates, tanning and colouring matters, resins and terpenes, proteins, &c. The chapters on the ferments and toxins of fungi will be of particular interest to many readers. One chapter is devoted to the consideration of the nutritive value of fungi, which the author does not consider to be very high. In this chapter there are many valuable tables giving the quantitative results of the analysis of the proximate constituents of large numbers of species. In the case of certain chemical families of very wide occurrence, such as the carbohydrates, the author has been obliged to interpolate tables based on the botanical classification. Thus in chapter xii. there is a tabulated list of no fewer than 233 species, giving the distribution of mannitol, mycose (trehalose) and glucose, or other reducing sugar, together with the name of the observer and the year of the discovery of the carbohydrates. In giving the details of the various compounds, the author has wisely thought it unnecessary to enlarge upon the chemistry of well-known and widely distributed substances which are of general occurrence in the vegetable kingdom. On the other hand, compounds of special interest in mycological chemistry, such, for example, as muscarin, ergotin, choline, &c., which are essentially, if not exclusively, products of fungi, are dealt with exhaustively. As is so generally the case with German writers of monographs on scientific subjects, the references to authorities are fully given.

As a contribution to scientific literature there is nothing in this work calling for criticism. The author, unlike many specialists, takes a remarkably fair view of the "perspective" of his subject, and the result is a work which may be described as concisely complete. It may savour of impertinence for a "foreigner" to complain of the spelling of his own language by a German writer, but those who are in the habit of following German work in our own subjects—*i.e.* the working men of science of this country generally—have become accustomed to certain established modes of spelling in such scientific publications as the *Berichte* of the German Chemical and Botanical Societies, and so forth. We in this country have become "hardened" (literally) into seeing K for C (hard); we have got over the first shock of seeing such words as Glukose, Fruktose, Mykose, &c., and

we have even been obliged to admit that Muskarin is obtained from *Amanita muscaria*.[1] But now Dr. Zellner has a further shock for us, and we find such words as *Kalzium, Zitronensäure, Glyzerin, Azetyl*, &c., scattered throughout his pages. Thus (p. 97) Mykose forms an "*Oktoazetylverbindung*," which is no doubt chemically true, but, stated in this form, it seems to jar upon the orthographic nerve of the average English reader. All this is, of course, purely personal, perhaps old-fashioned or narrowly insular, and has nothing to do with the scientific merits of the work, which, as has already been said, are of a very high order, and every worker in the domain of plant chemistry will be grateful to the author for having produced it.

R. MELDOLA.

BOTANICAL INSTRUCTION.

Plant Biology. A Text-book of Elementary Botany arranged for Modern Methods of Teaching. By Dr. F. Cavers. Pp. xvi+460. (Cambridge: University Tutorial Press, 1907.) Price 3*s*. 6*d*.

Laboratory and Field Manual of Botany. By J. Y. Bergen and B. M. Davis. Pp. viii+257. (Boston and London: Ginn and Co., n.d.) Price 4*s*. 6*d*.

Studies in Plant Life. By J. Adams. Pp. v+179. (Dublin and Belfast: Fallon and Co., Ltd., n.d.)

Elementary Botany. By M. A. Liversidge. Pp. 128. (London: Blackie and Son, Ltd., 1907.) Price 1*s*. 6*d*. net.

Introduction to Elementary Botany. By Charlotte L. Laurie. Pp. viii+84. (London: Allman and Son, Ltd., n.d.) Price 1*s*. net.

Our Woodlands, Heaths and Hedges. By W. S. Coleman. Pp. viii+141; with 8 plates. New edition, entirely reset. (London: George Routledge and Sons, Ltd., 1907.) Price 1*s*.

THE advocates of an exclusively experimental course of study in the natural sciences are confronted with the difficulty of time limitations, so that in practice it becomes necessary to strike a balance between lecture and practical work. Dr. Cavers has indicated in "Plant Biology" the lines of work that he has found successful with training-college students, in which the training is almost entirely derived from observation and experiment. The foundation of the course consists of experiments—of which about three hundred and fifty are outlined—in connection with the nature and function of parts of the flowering plant; so far as possible the bean plant is used as the type. Flower and soil, biology and ecology provide a subsidiary section. The course differs mainly from ordinary practice in excluding the examination of selected types from the main groups and in the general omission of flowerless plants. With regard to the composition of the subject-matter, the author deserves great commendation; the arrangement is well planned, the experiments are generally simple and practicable, and the information is contrived to make the student think. A series of questions at the end of each chapter can be used either by the student or his instructor to gauge the progress that is being made. The appendices also contain much useful matter; hints on practical work refer to special opportunities afforded month by month; a summary of Engler's system of classification is provided, and a glossary of botanical terms.

The manual prepared by Mr. Bergen and Dr. Davis is a practical handbook primarily arranged in accordance with their text-book "Principles of Botany." The first part relates to the structure and physiology of seed plants. The plan adopted of outlining the instructions without detailed information that is left for the student himself to discover is good, but the authors have not been very happy in distinguishing between more and less important facts or in systematising the subject-matter. As an instance, it may be cited that the description of a typical young dicotyledonous stem is not particularly noted, while the structure of the climbing dicotyledonous stem receives undue prominence. The second part, indicating type studies of flowering and flowerless plants, is more felicitous. Spirogyra forms a suitable introduction for studying the cell in detail. Pleurococcus, Vaucheria, Ulothrix, and Œdogonium are chosen as the types of green algæ, while reference is also made to Ulva, Cladophora, and Coleochæte. Microsphæra, the lilac-mildew, is selected as the type of an Ascomycete, and the introduction of Marsilia is quite a desirable innovation. Ecology is dealt with in the third section under the headings of flower pollination, seed dissemination, types of vegetation, &c. The remainder of the book is devoted to accessory but valuable hints on reagents, methods of fixing and staining, cultures of the lower plants, and apparatus. Considered as a whole, the authors have provided a useful manual that presents a large amount of practical information in a limited amount of space.

The small book written by Mr. Adams is of an extremely superficial nature. Owing to generous spacing and a large number of illustrations, the text is less than would be expected. In the circumstances, it would have been advisable to give more space to the essentials of plant structure as exemplified in the flowering plant and to have omitted the cursory descriptions of flowerless plants and plant habitats. The author has taken pains to introduce facts of practical importance to the agriculturist, such as fertilisers, dwarf shoots, &c., but there is a lack of clearness and accuracy in some of the elementary definitions.

The limits of Miss Liversidge's book are set by the intention of covering the syllabus of work for the Oxford and Cambridge junior local examinations. It is evident that it has also been written rather with the view of giving facts for examination purposes than of training the young mind. There are four parts, assigned to external morphology, anatomy, physiology, and systematic botany. The design of the physiological part is good, but the experimental

[1] The familiar *Chemisches Central-Blatt* has now become a *Zentral-Blatt*.

instructions could be materially improved. The anatomical facts are clearly stated considering that this part of the subject is much more advanced than the rest of the book. But speaking generally, the author has aimed at brevity, and in so doing has sacrificed exactness; this is specially noticeable in the course of external morphology, where several mistakes and incomplete definitions occur.

The short introduction to elementary botany planned by Miss Laurie is a direct antithesis to the last, as the facts recorded are few, but they are deduced or suggested so as to arouse interest and stimulate experiment and thought. Written primarily for quite small children, it shows how facts in the life-history of plants may be taught from simple experiments, such as the growth of mustard seeds in a bottle In addition to morphology and the accompanying physiology, there are chapters on interrelation between plants and animals, climbing plants and colours of plants. Although the information is couched in a form understandable by young children, the book could be advantageously adopted as a first course for older children, and might be profitably consulted by many teachers as a guide to imparting instruction.

The observation of trees and shrubs is preeminently suited for a nature-study class, and possesses the advantage that there is much to be noted even during the winter months. A short, concise manual or primer at a modest price is an existing desideratum. The volume written by Mr. Coleman compasses the subject and certainly sells at a modest price, but it fails to satisfy the want alluded to. The author has culled much interesting information of a general and historic nature, but there is an almost entire absence of the numerous botanical features of interest, such as winter buds, arrangement of leaves, &c., and for identification the reader is mainly dependent upon the illustrations. The notes on animals and insects haunting the various trees and shrubs are so useful that one wishes the author had given more space to these facts of natural history. A list of British lepidopterous insects the caterpillars of which feed on certain plants is provided in an appendix.

APPLIED MATHEMATICS.

(1) *Computation and Mensuration.* By P. A. Lambert. Pp. ix+92. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1907.) Price 3*s.* 6*d.* net.

(2) *A First Statics.* By C. S. Jackson and R. M. Milne. Pp. viii+380. (London: J. M. Dent and Co., 1907.) Price 4*s.* net.

(3) *Practical Calculations for Engineers.* By C. E. Larard and H. A. Golding. Pp. xiii+455. (London: C. Griffin and Co., Ltd., 1907.) Price 6*s.* net.

(1) THE author says that the boys in the secondary schools of America are not taught to apply their mathematics independently, and consequently find, on entering college, that they have difficulty in making effective use of their theoretical knowledge, and this book is intended as a link between the school and college courses, to be studied either at the end of one or the beginning of the other.

The same deficiency is manifest in boys leaving our schools, and in this country is being met by improved teaching combined with practical work in the laboratory, as a regular part of the school course.

The book is admirably planned and written, is concise, neat in method and interesting, and meets a real want in a worthy manner. It begins with examples of direct measurement, approximate numbers, and contracted arithmetic, estimating the degree of accuracy by the number of decimal places; perhaps the number of significant figures would have been better. This is succeeded by examples of practical geometry, including the construction and measurement of triangles, and some squared-paper work. Then follows the volume of a prismatoid, and in later chapters on mensuration it is shown that the prismoidal formula, or Simpson's rule, is widely applicable. There is a useful chapter on trigonometrical computation, introducing very appropriately the notion of a vector with examples of vector summation. Logarithms and the slide rules are next considered, followed by an interesting chapter on limits, illustrated by several important convergent series. The author always seizes on the salient points, is never prolix, and the interest never flags; in each chapter the student is well started on his way, then provided with good and suggestive examples, and wisely left to his own resources. Thus, although the pages of the book are comparatively few, the usual ground is covered, and a thorough and efficient training in practical computation is provided. English teachers would do well to consult this work.

(2) This text-book proceeds on easy lines, and the student is provided with a wealth of examples at every stage from which to choose, the answers being collected at the end of the volume. In their scheme the authors have considered "the historical order of development of the subject, as indicating almost infallibly the line of least resistance." Thus in the first chapter the principle of the lever is introduced, and the law of moments for parallel forces is established by simple experiments, then illustrated by examples of ancient and modern steelyards and balances, and finally applied to find the conditions of equilibrium of three parallel forces in a plane. The next two chapters deal with the parallelogram law for forces at a point, the treatment being here again, as always, experimental, graphical, and analytical, with examples of useful applications in the arts. It is not quite clear why the authors should substitute the term "geometric" addition for *vector* addition, or why arrow-heads should "sometimes" instead of *always* be inserted in vector diagrams. In chapter iv. the principle of moments is again considered, being now deduced from that of the parallelogram and applied to couples. Then follow sections dealing with machines, friction, and centres of

gravity, the latter being somewhat extensively applied, including Guldinus's rules and mensuration problems. The concluding chapters relate to forces and jointed frames in two and three dimensions, with examples of roof and bridge trusses and cranes.

The general plan of the book is good, the endeavour being to "lay stress on the practical utility of the science" rather than on "rigour of deduction." In carrying out this very laudable idea, the authors, through lack of practical experience, sometimes err by giving drawings like that of the safety-valve on p. 242, in which the constructional details are almost offensively crude, or by giving examples like No. 16, p. 140, where the efficiency of a Weston differential pulley-block is stated to be 80 *per cent.*, or like No. 38, p. 77, in which a rail, supported at the ends and loaded as a beam at the middle, is said to be bent into a *circular arc*. In spite of these minor defects, however, the book can be recommended as affording an excellent introduction to statics.

(3) The general character of this work places it somewhere between the engineering pocket-book and the college text-book. The methods, formulæ, and appliances which a student encounters during a good college course in mechanical engineering are here, not demonstrated, but collected and described, systematically, and applied to such practical examples as are likely to occur in an engineering workshop. In section i. the subject-matter comprises arithmetical, graphical, and mechanical computations, by modern abbreviated methods, and includes technical mensuration, the use of the slide-rule and the planimeter, and mathematical tables. In section ii. we have laboratory experiments and calculations relating to machines, acceleration, momentum, force, work, energy, and power. Section iii. relates to boilers and heat engines, considered both from the thermodynamical and constructional point of view, with a chapter on the cost of motive power. These three sections are well adapted for students who have passed from college to practical work, in helping them to recall their theoretical knowledge as occasion may require. A good collection of examples will be found for practice. The style is perhaps somewhat diffuse, and there are a few minor defects, but this portion of the book will be appreciated in many quarters.

The fourth and concluding section, however, is of most interest and value. It deals with the business side of engineering, a branch that is beyond the usual college course, yet of paramount importance to the young aspiring engineer. The subjects discussed are the commercial aspects of engineering; the qualifications and duties of the works manager; the calculation of weights and the preparation of estimates and bills of costs; and the bonus and premium systems of wages. The authors give some most striking examples of the great value of squared-paper work in the systematic plotting of variable quantities in all branches of a manufacturing establishment, and the lessons to be learnt therefrom. This section is extremely suggestive, and will well repay the careful study of all practical engineers.

MULTUM IN PARVO.

(1) *Die Tierwelt des Mikroskops (die Urtiere).* By Dr. Richard Goldschmidt. Pp. iv+100; 39 figures. (Leipzig: B. G. Teubner, 1907.) Price 1.25 marks.

(2) *Das Süsswasser-Plankton.* By Dr. Otto Zacharias. Pp. iv+130; 49 figures. (Leipzig: B. G. Teubner, 1907.) Price 1.25 marks.

(3) *Befruchtung und Vererbung im Pflanzenreiche.* By Prof. K. Giesenhagen. Pp. iv+132; 31 figures. (Leipzig: Quelle and Meyer, 1907.) Price 1.25 marks.

(4) *Das Werden und Vergehen der Pflanzen.* By Prof. P. Gisevius. Pp. 132; 24 figures. (Leipzig: B. G. Teubner, 1907.) Price 1.25 marks.

(5) *Das Schmarotzertum im Tierreich und seine Bedeutung für die Artbildung.* By Prof. Ludwig von Graff. Pp. iv+132; 24 figures. (Leipzig: Quelle and Meyer, 1907.) Price 1.25 marks.

(6) *Die Mechanik des Geisteslebens.* By Prof. Max Verworn. Pp. iv+104; 11 figures. (Leipzig: B. G. Teubner, 1907.) Price 1.25 marks.

IT was Leibniz who said that the more science advances the more it will be expressed in little books. If that is so, the recent abundant crop of primers may be regarded as a healthy sign—especially when we find that many of them are very good. It need hardly be said that an introduction to the study of parasitism by von Graff, or to the study of fresh-water plankton by Zacharias, cannot fail to be useful and stimulating. There is also an economic side to the phenomenon presented by the bundle of primers before us. It seems as if the great encyclopædias, which were relatively costly, were being replaced by these cheap booklets. Instead of saving up to purchase the huge volume P, containing much that he does not want, the student can buy at a shilling each three little treatises on parasitism, plankton, and protozoa. This expresses a democratisation of scientific literature, with its familiar analogue in the popular "sixpennies."

(1) In a clear and precise way, Dr. Richard Goldschmidt tells the story of the Protozoa—how they came to be known, where they are found, how they live, what part many of them play in the economy of the sea, what they have done in building up chalk cliffs and the like, and how they come into close quarters with man in malaria and sleeping sickness, and other diseases. With the aid of excellent figures, most of which are familiar, and some of which, like Max Schulze's Polystomella, could hardly be improved upon, the author introduces the student to the rhizopods, the infusorians and Sporozoa, and although the book will not, of course, enable the observer to identify many of the Protozoa which he may discover, it will help him to understand them and to realise how many problems even the common amœba still raises in a reflective mind.

(2) The indefatigable director of the biological station at Plön deals with a subject to the study of which a great part of his life has been honourably devoted—the fresh-water plankton. His treatment of

it seems to us to be peculiarly successful, as we would expect from one writing out of full knowledge and with strong enthusiasm, and what he has to say may be profitably read by many besides the laity. Besides descriptions of the various constituents of the plankton—crustaceans, rotifers, infusorians, algæ, and so on—Dr. Zacharias gives an account of methods of study, of the relations of the plankton to environmental conditions, of the origin of new species and varieties by isolation, of the inter-relations of plants and animals, of the application of hydrobiology to fisheries, and of the pioneer station at Plön.

(3) Prof. K. Giesenhagen deals with a subject more difficult than those of the two preceding volumes—namely, fertilisation and heredity in the vegetable kingdom. He begins with the phenomena in their simplest terms in the green algæ, and works gradually upwards through moss and fern to phanerogams, not forgetting the by-paths of parthenogenesis and vegetative multiplication. The point about his treatment is that he uses the facts as a basis for a discussion of the deep problems of heredity, such as those raised and in part solved by the discoveries of Mendel and his successors.

(4) Prof. Paul Gisevius has compressed into a small volume what every educated person should know about plants, and there is a flavour of intellectual "pemmican" in the result. He deals first with the structure of plants, both inside and outside; he then discusses nutrition and respiration, constructive metabolism, and the migration of material; he leads us from seed and seedling to the flowering, fruiting and withering; he takes a survey of the vegetable kingdom, and throws the light of the past on the present; and he ends up with the phenomena of reproduction and with breeding experiments. It seems to us that he attempts too much, carrying terseness to an extreme, but his work is well done.

(5) Prof. Ludwig von Graff supplies a masterly introduction to the study of parasitism among animals. Without overwhelming us with details, he takes us into the heart of the subject, and the style of the book is a model. Von Graff has much that is extremely interesting to relate—for parasitology has made great advances of recent years—and his discussion of such themes as the origin of the parasitic habit and the influence of parasitism on the parasite is very instructive. Admirable too are the tabular summaries of life-histories. The appalling list of human parasites, based on Braun's well-known treatise, reaches a total of 129, and this number must be greatly increased, since in not a few cases several species are counted as one.

(6) In some ways the most striking volume in this bundle of primers is that in which Prof. Max Verworn deals with "the mechanism of psychical life." It consists of five lectures on the physiological aspects of mental processes, and the author has been well advised to leave them with the vividness of oral discourse. He deals with the relations of mind and body (the dualism of which he regards as a superannuated fiction), with the processes, *e.g.* fatigue-changes, in the nervous elements, with the dissimilatory stimuli that pass incessantly through the intricate maze of nerve-fibres and ganglion-cells, with the fascinating phenomena of sleep and dreaming, and with the puzzles of suggestion and hypnosis. More, perhaps, than in regard to the other little books which we have noticed is there room here for difference of opinion, but all will agree that the author presents his view of psychical life with masterly clearness. It must be clearly noted that he refrains from giving his facts any philosophical setting, he argues neither for materialistic nor for spiritualistic interpretation, he aims at a physiological analysis of the sequences with which we are all familiar, and he does not conceal that his title expresses a scientific ideal rather than an actual achievement. J. A. T.

OUR BOOK SHELF.

Index of Archaeological Papers (1665–1890). Edited by G. L. Gomme. Pp. xi+910. (London: A. Constable and Co., Ltd., 1907.) Price 25*s.* net.

THIS volume is in effect an author-index to the papers of archæological and kindred character published in the journals of learned societies and elsewhere during the twenty-five years prior to 1891. It includes the contents of some ninety-four periodicals, amounting in all to nearly 20,000 monographs under the authors' names. An appendix supplies a list of the titles which were found to have been omitted from the main classification during its compilation.

The papers of like characters which have appeared from 1891 until the last year or so have already been similarly treated in the annual index, published under the auspices of the Congress of Archæological Societies in union with the Society of Antiquaries. There is thus placed before the student of to-day, as the editor justly claims, a continuous index from the first publications in the Philosophical Transactions of the Royal Society down to the present time. This work is henceforth as indispensable to the student of British archæology, in particular, as are the tables of logarithms, sines, and cosines to the mathematician. The latter may be calculated, indeed, just as the archæological papers may be hunted out by individual workers; but those who in the past have wasted hours and days in turning over the pages of twenty-five times ninety-four volumes in search of their own quest will be grateful to Mr. Gomme and his helpers for their patient work, and for the completeness of the result.

This index includes within its scope, not only the archæology of the British Isles, but archæological fragments from many countries. Thus we find Evans (A. J.) on Albania, Birch, Budge, Petrie, Poole (R. S.), and Renouf on the problems of Egypt, Hogarth on inscriptions from Salonica, Ramsay on the results of his explorations in Phrygia and western Asia Minor, and so forth. The difficulty of editing such a mass of different material must have been very great, and the work laborious. Here and there we notice the inclusion, whether accidental or intentional, of papers which seem to us to be irrelevant; as, for example, "The Writings and Influence of Coleridge" (Redish), "The Height and Weight of Boys aged Fourteen in Town and Country Schools," and other more or less statistical writings, by Francis Galton. In other cases where folklore is the subject, discrimination is less easy; and we certainly think that the editor has been wise to incorporate writings of philological character in cases where the author's material was archæological. Thus M. Maspero on various

features of Egyptian archæology and philology, and Sir J. Rhys covering similar ground in Wales, are not inappropriate.

There is one thing, however, which we commend earnestly to the Congress, namely, the preparation and publication of a supplementary place-index, which might be brought as nearly to date as possible, and would render this volume and the annual indexes doubly or trebly valuable. The fact that some fifty-four of the journals indexed are the publications of local archæological societies speaks for itself. With Mr. Gomme's work completed the rest would be easy; but it is none the less an urgent need.

Notions générales de Biologie et de Plasmogénie comparées. By Prof. A. L. Herrera. Translated by G. Renaudet. Pp. xxviii+260. (Berlin: W. Junk, 1906.) Price 10 marks.

THIS is a remarkable book, full of suggestive speculation, much of which is unlikely to command general acceptance, but at the same time the analogies which the author draws between emulsions of various sorts and organic form are full of interest.

The whole book seems to have arisen out of a series of notes for students, and its rather disconnected form retains the impress of this original design. The result is rather original, and arrests the attention even where one does not agree with the author.

Prof. Herrera suggests that organic structure arises as the result of precipitation, coagulation, or solidification modified by the presence of diffusion currents and similar influences. A large number of experiments are given in which commonly occurring organic structure is closely imitated by precipitations of silica, &c., under conditions which are carefully described.

There is a refreshing freedom from dogmatism, but the author has the full courage of his own convictions, as is shown by the crisp and clear definitions which he gives of phases of organic life that most investigators find difficult of satisfactory expression.

The work is introduced by a preface from the pen of Moritz Benedikt, professor of medicine at Vienna, who is, of course, in sympathy with the general trend of the book, whilst he is, like its author, alive to the many difficulties in establishing all the conclusions. A sentence from the final essay of the volume, also contributed by Prof. Benedikt, puts the main thesis of Herrera so clearly that we may be pardoned for quoting it:—". . . le monde organique, et la vie, sont nées du monde minérale dans les masses de vésicules mousseuses hautment organisées."

Einführung in die Paläontologie. By Gustav Steinmann. Second edition. Pp. xii+542; illustrated. (Leipzig: W. Engelmann, 1907.) Price 14 marks.

IN the matter of bulk this edition shows a marked increase over the first edition (1903); while, in most cases, at any rate, it appears to have been brought fairly well up to date. The ancestral proboscideans from the Egyptian Eocene are, for instance, duly noticed, and recent work on Patagonian Tertiary vertebrates likewise receives due attention. On the other hand, we notice an absence of any reference to Dr. Broom's opinion that the South African Triassic Trity-lodon is, after all, a mammal; while in certain cases the author departs from the generally accepted classification without any apparent or sufficient reason. In the ungulate mammals, for example, the hippopotamus is removed from the Artiodactyla to find a place with Dinoceras and Coryphodon among the Amblypoda; in fact, Hippopotamus and the American Tertiary genus Merycochœrus are actually included in the family Coryphodontidæ. This is bad enough, but when we find Oreodon—the immediate ally of Merycochœrus—occupying its proper position in the neighbourhood of the camels, we are at a loss whether to attribute such eccentricities to mere carelessness or to lack of knowledge on the part of the author.

Carelessness cannot, however, be pleaded in the case of the phylogeny of the vertebrata given at the close of the volume. For there we have carefully compiled tables in which the dolphins are brigaded with ichthyosaurs as Ichthyotheria, while sperm-whales and plesiosaurs are grouped together as Plesiotheria, and whalebone whales and the mosasaurs as Thalattotheria. The giving of definite names to these incongruous groups is of itself a sufficient proof that the author regards them as definite phylogenetic assemblies, and not mere instances of adaptive analogy; but the matter is clinched by the following statement on p. 512, viz.:—" Wir sind also vor die Entscheidung gestellt, entweder ein unverständliches und geradezu übernatürliches Eingreifen vorauszusetzen, oder uns im Rahmen des gesetzmässigen Naturgeschehens die zahlreichen einzelnen Säugerstämme voneinander gesondert aus ebensovielen Stämmen der Reptilien herworgegangen zu denken."

With such eccentricities, alike in classification and phylogeny, we are unable to recommend Dr. Steinmann's volume as a trustworthy guide to the student of palæontology. Neither can we congratulate the publishers on the illustrations, unless, indeed, a " palæographic " style of art be deemed specially suitable to a palæontological treatise. R. L.

The Chemistry of the Diazo-compounds. By Dr. J. C. Cain. Pp. xi+172. (London: Edward Arnold, 1908.) Price 10*s.* 6*d.* net.

WHEN we compare the steady output of monographs on chemical subjects on the Continent with the few publications of this class in English, we naturally ask whether English publishers are less enterprising than their neighbours, or English chemists less given to specialisation.

We are inclined to the former view, and regard it as a welcome sign that the new departure in English chemical literature, introduced in the form of physical chemistry manuals, and published under the editorship of Sir W. Ramsay, has found favour with another enterprising firm, and extended to organic chemistry. It is to be hoped that the present volume represents the first of a series of similar publications.

Although the chemistry of the diazo-compounds appears at first sight to be a subject of rather restricted range, it must not be forgotten that it is of direct technical importance, connected as it is with one of the largest branches of the colour industry. Moreover, a special interest attaches to the appearance of Dr. Cain's book at the present time, for it stands as a memorial of the fiftieth anniversary of Griess's famous discovery. Although Johann Peter Griess was a German, born and bred, the bulk of his researches on the diazo-compounds were carried on in this country, first whilst he was acting as assistant to Hofmann in London, and later during intervals of leisure extending over many years after his appointment as chemist to Messrs. Allsopp, brewers, of Burton-on-Trent.

The protean character of the chemical changes which the diazo-compounds exhibit, their close connection with colour chemistry, as well as their structural relations, which still furnish a perennial subject of discussion, appeal in turn to the scientific and industrial chemist (if this distinction between the two forms of chemical energy is permissible). The author has been able to write with the authority of long experience in the works and in the laboratory, and his exhaustive method of treatment has not rendered

the subject either tedious or involved. It is, on the contrary, an eminently readable and attractive volume. It is divided into chapters describing the preparation and reactions of the diazo-compounds, their derivatives, and their constitution. In an appendix a short account is given of the author's new theory of their structure. This is not the place to enter upon a discussion of the subject, but a strong case is made out for the new view, which should stimulate fresh experimental work of an interesting character.

J. B. C.

Handbuch der Physik. By Dr. A. Winkelmann. Second edition. Fifth volume, second part: Elektrizität und Magnetismus, II. Pp. xiv+971; illustrated. (Leipzig: J. A. Barth, 1908.) Price 16 marks.

THE present portion of this encyclopædic treatise consists of electrodynamics and induction, by K. Waitz; absolute measurements of magnetic and electric quantities, by A. Oberbeck; technical applications of induction, by Th. des Coudres; telephony, by L. Rellstab; and the theory of electric phenomena, by L. Graetz. Important though every one of these sections is, it is doubtless to the last that the reader will turn first on account of the great developments of theory during the last decade; and especially will he turn to the chapters on electrons and on the electromagnetic equations for bodies in motion. We have stated in reviewing the previous parts that the treatise is not intended for continuous reading. It is essentially an encyclopædia, a book of reference. But it is the treatise *per excellence* to which reference should be made by all those who wish to know what has been done and what theories have been enunciated in the domain of physics.

LETTERS TO THE EDITOR.

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

The Condensation of Helium.

IN NATURE of March 12 I have found a note referring to my experiments on the expansion of helium, made in consequence of my determinations on the isothermals of helium, at −252° C. and −259° C., which yielded nearly −5° K. for the critical temperature of helium.

The prosecution of the experiments has shown that what I observed in expanding the gas was not the evaporation of solid helium, but solution phenomena of solid hydrogen in gaseous helium. I have communicated to the Amsterdam Academy a note on my experiments, which at the moment leave the condensation of helium a yet undecided question.

Of course, I have written the details to Sir James Dewar, and I hoped to do so to you to-day, but by pressing duties I cannot do it before to-night, and you will probably go to press before that letter reaches you. So I beg to be allowed to send you first this short notice.

Leyden, April 14. H. KAMERLINGH ONNES.

Mendelian Characters among Shorthorns.

PROF. WILSON is welcome to any satisfaction he can obtain out of the Mendelian interpretation he gives to our statistics of coat-colour in Shorthorns. As a matter of fact, some readers may consider that the same interpretation is given with greater numerical accuracy on pp. 440–4 of our original memoir (*Biometrika*, vol. iv.). For example, we give 656 crosses of roan and *whole* red alone, resulting in 243 whole reds, eighty-five red and whites, and *four whites*. The remainder consists of 324 roans. Of this we say "the close approximation to the Mendelian number of the roans is noteworthy, but the appearance of 4(WW) is again impossible unless some of the reds are to be treated as heterozygous." Why does Prof. Wilson reduce our *total* red roan crosses to 456, and leave out the inconvenient four whites? Why does he give only three whites crossed by white as giving three whites, while we dealt with ninety-one such crosses giving eighty-six whites, *four roans, and one red?* Why, further, does he leave out the whole of our Table I. on p. 441? We followed up the white cattle pedigrees, writing to the breeders about special cases, and finding in the great bulk of instances the crosses and colours stated in the Herd-book confirmed. If it be asserted that the colours given in the Herd-book are incorrect, or, still more vitally, that the confirmation of those facts given to us by reputable breeders are misstatements, then the only conclusion is that Mendelism cannot be discussed on the basis of the Shorthorn data. That is a logical position; it is not, however, logical to use the data, and escape inconvenient facts by the statement that they are due to errors or to deception, or to omission to enter calves (which we found on inquiry among English large breeders to be not so frequent as has been asserted).

The facts stated by us on p. 442 of our paper, which cannot at present be made fully public, show that there are probably latent colour determinants in white cattle which can be made patent if two individuals of pure white coat, but one of mixed race, be crossed. Recent experiments seem to show that the actual amount of pigmentation in the coat is an inherited character in mammals; no explanation, Mendelian or other, which overlooks the difference between whole and parti-coloured animals can in the present state of our knowledge be considered satisfactory. As it is, the parti-coloured cattle are being bred out, and the possibility of this shows that red and parti-colour are *not* interchangeable. This point is illustrated again by the fact that in whole red crossings about 3 per cent. of roans appear, but in parti-colour crossings about 8 per cent. of roans occur. There is at the bottom of this, I believe, a physiological fact, and I am not prepared to overlook it by saying, with Prof. Wilson, that 438 red by red matings gave twenty-five roans, which are to be put down as due to errors and misstatements because they do not fit his view of the case.

Within broad lines Shorthorns do show segregation in the results of the crossings; this is really the great idea embodied in the Mendelian view. It may be possible on a determinantal theory to offer a reasonable account of the Shorthorn data; such a theory would certainly follow recent Mendelian work in discriminating between whole and parti-colour coats. On the other hand, it is a possible attitude to discard the data as untrustworthy; it is not logical, I hold, to discard just as much as you please of the data and no more in order to make it fit the simpler Mendelian ratios.

KARL PEARSON.

Biometric Laboratory, University College.

THE validity of Prof. Pearson's criticism of the view that Shorthorn cattle are Mendelians turns upon the accuracy of my statements (*a*) that in the Herd-book roans are sometimes registered as reds and reds as roans; (*b*) that many white calves are not registered at all; and (*c*) that coloured calves are sometimes substituted for white ones. Unfortunately, these statements are all true, although the last one only need cause very serious regret. The following may make the position clearer.

A short time ago a very distinguished breeder was regretting the substitution of coloured calves and the difficulty of proving cases of substitution to be such. This breeder persistently uses white bulls in order to get roan calves from his red cows, and, in proof that red calves entered in the Herd-book as the progeny of reds and whites are probably substitutions, he mentioned that in all his experience he had got only one red calf from his white bulls and his red cows.

That red calf—a bull—came to Ireland, and is still alive. To the great disappointment of his owner, he has bred several white calves from roan cows.

First, by being the son of a white bull and a red cow, and, next, by breeding white calves from roan cows, this red bull disproves the theory that Shorthorns are Mendelians; but I had the privilege of seeing him this afternoon, and he is not red, *he is roan*. He is, however,

such a roan as might be mistaken for a red unless closely examined.

Here, then, is one of our most distinguished breeders referring to substitution, and making an error of description as regards the colour of a calf.

The last time I visited the farm where the above "red" bull is standing I saw some white calves, and this afternoon one of them, now six or eight weeks old, was missing. I asked the owner what had become of him, and got the reply, "I have sold him." This particular white calf may be referred to in the Herd-book by his breeder, but many another similar one is never referred to at all.

Prof. Pearson suggests that, if there are inaccuracies and misstatements in the Herd-book, "Mendelism cannot be discussed on the basis of the Shorthorn data." I do not agree. But, if not Mendelism, can biometric theories be discussed upon the same data?

The latter half of Prof. Pearson's letter does not bear much upon the present issue, but I should not be astonished, if his theories as to colour determinants and parti-colours are followed up, that each of the two races from which the Shorthorn is descended should split up into more than one variety.

Prof. Pearson thinks that, because I neglected the figures in the first part of his original paper, I was evading some of the data. This is not so. I did not notice that they comprised other data, for which I am sorry, because the ninety-one white crossings which gave eighty-six white calves, four roans, and one red, would have been helpful. I had not seen the original paper since the time it was published two years ago, and, when I conceived the idea that Shorthorns are Mendelians, I went straight to the two tables from which I quoted, in the belief that they contained all the relevant data collected by Miss Barrington and Prof. Pearson.

JAMES WILSON.

Royal College of Science, Dublin, April 8.

The Nature of γ and X-Rays.

IF I am putting the correct interpretation on Mr. Barkla's letter in NATURE of February 6 (p. 319), I have to thank him for the admission that his experiments are not so contrary to the neutral pair theory as he had at first supposed.

Mr. Barkla still concludes, however, in favour of the ether pulse theory. He has compared the intensities of two secondary beams emitted by carbon under the influence of an unpolarised primary beam, the one returning on the track of the incident rays, the other moving in a perpendicular direction. His calculated ratio is 2 : 1; experiment gives 1·85 to 1 (*Phil. Mag.*, February, p. 293). Such an agreement has its value. But, at the same time, he finds that for harder rays the ratio drops to 1·45 to 1, with no sign of a limit. His theory is unable to predict this decline, far less to measure its amount. It is no compliment to the ether pulse theory to describe such incomplete successes as "absolutely conclusive evidence."

He invites me to suggest a theory of scattering which shall have as much success as his own. But, on the neutral pair theory, the laws of scattering must depend directly on the constitution of the atom, as to which it is scarcely possible to do more than speculate. It is not incumbent on me at this stage to frame an independent hypothesis by the success of which my older one is to be judged.

He wishes to avoid arguments founded on an experimental study of the γ rays. But it is quite legitimate to begin with the γ rays, and to carry the argument over to the X-rays, on the ground that there is an extremely close parallelism between the two types. Evidence of this sort cannot be avoided by resolutely facing the other way.

It will perhaps conduce to greater clearness if I state my position briefly.

(1) Nearly a year ago I pointed out that almost all the phenomena of γ and X-rays could be explained on a neutral pair theory at least as well as on an ether pulse theory. This applied particularly to all effects connected with the production of secondary kathode rays of high velocity, effects which are at the root of most of what has been observed.

(2) I have recently described some experiments carried out by Dr. Madsen and myself which seem to me to support my contention in the strongest way as regards the γ rays.

(3) Since X-rays and γ rays resemble each other so faithfully in most respects, particularly those connected with the high-speed kathode rays, I have therefore suggested that the experiments also support my contention regarding the nature of the bulk of the X-rays.

(4) There are a few outstanding phenomena of the X-rays which do not fit in so readily with a neutral pair hypothesis, particularly Marx's velocity experiment, and the diffraction experiments of Haga and Windt. These seem to prove the existence and activity of ether pulses. As regards Mr. Barkla's polarisation effects, I have indicated a possible way of explaining them on the neutral pair theory; but I am quite content to wait for the guidance of future experiments, amongst which Mr. Barkla's recent work will take its proper place.

(5) If I admit the existence of ether pulses, I do not thereby weaken my contention that the most important and effective part of γ and X-ray radiation is material. We know that ether pulses exist; it does not follow that they do everything. On the contrary, the evidence for the ether pulse theory is extremely weak in just this direction; there is a danger that the *post hoc* has been confused with the *propter hoc*. When I see a boy jerk his arm, and hear immediately afterwards a rattling on my roof, I know quite well that the motion of the boy's arm has set an air pulse going, but I do not conclude that one of my chimneys was in a dangerously explosive condition, and that the air pulse has precipitated the violent discharge of half a brick.

W. H. BRAGG.

The University of Adelaide, South Australia, March 12.

The Corrosion of Iron and Steel.

A PAPER describing the investigation of the causes of rusting of iron was read in May, 1907, before the New York Section of the American Chemical Society by Mr. William H. Walker and others, and has been recently printed in this country. After criticising the various explanations which have been put forward of the rusting of iron in contact with water, the authors approve the suggestion of Whitney that the first step in the process is the escape into the liquid of iron in the form of positively charged ions. In confirmation of this, the authors state that they succeeded in detecting iron by chemical tests in water which contained only a trace of electrolyte, and was free from oxygen and carbon dioxide, after the water had been in contact with iron.

Such an explanation would apply to a fact which confronted me some years since when investigating the cause of the action of water on lead. Every precaution was adopted to bring a surface of metallic lead absolutely free from oxide into contact with water free from dissolved gases, with the expectation that if these conditions were fully complied with no lead would pass into solution. In the course of the investigation the precautions which were taken to secure the conditions specified gradually became more stringent, and the amount of lead passing into solution was correspondingly reduced; but when the utmost possible care had been taken, lead in very minute proportion was still detectable in the water by chemical tests. It is of interest to note that the proportion of lead was constant when the contact of water with lead had been brought about in repeated experiments with some variations in detail. The impression produced by these results on my own mind was that undoubtedly lead in the metallic state must have passed into the water, and upon reconsideration of the experimental work and its results I feel satisfied that this was the case, and that the lead probably passed into the water as iron did in the experiments made by Whitney and repeated by the American investigators, when they brought iron into contact with water under conditions similar to those which I had secured.

FRANK CLOWES.

The Grange, Dulwich.

THE GEOLOGY OF SOUTH VICTORIA LAND.[1]

THE National Antarctic Expedition is to be congratulated upon the care and promptitude with which its scientific collections are being worked out by the staff of the Natural History Museum. The results are being issued with the fulness of illustration and the excellent form characteristic of the publications of that institution. The work has been thoroughly supervised and edited. The first volume has a general preface by Sir Ray Lankester, and a special preface by Mr. Fletcher, in whose department the work of this volume was executed; the biological work is being edited by Mr. Jeffrey Bell. The first volume deals with the geological work of the expedition, and contains two reports. The first, by Mr. H. T. Ferrar, records his observations upon the stratigraphical and glacial geology. It is accompanied by a valuable geological map of the district around MacMurdo Sound, based on the topographical survey by Lieut. Mulock, and by an admirable series of photographs, that are a valuable supplement to the text, but by whom they were taken is not stated. The geological specimens obtained were mainly collected near the *Discovery's* winter quarters, and on the opposite part of the mainland. The extended field observations and the large amount of material collected are clearly the result of most indefatigable and courageous work, under difficult and dangerous conditions, and are a most important addition to Antarctic geology. The geological formations at MacMurdo Bay are divided by Mr. Ferrar into four series: the recent volcanic rocks of the islands; the gneiss and granite that form the foot hills and the basement of the mainland plateau; a wide series of horizontal sandstones, the Beacon Sandstones, that form the plateau of southern Victoria Land; and some dolerite sills intrusive into the Beacon Sandstones. Unfortunately there is no definite evidence as to the age of these sandstones. Some plant remains were found in them, and are described by Mr. Arber, according to whom they are "unfortunately of little value botanically"; he calls them "carbonaceous impressions," "which in all probability are of vegetable origin." Mr. Arber concludes that the specimens "neither permit of any opinion as to the botanical nature or affinities of the fossils themselves, nor of the geological age of the beds in which they occur." Considering the extent and abundant exposure of these sandstones, the apparent rarity of organic remains in them is significant. Mr. Ferrar devotes three chapters to glacial observations, and describes Ross's ice barrier as a Piedmont glacier, formed of confluent flows of land ice. The evidence offered in support of this conclusion is not very convincing, but until the issue of the meteorological data collected by the expedition, it is better to suspend judgment upon this question; and it may be hoped that Lieutenant Shackleton's expedition will collect further information as to the intimate structure of this ice.

The second part of the volume is occupied by Dr. Prior's report on the rocks of South Victoria Land. This report is masterly from its combination of refined petrographic research with insight into the tectonic bearings of the microscopic evidence. Dr. Prior shows that the volcanic rocks include basalts, kenytes, phonolites and trachytic phonolites; the dykes are of camptonite, kersantite, and banakite; and the basement rocks of South Victoria Land include granite, diorite, gneiss and a crystalline limestone, of which a specimen was found by Dr. Wilson. Dr. Prior's report contains an interesting discussion of the chemical relations of the rocks and their interpretation by the American quantitative system of classification. He shows that the district is a distinct petrographic province characterised by the association of limburgites with intermediate rocks, which are rich in alkali and contain anorthoclase as the predominant felspar. He has calculated the percentage mineral composition of the rocks and assigned to them the names they would receive in the American quantitative classification, and he concludes (p. 120) that "the result shows that the classification supplies a variety of names to rocks not differing very widely in chemical composition."

The sequence of the volcanic rocks is a question of much interest, especially as some field observations were regarded as showing that the trachytes were younger than the basalts; but Dr. Prior concludes from his study of the rocks that this view is improbable, and that the trachytes and kenytes preceded the basalts, as they did in the typical kenyte area in East Africa. The most widely interesting part of Dr. Prior's report is probably that discussing the geographical relations of South Victoria Land. He points out that the rocks are chemically allied to those of the Atlantic coast type, and not to those of the Pacific coast type. He, of course, recognises that, according to this use of the terms Atlantic and Pacific, the southern end of New Zealand must be regarded as of the Atlantic type, for the rocks of South Victoria Land are petrographically allied to those of Dunedin described by Dr. Marshall. An article in NATURE (in 1901, vol. lxiii., p. 610) on the probable geological relations of Victoria Land pointed out that the sudden change in the geographical grain of southern New Zealand might very likely be continued into Ant-

FIG. 1.—The two lower men are standing upon the upper surface of sea-ice depressed by snow below water-level. National Antarctic Expedition.

[1] National Antarctic Expedition, 1901–1904. Natural History, vol. i. Geology (Field-Geology; Petrography). Pp. xii+160; 10 plates and 2 maps. (By order of the Trustees of the British Museum, 1907.) Price 30s.

arctica, and that accordingly the view suggested by Reiter that the mountains of South Victoria Land were the continuation of the mountain chain of New Zealand might require modification. The geological results issued in this volume show that, as expected, South Victoria Land is a high plateau broken off to the east by the subsidences which have formed the Ross Sea. Moreover, the suspected affinities between Victoria Land and New Zealand have been greatly strengthened by the discovery of the kenyte series of Ross Island; and the predictions in NATURE (vol. lxiii., p. 610) that "the palæontological results may be meagre" has proved only too true. Reiter's theory, however, requires one modification. The earlier descriptions of Victoria Land asserted the volcanic nature of the mountains on the plateau of South Victoria Land (as, *e.g.*, is the case in Mexico and parts of the Andes), whereas the volcanoes, at least in the area reached by the expedition, were limited to the foundered area in front of the plateau, as is the case in eastern Asia. Accordingly the structure of South Victoria Land may be of the inner or secondary Pacific type, and any remains of an outer or primary Pacific coast connecting New Zealand and Graham Land may be expected further to the east. The evidence is not yet sufficient for a final opinion, and an alternative interpretation, in deference to the petrographic evidence, is to regard the coast of South Victoria Land as of the Atlantic type; but there does not seem any clear reason why the distribution of volcanic rocks of different chemical types should be controlled by the nature of the crustal movements. The suggestion that fold movements produce volcanic rocks of the Pacific type, and subsidences those of the Atlantic type, is no real explanation; and though the coincidence is certainly widespread, it does not appear to be universal. The chemical character of the volcanic rocks can only be used as a test of the tectonic structure of coasts with important limitations; and the coastal types may still be regarded as based essentially on geographical structure, and not on the chemical composition of their lavas.

J. W. GREGORY.

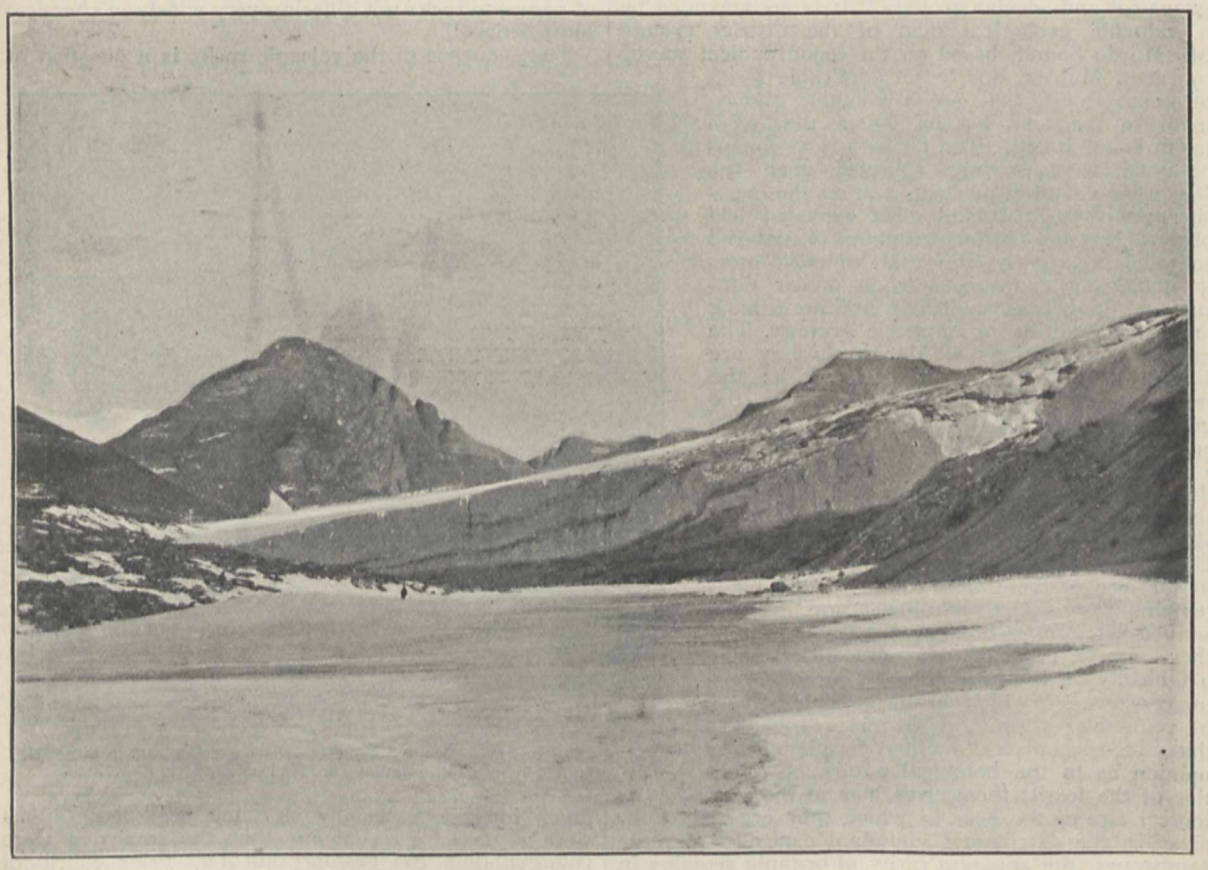


FIG. 2.—Uplift of morainic material in the ice at the foot of Knob Head. National Antarctic Expedition.

NAVIGATION OF THE AIR.[1]

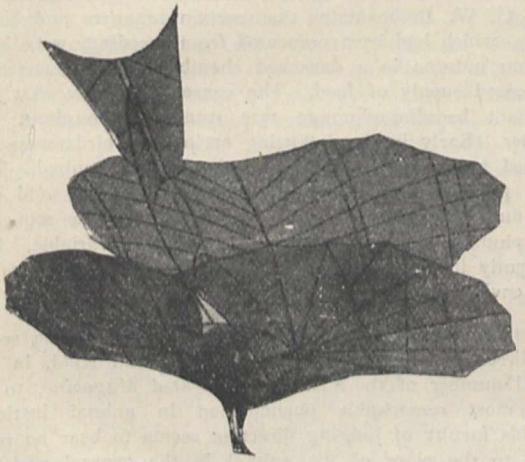
THE author of this work at the outset states that he has no intention of writing a technical text-book, and his treatment of the subject, which embraces aërial navigation generally, is distinctly of a popular kind. Portions of the work, for example, those relating to ballooning and balloon photography, are dealt with in great detail, and show an intimate practical acquaintance with the subject; the section also relating to carrier pigeons, both in connection with ballooning and otherwise, is a welcome addition to the literature of the homing pigeon. On the other hand, some portions of the work are scarcely satisfactory, even from the popular standpoint, the chapter devoted to flying machines, for example, being a collection of scraps of information strung together without any definite scheme; on the face of it, this chapter is intended to be arranged in historical order, but

[1] "Airships Past and Present, together with Chapters on the Use of Balloons in Connection with Meteorology, Photography, and the Carrier Pigeon." By A. Hildebrandt. Translated by W. H. Story. Pp. xvi+364. (London: A. Constable and Co., Ltd., 1908.) Price 10*s.* 6*d.* net.

dates are not given where they are of importance, and even so well-known a worker in the field as Hargraves is practically ignored.

The illustrations are numerous, and, on the whole, are very good; of special interest is the photographic reproduction of a "double deck" Lilienthal machine in flight, which appears to be of the type used by the late Herr Lilienthal on the occasion of his last flight, when he unfortunately met with his fatal accident. Of the great variety of "birds' eye" photographs given, perhaps the most interesting are the cloud studies given in Figs. 125, 143, and 185; also a fine view of the pyramids of Egypt, Fig. 200.

The chapters on ballooning entitled "Ballooning as a Sport," "Scientific Ballooning," and "Balloon Photography," in addition to those on "Military Ballooning," make interesting reading, and constitute the most useful and trustworthy portion of the book; there is much information collected in pages devoted to these chapters that might be sought for elsewhere in vain. The account, however, is essentially of a popular kind; it is difficult to read these chapters without raising an "aëronautical appetite"; the description of over-sea ballooning and the illustrations of the de la Vaulx *deviator* are particularly interesting.



Lilienthal on his flying machine. From "Airships Past and Present."

It is when departing from the declared intention of the work that its author most lays himself open to criticism. Thus, on p. 17, in discussing the theory of the ascension of the *Montgolfiere,* there is a simple little pitfall into which the author has gratuitously precipitated himself. On the assumed barometric pressure of 30″ of mercury, it is stated (we may presume correctly) that the weight of a cubic foot of air heated to 212° F. is 0·059 lb. Herr Hildebrandt then goes on to say:—

"At a height of 8330 feet, a cubic foot of air at a temperature of 32 deg. Fahr. weighs only 0·059 lb., and therefore a 'Montgolfiere' cannot reach a greater height than this, seeing that the lift then disappears, unless the temperatures, given in the above table, can be exceeded."

The assumption made here seems to be that the air within the balloon does not expand as the pressure is relieved by altitude, just as if the air inside the balloon were contained by a hermetically sealed pressure-proof envelope.

On p. 30 a description is given of an aneroid barometer which certainly is a mistake; either the word *tube* has been used in translation instead of *diaphragm,* or else the author describes a particular aneroid (probably made by Bourdon, of Paris) instead of the aneroid as generally constructed; the almost universal practice of instrument makers is to employ a flexible diaphragm, not a tube as stated.

On p. 89 it is somewhat puzzling to find that most of the "dirigibles" have a greater content than that of their containing cylinder—according to the figures given. For example, a balloon 30 feet in diameter and 148 feet long is given as holding 137,500 cubic feet of gas; in view of the fact that a cylinder of these dimensions has a volume of only 105,000 cubic feet, this requires some explanation. Several other cases are equally incomprehensible.

On p. 96 the year 1862 is assigned to Phillips's "venetian blind" captive machine; this appears to be an error of about thirty years (antedate).

The fatal accident to Herr Lilienthal is stated to have been due to a want of adjustment, the machine turning over at a height of 50 feet from the ground. The authority for this version of the accident should be stated; the account, as published in NATURE (September 3, 1896), contributed by Prof. Carl Runge, from the evidence of an eye-witness (the assistant of Herr Lilienthal), made no mention of any error of adjustment, but attributed the capsize to a sudden gust, which carried the machine to a height of 30 metres (100 feet), from which the fatal plunge took place.

In the chapter on carrier pigeons an account of certain experiments, stated to have been made with trained swallows, is given, but again no trustworthy authority is mentioned. A passage may be quoted as follows:—"An Antwerp trainer sent up some swallows and pigeons at the same time at Compiègne, in France. The pigeons covered the distance of 145 miles in 3¾ hours, while the swallows arrived in 1 hour 7 minutes; the speed of the latter was therefore three times that of the former." Now the time taken by the pigeons appears to denote that there was no wind of consequence, and therefore the velocity of flight of a swallow may be calculated as 130 miles per hour, a conclusion full of improbability. Statements of this kind should only be inserted in a serious work after careful verification, and with the authority stated, place and time also being given, if possible.

NOTES.

THE fourth International Congress of Mathematicians was opened at Rome on Monday, April 6, in the presence of King Victor Emmanuel II., and the proceedings concluded on Saturday last, when an invitation was accepted to hold the congress of 1912 at Cambridge. The number of members shows a considerable increase on that of previous congresses, and a great deal of valuable work has been done in the sections. The Guccia medal has been awarded to Prof. Francesco Severi, for his papers on the geometry of algebraic surfaces. We hope to give an account of the proceedings of the congress next week.

IT was announced at the meeting of the Institution of Naval Architects on April 8 that the council had gratefully accepted an offer from Mr. A. F. Yarrow, vice-president of the institution, to defray the cost, up to 20,000*l.*, of an experimental tank for research purposes to be erected at the National Physical Laboratory, provided that cost of maintenance for the first ten years was assured. A committee is to be appointed to carry out the scheme. Papers on the employment of the steam turbine for various classes of ships took a prominent place in the proceedings of the meeting. Lord Cawdor was elected president of the institution upon the retirement of Lord Glasgow.

THE annual conversazione of the Selborne Society will be held at Burlington Gardens, New Bond Street, W., on Friday, May 1, from 7.30 to 11 p.m.

THE death is announced, in his eighty-seventh year, of Prof. Franz von Leydig, of the University of Bonn, distinguished by his studies in comparative histology and various works upon anatomical subjects.

MR. J. P. JOHNSON, of Johannesburg, has been commissioned by the Government of Orange River Colony to investigate and report on the Bushmen sculptures and paintings in that territory.

AT Issy les Moulineaux on March 11, M. Delagrange, mounted upon an aëroplane, traversed the marked circuit seven times, the total distance being about 10 kilometres, in 9m. 15s. The motor with which M. Delagrange's machine is provided is a forty horse-power light cylinder Antoinette.

THE Town Council of West Ham has resolved to confer the freedom of the borough on Lord Lister, "who was born in the county borough, and has rendered such illustrious service to the human race by his famous discovery of the antiseptic system of treatment in surgery and in a variety of other ways connected with science and the alleviation of pain and suffering."

REUTER'S Agency learns that the British Government has decided to take independent action regarding sleeping sickness by establishing a National Sleeping Sickness Bureau with headquarters in London. It will be remembered that the recent international conference in London collapsed mainly owing to the opposition offered to the proposal to establish any international bureau in London. Alternative recommendations in favour of Paris and Brussels were put forward at the time, but no agreement was come to on the question. The British National Bureau will be managed by a strong committee. Annual grants will be made by the Imperial and Sudanese Governments. To combat sleeping sickness, Great Britain and Germany are concluding a convention on the subject of joint measures for the prevention of the malady in Uganda and German East Africa. This is expected to be signed at an early date.

THE Naples Table Association for Promoting Laboratory Research by Women announces the offer of a fourth prize of one thousand dollars for the best thesis written by a woman, on a scientific subject, embodying new observations and new conclusions based on an independent laboratory research in biological, chemical, or physical science. The theses offered in competition are to be presented to the executive committee of the association, and must be in the hands of the chairman of the committee on the prize, Mrs. Ellen H. Richards, Massachusetts Institute of Technology, Boston, Mass., before February 25, 1909. The prize will be awarded at the annual meeting in April, 1909. The papers presented will be judged by a board of examiners, or by such specialists as they may choose. The board of examiners is constituted as follows:—*Biological sciences*, Dr. W. H. Howell, Johns Hopkins Medical School; *chemical sciences*, Dr. T. W. Richards, Harvard University; *physical sciences*, Dr. A. A. Michelson, University of Chicago.

WE have received a somewhat belated copy (published in 1906) of No. 26 of the *North American Fauna*—U.S. Department of Agriculture—in which Mr. A. H. Howell classifies the little skunks of the genus Spilogale.

TO Nos. 3 and 4 of vol. xxix. of Notes from the Leyden Museum, Dr. E. D. van Oort contributes two papers on Papuan birds, in the second of which he describes, under the name of *Casuarius casuarius bistriatus*, an apparently new race of cassowary from the north coast of New Guinea. It is remarkable that this bird appears to be related to an Aru Island species, and thus quite different from those inhabiting the interior of New Guinea. A coloured plate of the head and neck is given.

TO *British Birds* for April Messrs. Witherby and Ticehurst contribute an article on the spread of the little owl in England. This owl cannot now be regarded otherwise than as an introduced species in England, owing to the fact that so many have been turned loose in various parts of the country. The process began in 1843 at Walton Park, Yorkshire, but the chief centres of spread have in recent years been Hampshire, Tring, Edenbridge in Kent, and Oundle. From Oundle the birds appear to have reached Woburn, where they breed freely. They also breed near Watford and other parts of Hertfordshire, while from the Kent centre these owls have colonised a considerable portion of the south-east of England.

IN an article on the seasonal colour-change in birds, published in the January number of the *American Naturalist*, Mr. C. W. Beebe states that certain tanagers and bobolinks, which had been prevented from breeding, were kept during autumn in a darkened chamber with a somewhat increased supply of food. The consequence was that the brilliant breeding-plumage was retained throughout the winter. Early in the following spring the birds were returned to normal conditions, and speedily moulted. The new plumage was, however, the nuptial dress, and not the dull winter livery, which was skipped. The sequence of plumage-change is not, therefore, invariable, but evidently in some degree dependent on external factors in the environment.

THE faculty of orientating their position, or the sense of direction, is considered by Mr. Benjamin Kidd, in the April number of the *Century Illustrated Magazine*, to be the most remarkable phenomenon in animal instinct. "This faculty of judging direction seems to bear no relation to the place of the animal in the general scale of intelligence. It is possessed to a considerable degree by dogs and cats, but in a very high degree by seals, which find their way back year after year to their rookeries from enormous distances in the open sea. It reaches a high degree of perfection in migratory birds not otherwise noted for intelligence. . . . The turtles which annually visit Ascension Island to deposit their eggs afford another example of the perfection of this instinct. How these reptiles can find this comparatively small speck of land in the midst of a vast ocean is, with our present knowledge, unaccountable."

TWO pamphlets dealing with the food of American birds have just come to hand. In the first of these (from the Year-book of the U.S. Agricultural Department for 1906), Mr. W. L. McAtee gives a list of species feeding upon scale-insects, among which those included in the States under the name of grosbeaks occupy a prominent position. According to the second paper, which is by the same author, and forms Bulletin No. 32 of the Bureau of the Biological Survey, the birds last-named are valuable in other respects to the agriculturist and horticulturist. It should be mentioned that in America the scarlet cardinal and other members of the genus Cardinalis are commonly termed grosbeaks, and it is to this group that the remarks

of the author apply. These birds are much less exclusively vegetarians than other members of the finch tribe, nearly half their food-supply consisting of animal substances. Moreover, the five species discussed in the pamphlet consume, on the average, nine times more wild seeds than grain and fruit, while the proportion of noxious to useful insects devoured by them is nineteen to one. Cardinal grosbeaks and their relatives are, therefore (after due allowance is made for certain injuries they inflict), of great economic value to the farmer, by whom they ought to be encouraged and protected.

WE offer our congratulations and best wishes for a successful life to the Transvaal Biological Society, the first meeting of which was held at the Transvaal Museum, Pretoria, on January 17, Dr. Theiler, C.M.G., being in the chair. We are unable to find space for descriptions of the papers read at the opening meeting, but the titles are given among our reports of societies and academies. The honorary secretary and treasurer of the society is Dr. L. H. Gough.

AN account of the sporangium in the Ophioglossaceæ, contributed by Mr. L. L. Burlingame to the *Botanical Gazette* (July, 1907), is based on an examination of the middle and later stages of development of the sporangium of *Ophioglossum reticulatum*. Irregular divisions of the sporogenous tissue, a remarkable difference in the stages of division of the mother cells, and an absence of definite arrangement in the positions of nuclear spindles in adjacent cells, were the chief points brought out in the investigation. A multipolar spindle changing to a tripolar, and subsequently to a bipolar, condition is figured. The development of the sporangia in the three genera Ophioglossum, Botrychium, and Helminthostachys is collated in tabular form.

DR. H. VON SCHRENK communicates to the report of the Missouri Garden for 1907 two interesting notes on growth connected with natural injuries to trees. In the one case sycamore buds were caught by the late frosts, with the result that the outer buds on the branches were killed, but the lower buds survived, and there was also a well-marked development of adventitious buds. The second note refers to hollow or button-like branch cankers formed on shrubs of *Rhododendron maximum* as a consequence of the slow growth of the healing callus tissue. Mr. H. Hus records his experiments on the germination of *Hydrastis canadensis*, a sylvestral plant yielding rhizomes that are officinal in certain pharmacopœias. The same author instances a case of virescence in the petals of *Oxalis stricta*, and mentions that the character was transmitted to the second generation.

THE annual report of the botanic station, agricultural school, and experiment plots in Dominica contains also an account of the inception and development of these establishments, and illustrations of local views. In Dominica much attention has been paid to the cultivation of limes; the establishment of a spineless variety of the fruit, and the introduction of the system of manufacturing citrate of lime for export, are expected to improve the industry. The characters of the spineless lime and the qualities of the juice are compared with those of the ordinary variety. Another feature has been the dissemination of the value of budding and grafting; in this connection, experiments in grafting cacao are noteworthy; training in these methods forms a part of the curriculum provided at the agricultural station. The manurial experiments on cacao plots indicate that various manures may be profitably applied, but the best results were obtained with mulchings of grass and lawn sweepings.

A REVISED list of the flora of Natal, compiled by Mr. J. M. Wood, has been published in the eighteenth volume (part ii.) of the Transactions of the South African Philosophical Society. The preponderance of the order Compositæ is very marked, and is partly due to the numerous species of Helichrysum, Senecio, Berkheya, and Vernonia. The next largest orders are the Gramineæ and Leguminosæ, then the Liliaceæ and Orchidaceæ. The genera Crassula, Indigofera, Royena, Selago, and Mahernia are well represented. The author recognises three botanical regions, and alludes to the palms *Hyphaene crinita* and *Phoenix reclinata*, *Strelitzia augusta*, and the handsome shade tree, *Trichilia Dregeana*, that grow in the coastal region. In the midlands the hills are grass-clad, and the forests are generally confined to the valleys, where two species of Podocarpus and *Ocotea bullata* occur. In the uplands, *Callitris cupressoides*—one of the three conifers indigenous to the country—forms isolated forests; two plants with conspicuous flowers are *Ranunculus Cooperi* and *Anemone Fanninii*, and the well-known *Galtonia candicans* is found.

IN the *Reliquary* for April, a noteworthy article is that by Mr. E. D. Goddard on certain fibulæ of the La Tène type found in Wiltshire, which may be dated about 200 B.C. This is a useful supplement to the discussions on the same subject by General Pitt-Rivers, Prof. Ridgeway, Mr. Reginald Smith, Dr. Arthur Evans, and others. The writer traces twenty-six examples found in England, of which Wiltshire and the adjoining counties claim no fewer than twenty—a fact which he thinks may imply a special connection of this part of England with Gaul in the period preceding the Roman invasion. In the same number Mr. J. L. Cowan contributes a well-illustrated article showing the evolution of house building in the Pueblo region of New Mexico, Arizona, Utah, and Colorado.

THE Observatory of Rio de Janeiro is doing very useful work in collecting and publishing in its *Boletim Mensal* series of meteorological observations made at various places in Brazil. In the number for January-March, 1907, which we have recently received, are to be found—in addition to the current tri-hourly observations at the observatory and ten-day means for other stations—monthly and annual summaries referring to several departments for 1906. Monthly and annual rainfall values are also given for Recife (Pernambuco) for fifty-four separate years between 1842 and 1906.

A COPY has just reached us of the observations made at the Royal Magnetical and Meteorological Observatory at Batavia in 1905; the principal change for this year is the omission of the hourly values of atmospheric humidity. In this valuable series of hourly readings the meteorological observations date from 1866, the magnetical from 1868; in both of these elements the influence of the moon has been taken into account. The seismometrical observations date from 1898. The present volume includes the results of meteorological observations for 1901–5, and for 1866–1905; we also note that a discussion of the rainfall at 700 stations in the archipelago is in the press. Three important appendices accompany the volume; one of these gives a list of magnetic disturbances during 1880–1899; some of the statistical results have been published by the Amsterdam Academy. We hope to refer to the others, dealing with meteorological subjects, later on.

THE Survey Department of the Ministry of Finance of Egypt has issued an account of the magnetic observations made in Egypt during the ten years 1895–1905, together with a summary of the observations made previously in northern Africa. According to the charts which embody the

results, the declination at Alexandria has decreased from 13° to 3° west, and the dip from 47° to 42°, in the last 100 years. The lines of equal declination at present run nearly parallel to the Red Sea, where the declination is 2°. At the Victoria Nyanza it is 7°. The lines of equal dip run east and west, the dip being 43° north at Port Said and 23° south at the Victoria Nyanza. The horizontal force varies from 0·30 at Cairo to 0·35 at Aden, and the curves of equal force are not unlike ellipses with their major axes east and west and their centres in the Gulf of Aden.

A PAPER on "The Possibility of a Topography of the Air, based on Balloon Observations with Special Theodolites," by Captain C. H. Ley, appears in the last issue of the Quarterly Journal of the Royal Meteorological Society (vol. xxxiv., No. 145). The paper forms a further contribution to the investigation of the upper atmosphere, which now plays so important a part in meteorological work. In all experiments hitherto made to determine the motion of the upper air from the drift of pilot balloons, it has been necessary either to observe the motion of the balloon through two theodolites at either end of a measured base line, or, if only one theodolite was available, to assume a value for the upward velocity of the balloon. In the present experiments only one theodolite was used, and the remaining data necessary for determining successive positions of the balloon were obtained from measurements of its apparent diameter made with a special arrangement of cross-wires in the eye-piece. Allowance was made for the expansion of the balloon by assuming approximate values for the rate of decrease of temperature and pressure with height, and calculating the volume of the balloon from the usual laws for the expansion of gases. The experimental and other difficulties which arise are considerable, and it can hardly be claimed that the author has succeeded in overcoming them completely, but the advantages of a method which dispenses with a second theodolite are considerable, and it is to be hoped that the experiments will be continued. The results obtained go to show that the ascensional velocity of a pilot balloon is far from uniform, as is generally assumed in experiments with only one theodolite. The most striking variations were found to occur as the balloon passed over a ridge of hills. In the vast majority of cases, when this occurred a marked increase in the rate of ascent was observed as the balloon approached the ridge, even though it was at an altitude of several thousand feet above the summit. The increase in the rate of ascent of the balloon is regarded as direct evidence of an increase in the vertical component of the motion of the air in which it floats, so that the topography of the land appears to have a close connection with the vertical motion of the air even up to altitudes of 20,000 feet.

SOME excellent photographs and drawings of the new Charing Cross Station of the South-Eastern and Chatham Railway are given by Mr. C. S. Lake in *L'Ingegneria Ferroviaria* of March 16. It is noted that the quantity of steel used in the construction of the new roof was 1000 tons.

THE School of Mines at Golden, Colorado, with 329 students, possesses exceptional environment for mining and metallurgy, and the current issue of the school Bulletin (vol. iv., No. 2), published semi-annually by the Technical and Engineering Society, affords evidence that excellent work is being done by the students. Mr. F. H. Cronin gives an outline of the course in steam-power plant design. Mr. D. Hollis and others contribute an admirable paper on the electrometallurgical treatment of copper slimes, and Mr. C. D. Test gives an account of the occurrence, production, and commercial value of monazite.

AN important contribution to the knowledge of the economic geology of Peru is afforded by a monograph, by Mr. Enrique I. Dueñas, on the mineral resources of the department of the Cuzco, forming *Boletin* No. 53 of the Corps of Peruvian Mining Engineers. Descriptions are given of the gold washings of the river Nusiniscato, of the nickel and cobalt ore deposits of Vilcabamba, of the Silurian gold veins in Paucartambo, of the oil fields of Pallpata and Pusi, of the Tertiary and Mesozoic coalfields of the department, of the iron-ore deposits of Chumbivilcas, and of veins of copper sulphide, argentiferous galena, gold quartz, and stibnite in various parts of the department. The occurrence of mica in pegmatite dykes, of asbestos, of tripoli, and of other non-metallic minerals of economic value is also recorded.

AT the Institution of Mechanical Engineers on March 27, papers were read by Dr. F. J. Brislee on combustion processes in English locomotive fire-boxes, and by Mr. L. H. Fry on combustion and heat balances in locomotives. Dr. Brislee's object was to ascertain what percentage of carbonic oxide escaped unburned, and to this end he carried out interesting trials on the London and North-Western Railway. Mr. Fry gave selections from the data published in "Locomotive Tests and Exhibits, Pennsylvania Railroad," at the St. Louis Exhibition, a book which was issued in 1905. Both papers represent a great deal of labour, and the carefully tabulated experimental results will undoubtedly prove of permanent value, although it is doubtful whether either paper is likely to affect locomotive practice.

AT the last meeting of the Institution of Engineers and Shipbuilders in Scotland, Mr. M. Kahn read a paper on the practical application of reinforced concrete. He expressed the opinion that reinforced concrete was the best form of construction when properly handled, and the worst when improperly handled. Such being the case, it behoves the owner and the architect to ensure that only the best class of contractor is employed on his work. Contractors can only afford to carry out work which will ensure them a fair amount of profit, and if, by the adoption of reinforced concrete, the owner is saved 10 per cent. of the cost of construction, it is advisable to grant the contractor any extra saving, so as to ensure his giving a construction which will prove satisfactory in every respect. When owners and engineers realise this point, and act accordingly, reinforced concrete will then reach that position in the category of structural materials where it justly belongs.

THE preliminary official report on the mineral production of Canada in 1907 shows that the total value of the output was 86,183,477 dollars, the largest total ever reached. Compared with the production of the previous year, there are some decreases to record, such, for instance, as in gold and lead, in corundum, felspar, and graphite, but these are more than counterbalanced by large increases in the production of pig iron, silver, asbestos, coal, natural gas, petroleum, and cement.

A REPORT on the work and results of the Khatanga Expedition, organised in 1905 by Dr. F. Schmidt, with the cooperation of the Russian Geographical Society, appears in the February number of *La Géographie*. The work of the expedition was divided into three sections—the exploration of the higher course of the Khatanga, and its relations with the tributaries of the Yenisei; the discovery of the main features of the lake region, and the course of

the Moiero; and, finally, the exploration of the extreme north of the Khatanga and Anabar. A map of the Khatanga and its upper branches shows the important additions to geographical knowledge resulting from the expedition, which has proved that the supposed immense lakes of that district do not exist. In addition, geological information of great interest has been obtained, together with important zoological and ethnographic collections.

PROF. ARISTIDE FIORENTINO, writing in the *Rendiconti* of the Lombardy Academy, directs attention to a school-room experiment for showing the absorption of energy by an acoustic resonator. He places the resonator in the neighbourhood of a singing flame, and if the two are in unison the vibrations of the flame instantly cease. The author has further used the singing flame as a test for syntonised resonation. Thus he has demonstrated in the case of a gramophone horn that those tones are most readily absorbed which are most strongly reinforced. The failure to take account of this fact is no doubt partly the reason why gramophone reproductions usually represent little more than a caricature of the original music. The same records are habitually snorted out through horns of all sizes and shapes, whereas if the free vibrations of any particular horn were reduced by the absorbing action of similar horns in the manufacture of the records, the results would be much better.

Himmel und Erde for March contains the report of a popular lecture on electric transmission of power to great distances, delivered by Prof. H. Görges, of Dresden, before the Scientific Association of Berlin. The lecturer deals in a clear manner with the generation of electric current by the motion of a conductor through a magnetic field, and shows how the modern dynamo is merely an application of this principle. The generation of the power to drive the machines is also treated, special attention being given to the utilisation of the waste gases from blast furnaces and to water power. Prof. Görges believes that the greatest future lies open to the simple alternating as distinguished from the triphase current, and instances the recent installation of the Ohlsdorf-Hamburg-Blankenese electric railway as a step in this direction. The pressure in this case is 6000 volts, with 30,000 for transmission to distant portions of the line.

THE London Geological Field Class excursions, conducted by Prof. H. G. Seeley, F.R.S., for the study of the Thames Basin, will commence on Saturday, May 9. Mr. J. W. Jarvis, St. Mark's College, Chelsea, S.W., is the honorary secretary.

A SECOND edition of the "Guide to the Archives of the Government of the United States in Washington," by Messrs. C. H. V. Tyne and W. G. Leland, has been published by the Carnegie Institution of Washington. The new issue has been revised and enlarged by Mr. W. G. Leland; the usual work of correcting errors, verifying statements, supplementing the bibliographical data, altering classification when required by administrative changes, and bringing the accounts to date, has been performed, and in several cases the text has been much amplified.

OUR ASTRONOMICAL COLUMN.

THE RECENTLY DISCOVERED SATELLITE OF JUPITER.—The observations made at Greenwich of the object near Jupiter, recently discovered by Mr. Melotte, tend to confirm the assumption that this object is in reality a satellite, the eighth of the known Jovian satellites.

In the April number of the *Observatory* (No. 395, p. 177) there appears a note which states that the observed positions, from January 27 to March 23, may be satisfied by the assumption that the satellite has a retrograde motion; the pole of the orbit plane lies in R.A.=334° 48′, N. dec.=56° 44′; distance from Jupiter 0·24 astronomical unit; daily motion about Jupiter, 0°·266. On February 18 it passed the minor axis of the apparent ellipse. The arc yet observed is so small that any solution can only be tentative, but it is hoped that sufficient observational material has been gathered to ensure the re-discovery of the satellite at the next favourable presentation.

MUTUAL OCCULTATIONS AND ECLIPSES OF JUPITER'S SATELLITES.—A partial occultation of Ganymede by Europa was observed by Mr. Whitmell on January 25, the phenomenon lasting for some fifteen minutes. Prof. Oudeman recently published some ephemerides for occultations to take place in June next, but in No. 395 of the *Observatory* (April, p. 178) there appears a list of times at which occultations will take place during the present month. In the following extract the first Roman figure indicates the eclipsed, the second the eclipsing, satellite:—April 17d. 10h. 41m., II., III.; 17d. 14h. 17m., II., I.; 21d. 12h. 19m., IV., II.; 22d. 9h. 41m., IV., III.; 22d. 11h. 27m., I., II.; 28d. 13h. 29m., IV., III.

THE TRANSIT OF MERCURY, NOVEMBER, 1907.—In No. 4238 of the *Astronomische Nachrichten* (March 9, p. 218) M. Gautier records the results of the observations made, at the Geneva Observatory, of the recent transit of Mercury. Neither the bright outer ring nor the central luminous spot was observed at any time during the transit. Times of the contacts and the positions of Mercury referred to the sun's limb at different times during the transit are given, and it is recorded that M. Pidoux, using the Plantamour equatorial of 271 mm. aperture, found the apparent diameter of the planet's disc to be 8″·4, an amount sensibly less than that given by the ephemerides.

PARALLAX OBSERVATIONS.—The results of various parallax observations made by Dr. Karl Bohlin at the Stockholm Observatory appear in No. 4240 of the *Astronomische Nachrichten* (March 23, p. 247). The first object considered is a nebula, G.C. 1532, and the second an adjacent star, Lalande 14512. Their respective parallaxes are −0″·036 and −0″·058, the Brünnow relative corrections for the aberration constant being +0″·186 and +0″·149 respectively, corrections to which Dr. Bohlin directs especial attention on account of their magnitude. The corresponding figures for Bossert 947 (=Lalande 18115) and 61 Cygni are +0″·085 and +0″·363 for the parallaxes, and +0″·102 and +0″·048 for the corrections.

ASTRONOMICAL PHOTOGRAPHY WITH PORTRAIT LENSES.—Some good examples of celestial pictures taken with portrait lenses are reproduced in No. 187, vol. xlvi., of the Proceedings of the American Philosophical Society (October-December, 1907, p. 417), in order to illustrate a paper by Prof. Barnard on the subject of astronomical photography. Prof. Barnard, in the first place, discusses the great advantages accruing from photography in the correct delineation of celestial objects, and then points out the special suitability of the earlier portrait lenses of large aperture for this purpose. This is followed by a discussion of each of the objects shown, including nebulæ, star clusters, meteor trails, comets, &c. Most of the pictures were taken with the 10-inch Brashear doublet of the Bruce telescope.

THE HARVARD COLLEGE OBSERVATORY.—Prof. Pickering's report of the work done at the Harvard College Observatory during the year ended September 30, 1907, is the sixty-second of its series, and contains the usual brief summary of an immense amount of work. With the 11-inch Draper telescope, 356 photographs were secured, making 17,035 in all, and with the 8-inch Draper telescope the taking of 611 photographs brought the total to 34,886. The spectra of 456 stars, taken with the 11-inch instrument, were studied and classified by Miss Cannon, thus bringing near to completion a catalogue of the spectra of more than 1200 stars north of declination −30°. 2710 stellar photographs were taken at Arequipa, the total numbers now taken with the 13-inch Boyden and 8-inch Bache telescopes being 11,847 and 38,224 respectively. Other results, too numerous to mention here, are contained in the report, and it is announced that to private

individuals a nominal charge will in future be made for the Harvard publications.

THE SATURN PERTURBATIONS OF VARIOUS COMETS.—An abstract (No. 3) from the *Archiv der deutschen Seewarte* (vol. xxx., 1907) contains an important mathematical discussion of the perturbations of several comets by Saturn. The first-order perturbations of comets 1889 V., 1896 VI., and 1903 V. (Brooks) are discussed, and the work has been carried out by Dr. Johannes Wendt.

THE GAMES OF NORTH AMERICAN INDIANS.[1]

IT has been known that Mr. Stewart Culin, formerly of the Free Museum of Science and Art in Philadelphia, and now of the Brooklyn Institute Museum, has for many years been engaged in a study of the games of the American Indians, and his monograph on the subject has recently been published in the "Twenty-fourth Annual Report of the Bureau of American Ethnology." The value of the memoir can partly be judged by the fact that, with the full index, it extends to 846 pages and contains 1112 figures in the text, in addition to twenty-one plates. The memoir itself is practically an illustrated catalogue of specimens in various museums, combined with extracts from numerous authors. Students of this interesting and suggestive branch of ethnology have now for the first time a mass of data at their disposal, and it is to be hoped that other regions of the world will be treated by equally qualified investigators in a similarly thorough manner. Some material for such studies occurs scattered in various publications and in unpublished museum specimens, but more field-work is necessary before anything so complete as Mr. Culin's monograph can be accomplished.

The collection has been confined to games in which implements are employed, but Indian children have many amusements played without accessories which belong to a different category from those described by Mr. Culin. It is to be hoped that these will eventually be studied, as they are of equal interest with the others.

The indigenous games of the American Indians, excluding purely children's games, may be divided into two groups:—(1) games of chance; (2) games of dexterity. Games of pure skill and calculation, such as chess, are entirely absent. In the first group are:—(1) games in which implements of the nature of dice are thrown at random to determine a number or numbers, and the sum of the count is kept by means of sticks, pebbles, &c., or upon a counting board; (2) games in which one or more of the players guess in which of two or more places an odd or specially marked lot is concealed, success or failure resulting in the gain or loss of counters. In the second group are:—(1) archery in various modifications; (2) a game of sliding javelins or darts upon the hard ground or ice; (3) a game of shooting at a moving target consisting of a netted wheel or a ring; (4) the game of ball in several highly specialised forms; (5) the racing games, more or less related to and complicated with the ball games. In addition, a few other games are described, and allusion is made to introduced games, such as cards and board games.

References to games are of common occurrence in the origin myths of various North American tribes. They usually consist of a description of a series of contests, in which the first man or culture hero overcomes some opponent or foe of the human race. The primal gamblers are the Divine Twins, the miraculous offspring of the Sun, who are the principal personages in many Indian mythologies. They, who are the morning and evening stars, live in the east and the west, ruling day and night, summer and winter. Their virgin mother, who also appears as their sister and wife, is constantly spoken of as their grandmother, and is the Moon or the Earth, the Spider Woman, the embodiment of the feminine principle in nature. Always contending, they are the original patrons of play, and their games are the games now played by men. Mr. Cushing thus described the Twins in his account of the Zuñi War Gods:—

"Lo! and of Chance and Fate were they the masters of foredeeming, for they carried the word-painted arrows of destiny, like the regions of men, four in number. And they carried the shuttlecocks of divination, like the regions of men, four in number. And they carried tubes of hidden things . . . and the revealing balls thereof. . . . Yea, and they bore with these other things, the feather bow and plume arrow of far-finding, tipped with the shell of heart-

FIG. 1.—San Carlos Apache Indians playing hoop and pole, Arizona. From a photograph by Mr. S. C. Simms.

searching; and the race sticks of swift journeys and way-winning, two of them, the right and the left, the pursuer and the pursued of men in contention. All these things wherewith to divine men's chance, and play games of hazard, wagering the fate of whole nations on mere pastime, had they with them."

The gaming implements of most North American Indians "are almost exclusively derived from these symbolic weapons." Thus the stick dice are either arrow-shafts or miniature bows, and a similar origin may be asserted for the two or four bones employed in the hand-guessing game or in the four-stick game. Counting sticks in general and the numerous sticks of the widely spread stick game are arrows. The engraved and painted tubes used in the guessing game are arrow shaftments, and this variant probably arose in a country where strong, hollow reeds were used as arrows. In the games of dexterity we also find bows and arrows, often associated with the netted shield. The snow-snake, or game in which missiles are hurled along snow, ice, or frozen ground, appears to be confined to the northern range of tribes within the limit of ice and snow; the projectiles are apparently

[1] "The Games of the North American Indians." By Stewart Culin. Twenty-fourth Annual Report of the Bureau of American Ethnology, 1902-3. Pp. xl+846. (Washington: Government Printing Office, 1907.)

derived from clubs, bows or arrows, and may be referred to the weapons of the twin War Gods.

The opposing players are frequently the representatives of the two War Gods, and gaming implements are among the objects sacrificed upon the altar of the Twins Zuñi. In general, games appear to be played ceremonially, as pleasing to the gods, with the object of securing fertility, causing rain, giving and prolonging life, expelling demons, or curing sickness. There is no direct evidence of the employment of games in divination, apart from an observation by Cushing.

The game of hoop and pole, like the dice game, was played throughout the entire continent north of Mexico. It consists essentially in throwing a spear or shooting an arrow at a hoop or ring, the counts being determined by the way in which the darts fall with reference to the target. The game is remarkable for the wide diversity in the form of the implements employed, as well as in the method of play. A common and most widely distributed form of the hoop is twined with a network resembling

FIG. 2.—Altar of War God, Zuñi, New Mexico, with corn-cob darts used in the ring (or hoop) game. From a photograph of the reproduction in the United States National Museum.

a spider's web, the counts being determined by the particular holes which are penetrated by the darts. The author regards the plain hoop as a modification of the netted hoop, which represents the net shield of the twin War Gods. This object, which the Twins derived from the Spider Woman, is a feminine symbol, and may be used as an amulet. The dart or arrows are masculine. Dr. G. A. Dorsey, who has studied the symbolism of the ring employed in the Sun dance of the Arapaho, says it is symbolic of the creation of the world, for it represents the sun, earth, sky, water, and wind. Although Mr. Culin states "there is no record of women participating" in this game, it is played, as he himself notes, by Hopi maidens as a part of the prolonged Oraibi Oáqöl ceremonies (H. R. Voth, Field Columbian Museum, Anth. Series, vi. [1903], p. 42). Though this cult is largely concerned with producing rain, it seems to be essentially a germination ceremony, and probably has reference to the maturation of the maidens. Mr. Culin adduces other evidence in support of a fertility significance for this game, but he does not make any special allusion to it. Amongst some tribes the game is mythologically connected with the increase of buffalo; indeed, the Cheyenne and other Plains Indians call it the "buffalo game." The game had a religious character among the Apache, and probably this held good everywhere.

Probably connected with the foregoing is the widely spread game played by one person which consists of catching a ring, perforated object, or a ball on a peg. Dr. G. A. Dorsey says the Klamath always play it in winter; it is called "splitting or punching out the moon," and in this way the winter months are shortened and the advent of spring is hastened.

Ball games are well developed in North America, and Mr. Culin deals with them as fully as possible. The game of cat's cradle receives some attention, and various figures are illustrated, but as no instructions are given as to how they are made, much of the information is of little value. Mrs. Jayne's remarkable book on the subject is not referred to, neither is the magical aspect of the game among certain Eskimo as recorded by Boas on the authority of Captain Comer. The holy spiders taught the game to the Navaho, but calamity would befal if it were played at any other time than winter. The Zuñi explain cat's cradle as the netted shield of the War Gods, the game having been taught to them when little boys by the Spider Woman for their amusement. Owing to the ubiquitous nature of this pastime, it is evident that the Zuñi explanation of its origin is purely secondary, and was invented to bring it into their mythological system. We may suspect that the same may have happened for the hoop and pole game, in spite of Mr. Culin's belief that the oldest forms of existing games occur in the south-western United States. Lack of space precludes due mention of the numerous minor amusements described by the author, though they are of considerable interest.

In introducing the memoir, Prof. W. H. Holmes, Chief of the Bureau, states that "the paper practically creates the science of games, and for the first time gives this branch its proper place in the science of man." This eulogy is somewhat exaggerated, as others on this side of the Atlantic have directed attention to the ethnological value of the study of games, and while Mr. Culin has produced a memorable monograph of lasting value, he can hardly be said to have introduced therein any general principles that had not previously been enunciated.

A. C. HADDON.

NERVE AS A MASTER OF MUSCLE.[1]

WE have on the table before us two muscles. The animal was dead when they were taken from it a short while ago. But the animal was, as we are ourselves, an assemblage of organs, and many of these organs go on living for a certain time after the animal, as an animal, is dead. Hence these muscles, carefully removed, are still alive. We notice a marked difference between their behaviour now. To understand the behaviour of organisms we have to think of them as processes rather than as structures. An animal is something happening. The function of muscles is to contract. Of the two muscles now before us, one still goes on contracting, although quite isolated from the body of which it formed a part; but the other does not contract, although that is its function in the body. The muscle which still goes on contracting is the heart; the other is a muscle like the biceps of our own arm. We might think that, as it rests there motionless, it is not alive. It is, however, fully alive. We can satisfy ourselves of that. If I apply to it a faint electric current, it answers by exhibiting its functional activity—it contracts. Yet it does not contract of itself, nor will it, however long we may preserve it; it will die without of itself even contracting once. What is the significance of this difference between the two?

The secret of this difference is largely an affair of the nervous system. The tie between muscular activity and nervous activity is always close; but it is very different in

[1] A discourse delivered at the Royal Institution by Prof. C. S. Sherrington, F.R.S.

different muscles. The nervous system has been called, with a picturesque truth, the master-system of the body. It controls the action of organs; it controls, quite especially, the activity of the muscles. This heart which we see beating here receives nerves. One of those nerves when stimulated will cause it to contract less, the other to contract more. The contraction of the heart is its "beat." The vagus nerve slows the beating, the other nerve quickens the beating.

The heart is a tubular muscle; it drives blood through itself. When it contracts it squeezes the blood from it into the arteries, and so the blood flows to feed all the myriads of minute lives—cells—composing the whole complex living animal. The lives of these myriad minute entities all depend on their supply of blood, and therefore the life of the whole creature depends on the contraction of the heart. At each beat the heart by squeezing the blood out of its arterial end maintains the flow of blood, and this flow resulting from its own contraction refills it, because the blood returns to it by the veins.

This beating is all which the heart has to do. Whatever happens it must continue to do this, or the creature perishes. Life-long, night and day, winter and summer, it must do this. Whatever act the creature may be accomplishing, sitting, walking, feeding, sleeping, catching its prey, or escaping its enemies, this beating must go on, in the frog about ten times a minute, in ourselves about seventy times a minute. The task is monotony itself. How admirably is the heart muscle adapted to fulfil it!

Self-adjustment to meet the environmental conditions differentiates animate from inanimate nature. As characteristic as this self-adjustment itself is its constant trend toward what has sometimes been termed "purpose." Animate objects are observed to adjust themselves to their own advantage, that is, so as to prolong their individual existence or that of their species. The more we know of them the more complete appears to us this trend in their reactions. The living organism advantageously adapts itself to its surroundings; and every part of a living organism exhibits this power. The heart-muscle reveals it clearly. It must not tire, and in normal circumstances the healthy heart, unlike other muscles, shows no fatigue. Its beat must always be strong enough to press its contents over into the artery against considerable resistance which opposes it. A heart-beat which did not expel the blood would be useless, worse than useless, wasteful, because it would be energy spent in vain. Its task can be roughly likened to that of a man with a bucket who has to keep lifting water from a tank at his feet to pour it over a wall of certain height before him. If he lift the bucket much above the wall he expends more energy than he need do; if he lift it less than the wall's height his work fails altogether. If he still, when the bucket is emptied, keep it above the wall's height, his work stops, although his effort does not.

The heart, whether its stimulus be weak or strong, beats always with sufficient power; it thus avoids the useless labour of a beat too weak to fulfil the office of a beat. If the heart were to give too prolonged contraction it would defeat its own purpose; after its beat, which empties it of blood, it must relax to refill for the next beat; to keep contracted would be for its purpose as harmful as to cease from beating; it would stop the blood instead of pumping it onward. In harmony with this, we find a prolonged stimulus to the heart does not keep the heart contracted; after the heart has replied to the stimulus by a beat it exhibits a refractory phase, during which it pays no attention to the further stimulation, and relaxes; and only after it has fully relaxed does it again pay attention to the stimulus and contract, that is to say, beat again. In short, it replies rhythmically to a continued stimulus which would keep the other muscle continuously contracted.

That the heart should go on beating after removal from the body does not seem greatly surprising, because it is still then alive. The wonder lies rather in its continuing to live so long when thus removed; that granted, it seems natural that it should do what it has done previously all its life.

But this other muscle, which likewise continues to live when removed from the body; it, though it *can* contract, does not. That seems—at least at first sight—the more remarkable. Why does this muscle stop? So long as it was part of the living creature it showed contraction over and over again. We must turn to the nervous system for our answer.

In the first place let us note that an animal, unlike that other great example of life, a plant, cannot nourish itself from naked earth and air alone. The plant strikes down roots and throws up leaves, and draws through these material and energy with which it can replenish its own substance and activities. Where it as a seed fell, there its foster-moster Earth gives it the food it wants. Not so the animal. It must have subtler and rarer stuffs, or die. The material it needs is not spread so broadcast. It, to replenish itself, must have more special material; it must have for food material that is living, or has lived. To obtain this it has to range about. It has to hunt for it; and it itself is hunted by other animals following the same quest. Therefore its very existence involves locomotion. It must find food and seize it, and must itself escape being found and seized. It is both hunter and hunted. Moreover, in a vast number of cases it has to seek its kind to propagate its species. The movement necessary in this great game of life is million-sided—subtle beyond words—and most animal lives are spent in nothing else. Existence for the individual and the race depends upon success in it. Man plays it also—let us hope that sometimes he plays something else as well. In all cases the chief instruments of the game are the skeletal muscles, those muscles of which the biceps of our arm may stand as type. An old philosophic adage has it that all which mankind can effect is to move things. The dictum illustrates how supremely chief an executant of man's activity his muscles are. All the things which man can move are moved in the first instance by that prime thing which he can move, his body; and for this his main agents are his skeletal muscles. These execute his movements, but in doing so are but the instruments of his nervous system. Therefore it is in reality the nervous system which is the player of the game; and it is because it is really the nervous system which is the player of the game that man is the most successful creature on earth's surface at the present epoch, for his is the nervous system which, on the whole, is the most developed, much best adapted to dominate the environment.

To understand a little how the nervous system compasses this end we may turn to examine its performance in some of its simpler governing of the muscles. Its main office is to react to changes in the environment. The animal body is provided with a number of organs specially attuned to react to changes in the environment. These changes, in so far as they excite these organs, are termed stimuli. Thus, it has organs stimulated by the radiant energy of light and heat, others by chemical particles drifting from odorous objects, others mechanically by objects touching the skin, and so on. These organs, specially adapted to environmental stimuli, are called *receptors*. Attached to them are nerves. Through these the excitement set up in the receptor by a stimulus spreads to the general nervous system. Arrived there, two kinds of effect ensue from it—one, a change in nerve-cells innervating muscles and glands, the other, a change in consciousness on the basis of sensation. These two effects are separable. The former, or "reflex" reaction, is not necessarily accompanied by any manifestation of the latter, though it may be so, and very often is so. We will confine ourselves to the former, or purely reflex effect, and to its operation on muscle.

The endowment with receptor organs is not equally rich in all parts of the body. It is the external surface of the animal which, as we might expect, has them in richest profusion; and the receptors of the external surface are likewise those most developed, specialised, and sensitive. This also we might expect; for it is the external surface that for countless ages has felt the influences of the illimitable outside world playing on it. Through refinement of the receptors of its outer surface the animal has been rendered sensitive in many cases to stimuli delivered even by the remotest stars.

It is a feature of receptors generally that they react most to their agent when the intensity of that agent

changes, and the more so the more abrupt the change. It is, therefore, changes in the outside world that operate especially as stimuli, though, of course, only changes which have relation to the animal in question. If we regard the mutual relation between the animal and the world at any moment as an equilibrium, then we can say that any change in the world which changes that relation disturbs the equilibrium.

Take the instance of a child asleep. A thousand agencies of the external world are playing upon it. Upon its skin, for instance, there is the pressure of the child's own weight against the receptors, and there is the pressure of the clothes which cover it; yet it lies restful. Suppose we touch its foot. That is a change in the external world in relation to the child. The familiar fact is that the foot is drawn up out of harm's way, as it were. The change has acted upon the child as a stimulus to some receptors of the skin. It may be quite unconscious of the touch, for its sleep may be deep. Yet the reflex action has occurred, and has done the appropriate thing. A candle may be brought into the room and its light reach the face of the child. That is a change in the outside world in relation to the child. The familiar fact is that the child's head turns from the light. It *sees* no light, but reflex action averts its face. Or, turning to other forms of life, take a fish quiet in its aquarium. A worm is dropped into the water, and the disturbance of the water reaches the surface of the fish. The fish turns and seizes the morsel. Such a reaction on the part of such a creature is probably wholly reflex.

The point for us here is, that the changes in the outside world which act as stimuli bring about appropriate re-adjustments of the body to the external world, and that in doing so the instruments of readjustment are the skeletal muscles, worked by the nervous system. The child's heart goes on beating, whether the child's foot lies quiet or is moved, whether its face lies this way or lies that; the fish's heart whether the animal's skin was stimulated by fresh commotion in the water, or was not. But with the skeletal muscles it was different. Flexor muscles of the leg, that were relaxed, are by the touch to the foot thrown into action; muscles which lay relaxed were, when the light came, caused to contract, turning the head away. Muscles of the fish that were inactive were thrown into activity by the new commotion in the water. It is these skeletal muscles, therefore, that the daily thousand changes of the external world so repeatedly and constantly affect in this way or that, and in reflex action it is always the receptors and the nervous system which impel them to react; and the result is to re-adjust advantageously to the animal its relation to the altering external world. Hence these muscles are called the muscles of *external relation*. So prominent are these muscles in the everyday work of life that they are *the* muscles of ordinary parlance. The man in the street is hardly aware that he has in his body any other muscles. These muscles are, through the nervous system, driven by the external world. The world outside drives them by acting on the receptors. It is not surprising, therefore, that this little muscle, removed from the body, and therefore separated from the nervous system and all its receptors, remains, although still living and able to contract, as functionally inactive—for contraction is its function, and it does not contract—as if it were already dead.

Now this muscle, when in the body, was the servant of a thousand masters. It had to contribute to a thousand acts. In a certain sense, it, like the heart, had to do for them all but one thing, inasmuch as it had to pull the limb in one certain direction; and yet its task is a very varied one. It has to pull the limb sometimes far, sometimes very slightly, or through all intermediate grades. It has to pull it strongly against great resistance, or weakly, and with all intermediate grades of intensity. We may suppose that in the course of evolution it had become adapted to this scope of purpose.

And indeed we find it so. Unlike the heart muscle, this muscle when a strong stimulus is applied contracts strongly, when a weak stimulus, weakly; under a long stimulus it contracts long, under a brief, briefly. The nervous system, in making use of this muscle, wants of it just such varied action as this—now weak, now strong, now brief, now long, as may be suited to the act required. The little organ is admirably adapted to be the animal's instrument in the world in which it is placed. This muscle has its place in the economy of nature, and into it it fits as a key into the lock for which it has been made. Man's naïve view, until somewhat recently, was that the earth and the universe were made to fit him. Was the universe made to suit this little muscle or was this little muscle made to suit the universe? The problem concerning this muscle and that concerning man are, in so far, the same. Surely our answer is that the muscle and the rest of the universe fit each other because they have grown up together—because they are part of one great whole; they fit just as a lock and key fit because they compose one thing, and it is pointless to ask whether the lock was made to fit the key or the key the lock.

The office of the nervous system is to coordinate the activities of the various organs of the body, so that by harmonious arrangement the power and delicacy of the animal's mechanism may be obtained to the full. When reflex action withdraws the foot of a sleeping child, it is not merely one such muscle as this which moves the limb, but many. The limb has many muscles, and even in such a simple act many and many of them are employed.

That the act occurs during sleep shows that consciousness is not its necessary adjunct. A similar act can be similarly evoked in an animal when the brain—the seat of consciousness—has been removed. The brain can be removed under deep narcosis of chloroform without any pain or feeling whatsoever. After that removal the animal is no longer a sentient or conscious thing at all. Then we can study in it the power of reflex action sundered from conscient and sentient life altogether. Then it is that opportunity is given for further reverent analysis of those wonderful and subtle workings of the nervous system which in ourselves are so difficult to unravel for the very reason that their working goes on without appeal to, and often beyond access of, the conscious self.

When analysing the muscular action of even so simple a reflex act as that of drawing up the foot, a fact which early meets the observer is that the nervous system treats whole *groups* of muscles as single mechanisms. In lifting the limb it employs together muscles, not only of one joint of the limb, but of all the joints—knee, hip, ankle, &c. It deals with all these muscles as if they were but one single machine. If the movement is forcible, it throws them all into strong contraction; if weak, into weak. In the grading of the reflex action its influence is graded in all these muscles alike. So also the contraction in all of them is timed to begin together, to culminate together, and to desist together. Further, although the movement of this lifting of the limb is mainly flexion at its joints, the reflex accomplishes along with that some internal rotation of the hip and some abduction of the thigh. Why it should do so we shall see presently. Suffice us for the present that, besides the flexor muscles, the nervous system brings into play, at the same time and harmoniously with those, two other great groups of muscles, the internal rotators and the abductors. So perfect is its skill in using the muscles as its instruments that it can deal harmoniously and simultaneously with all these individually complex groups of motor organs as though they were but one.

Were we to attempt to produce this movement in the limb experimentally without employing its nervous system, we should have to apply I know not how many stimuli simultaneously to more than half the muscles of the limb. Not only that, but we should have to grade the stimulation of each of these most accurately to a particular strength. We should also have to arrange that, not only did each stimulus develop its full strength with the right speed, but that each should maintain it for the appropriate time and desist at the right speed and moment, and with proportioned intensity. Moreover, in the real reflex act the contraction of this or that muscle is now stressed, now subdued, with a delicacy and accuracy baffling all experimental imitation. The coordination in even the simple reflex we are considering may be likened to that exhibited by a vast assemblage of instruments in very perfect orchestration directed by a supremely capable conductor.

But it is more subtle and delicate than that, even in

the simple reflex we are considering. The coordination goes much farther than we have yet assumed. The musculature of the limb is an instance of that kind of musculature which obtains where parts are adapted to move, not in one direction only or one way only, but in many. The limb has to do many different things. It has, according to circumstances, to bend or to straighten, to turn inwards at one time, at another to turn outwards, to move this finger or move that. Its musculature is therefore split up into many different muscles—some doing this, some doing that. Hence it comes that in the limb are muscles which when they contract do with the limb exactly opposite things. Thus we find a set of muscles which bend the knee, and another which straighten the knee; so, similarly, at hip and ankle, at elbow, shoulder, and wrist. These muscles of opposed action are called antagonists. Now in the flexion reflex—the reflex we are considering—when the reflex bends the knee by causing the flexor muscles to contract, what happens with regard to the muscles which straighten the knee? Do the opponents, the muscles which straighten the knee, contract, or does the reflex nervous influence leave these muscles untouched? It used to be taught that the muscles which straighten the knee, the extensor muscles, contract, and by their contraction exert a moderating influence on the muscles which execute the flexion. That was the anatomical speculation deduced from simple dissection of the musculature of the dead limb. Experiment with the living limb teaches that nature does not expend her muscular energy in using the power of one muscle simply to curb the power of another. When the knee is bent the reflex act does not hamper the working of the flexor muscles by causing a contraction of the extensors also. Nor does it simply leave the extensors out of account. No; it causes them to relax and lengthen at the same time as it causes the flexor muscles to contract and shorten. This it does by reflex *inhibition*; and it proportions the grade of this relaxation exactly to the grade of contraction of the opponent muscles.

The inhibition acts, not on the muscle directly, but on the motor nerve-cells innervating the muscle. These nerve-cells are long filaments; one end of each lies in the muscle, the other in the spinal cord. The reflex inhibition is exercised upon them at the end which lies in the spinal cord. In the reflex we are considering, the reflex action, besides *exciting* the motor nerve-cells of the three muscle groups—flexors, abductors, and internal rotators—before mentioned, *inhibits* the motor nerve-cells of three muscle groups antagonistic to those, namely, the extensors, the abductors, and external rotators. We see, therefore, that in even the simple reflex lifting of the foot, almost every one of the many muscles composing the whole musculature of the limb receives from the nervous system a controlling influence, either of excitation to contract or of inhibition which relaxes contraction; and all this in result of a simple touch of the skin of the foot. The reaction typifies in a simple manner the action of the nervous system to knit the heterogeneous powers of the body together into one harmonious whole.

Thus we see that in these actions when one group of muscles contracts the group antagonistic to it relaxes. This is a fundamental part of the coordination of the act, and its discovery throws a welcome light on the nature of certain maladies. Were the antagonistic group to contract at the same time as the protagonist, the desired movement would not result. The movement which then ensued would depend on which of the two muscle groups were the stronger, the protagonist or the antagonist. The alkaloid strychnine and the poison produced by the bacilli which cause the malady called "lock-jaw" possess the power of destroying reflex inhibition. What the intricate nature of the process of this inhibition is we do not yet know, but it seems to be the exact converse of the process of excitation, the nature of which is also unknown. Strychnine and tetanus-toxin change the process of inhibition into its converse, namely, excitation. If a minute dose of strychnine be administered, the reflex which, as we saw, causes the limb to bend, now causes the limb to straighten instead. This is because the extensors, when the flexors contract, instead of being relaxed by inhibition, are excited to contraction, and being more powerful than the flexors move the limb in exactly the opposite direction to that in which it should move in this reflex action. Similarly with the toxin of "lock-jaw." The muscles which close the jaws are much more powerful than those which open them. In the normal act of opening the mouth the relatively feeble opening muscles contract, and the powerful closing muscles are simultaneously relaxed by reflex inhibition. But in an animal or man poisoned with this toxin the normal inhibition of the closing muscles is changed to the exactly opposite process of excitation, so that their contraction results. Against the power of these strong closing muscles the contraction of the weak opening muscles can effect little. Each time, therefore, that the sufferer tries to open his jaws to take food or speak, he clenches his jaws instead of opening them—experiencing a torture which, although unaccompanied by physical pain, is inexpressibly distressing; and the disorder leads to death from inanition.

But to return to the reflex lifting of the leg, whence we set out. It was mentioned that in this reflex the limb was not merely lifted, but was slightly rotated inwards at the hip, and that the thigh was slightly abducted, that is to say, drawn sideways, separating it more from the fellow-limb of the opposite. These accessory movements have a significance coinciding with much other evidence into which we have not time to enter now. They, together with other evidence, show that this lifting of the leg, so easily produced reflexly, is nothing more nor less than the first movement of the taking of a step. In fact, in our rough and imperfect analysis of this little movement, we have been examining part of the great and extraordinarily complex and perfect act which is called walking—or more technically, so as to include the cognate acts of trotting and running—locomotion. A little reflection will suffice to assure you that included in the action of locomotion is also that of standing. We are apt to forget that the muscles have a static as well as a kinetic action—that they are the instruments of maintaining position, as well as of the execution of movements. Directly we begin to analyse locomotion we see that its basis, as it were, is the position of standing, upon which movements of stepping are, as it were, grafted. Not much is known as yet of how animals and ourselves stand, walk, and run. In these acts, probably, every skeletal muscle in the whole body is concerned. Rheumatism can make us aware of that. A little receptor organ in the ear is a great factor in the whole matter. But of this we may be sure, that foremost in its factors are reflex actions of the limbs. Great economic questions are involved in this unravelling of the act of locomotion—all beasts of draught and burden are chiefly useful to us because they can stand, and walk, and run. We can only employ their powers to full advantage and with due regard to them as they unfold these powers when we shall have learnt something of the way in which these movements are conducted and performed.

The crude and imperfect analysis which I have attempted to outline concerned but *one phase* of the step of a *single* limb. In the complete act the other limbs will at the same time be executing other phases of the whole cyclic reflex. The neck and trunk are also involved; so, likewise, the head itself. Our imperfect analysis threw sidelights on the nature of the mischief wrought by strychnine-poisoning and the malady "lock-jaw." Interesting and useful though these sidelights may be, more really interesting and valuable would be any light which such analysis, crude as it is, could throw on that great normal process of every-day health, animal (including human) locomotion. Analysis of the reflex movement in unconscious animals seems at the present time the only way by which such knowledge can be gained.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Lord Rayleigh was on April 10 unanimously elected Chancellor of the University in succession to the late Duke of Devonshire. It is expected that the inauguration and the installation of the new Chancellor will take place during the May term.

EDINBURGH.—At the spring graduation ceremony on April 10, the honorary degree of Doctor of Laws was conferred upon several guests in recognition of scientific work. Sir Ludovic Grant, dean of the faculty of law, in presenting these recipients of the degree, made the following references to their achievements in the field of science :—

DR. J. O. AFFLECK.—Whether regard be had to Dr. Affleck's work as a teacher, or to his scientific contributions to medical literature, or to his eminence as a physician and his services in the practice of his profession, he is equally deserving of recognition at the hands of his old Alma Mater. Almost from the time that he graduated, Dr. Affleck has been an indefatigable writer. Indeed, the great bulk of the medical articles in the ninth edition of the "Encyclopædia Britannica" are from his pen. These, and his other papers, form together a veritable storehouse of scientific information.

DR. RICHARD CATON, Lord Mayor of Liverpool.—Dr. Caton was one of the band of devoted labourers whose strenuous exertions were instrumental in calling into existence the University of Liverpool, and he himself discharged the duties of professor of physiology for many years with conspicuous success. With his scientific attainments Dr. Caton combines the accomplishments of the scholar and the zest of the archæologist. His lectures—embodying the fruits of visits to Greece and the Greek colonies—on the Greek and Egyptian gods of medicine throw a flood of light on the medical and sanitary aspects of the ancient world.

SIR NORMAN LOCKYER, K.C.B., F.R.S.—The fairy-book of science contains no more fascinating and marvellous pages than those contributed by the illustrious astronomer whose name has been so long a household word amongst us. It is to his spectroscopic researches that the present generation is largely indebted for its knowledge of the material constituents of the sun and of the stars. He it is who, simultaneously with the French astronomer Janssen, devised a means of studying the luminous atmosphere surrounding the sun, and those gigantic flames which previously could only be observed in the brief moments of a solar eclipse. He it is who first detected helium in the sun before this element had been discovered on the earth, while his investigations into the sun's spots and corona are of the highest importance in solar physics. It is worthy of mention that he has acted as the leader of more eclipse expeditions than any contemporary astronomer. The stars, too, have yielded to him their secrets not less obediently than the sun. By means of the comparative study of stellar spectra, he has drawn up a classification of the celestial bodies according to their temperatures and the order of their evolution, which must be reckoned as not the least noteworthy of the achievements of modern science. The great subject of "orientation" has also engaged Sir Norman Lockyer's attention. He has examined the monuments at Stonehenge and elsewhere, in their relation to astronomical phenomena, a work which is of great value as serving to fix the dates of their erection. The cause of scientific education generally has had no more ardent and eloquent advocate than Sir Norman Lockyer, and, as editor of NATURE and as founder of the British Science Guild, he has done as much as any man living for the diffusion throughout the country of the scientific spirit. The University is sensible that it is doing honour to itself in adding Sir Norman Lockyer's name to its roll of honorary graduates.

M. E. C. M. SENART, Chevalier de la Légion d'Honneur, Membre de l'Institut, Paris.—The literature of ancient India has been handled in modern Europe by no scholar of more exclusive erudition or more splendid attainments than by M. Senart. He first attracted the attention of the learned world by the publication, some thirty years ago, of his "Essay on the Legend of Buddha." Then followed the volumes on the "Inscriptions of Asoka," and a highly popular and instructive work on the Indian castes. Of his subsequent writings, none better exemplifies the remarkable range and accuracy of his scholarship than his edition of the famous Kharoshthi MS. of the Dhammapada, which was recovered from Central Asia by a French mission, while his monumental translation of the Mahavastu is sufficient by itself to place him in the highest rank of philologists. His long series of publications, viewed as a whole, possess an importance which cannot easily be exaggerated, alike from the point of view of history, of philology, and of archæology. M. Senart's achievements have received honorary recognition throughout the civilised world, and it is gratifying to relate that his influence has been instrumental in raising up in France a distinguished school of Orientalists, who, it may be hoped, will continue to carry on his work.

The degree was also conferred *in absentia* on RAMKRISHNA GOPAL BHANDARKAR, C.I.E., lately professor of Oriental languages, Deccan College, Poona. Prof. Bhandarkar is famed as a Sanskritist throughout the length and breadth of British India. His learned labours have extended over many years, and have been productive of a rich and valuable harvest of exegetical editions of Sanskrit works. These are chiefly remarkable in that they exhibit all that is best in the methods of interpretation traditional in India in combination with the critical scholarship of modern times. Prof. Bhandarkar has also devoted himself to the study of history and antiquities. He is the author of an admirable "History of the Deccan" and of numerous archæological essays.

MANCHESTER.—The University kite station at Glossop Moor has now been equipped with a plant for the generation of hydrogen gas for use in work with captive and free balloons. Captain Ley has taken up residence on the moor in order to continue and extend his investigations for the study of the higher air currents by means of free balloons.

IN the new Ministry formed by Mr. Asquith in consequence of the retirement of Sir Henry Campbell-Bannerman from the office of Prime Minister, Mr. W. Runciman has succeeded Mr. R. McKenna as President of the Board of Education, and Mr. McKinnon Wood has succeeded Mr. T. Lough as Parliamentary Secretary to the Board.

To the April number of *Science Progress* Prof. H. E. Armstrong contributes a vigorous article on the reform of the medical curriculum, in which he replies to Dr. Wade's remarks on a previous paper dealing with the same subject. The article covers a wide field, and is by no means confined to the question of medical education, as it deals with the broader issue of university education in general. In particular, the position of affairs within the University of London—the opposition existing between the external graduates and the internal schools, which has culminated in the formation of two representative bodies, the Graduates' Union and the Graduates' Association—calls for comment. A strong plea is urged for extending the internal system so as to allow each of the larger colleges to organise its own scheme of education for the final degrees according to the particular work it has to accomplish, without being hampered by external control through examination. Such a scheme is considered as by no means likely to lower the standard of the degree, but to tend in the opposite direction by making the education imparted more real and effective.

SIR WILLIAM H. PREECE, K.C.B., F.R.S., read a paper on technical education in America before the Royal Society of Arts on April 8. Referring to the munificent gifts made by American millionaires to assist educational development in the States, he directed attention to the fact that the distribution of wealth is much a matter of fashion. In 1906, in London alone more than ten millions sterling were bequeathed for various purposes, but of this only 123,778*l.* was allocated to education. The total amount bequeathed over the whole country must have exceeded fifty millions sterling, and of this probably only 1 per cent. was devoted to education. Speaking of American employers of industry, it was pointed out in the paper that they fully recognise the advantage of technical attainments in their employees, they encourage research, they equip their own laboratories, and they support college and university by financial help, and by the gift of machinery. In America, said Sir William Preece towards the close of his remarks, all are working on fixed methodical lines, and gradually a national coordinated system will be evolved which will make the United States

the best secularly educated country in the world, and their education policy thoroughly organised.

AN interesting comparison of examination statistics in 1906 with those in 1899 is made by Mr. G. F. Daniell in *The School World* for April. Dealing with the results of the matriculation examination of the London University, the article shows that, whereas in 1899, out of 1250 candidates, 842 selected a language and 402 a science "option," 3140 chose a linguistic and 2962 a scientific subject out of a total of 3253 in 1906. In the senior local examinations held by the Cambridge University, the stunted condition of the scientific side shown by the 1899 statistics gives place in 1906 to a more reasonable balance of science and the humanities, and, in the aggregate, the statistics of the junior examination show that science subjects are now receiving fair attention in secondary schools in general. Apparently, however, this cannot be said of the great public schools. Referring to the statistics published by the Oxford and Cambridge Schools' Examination Board, which examines pupils from public and high schools, Mr. Daniell remarks that out of 1027 candidates for the lower certificate of this Board, a total of thirty-four passes in the first class was obtained in the science subjects—of these thirty-four, no fewer than half were in botany, the successful candidates being mostly girls. Among some 2200 candidates for the higher certificate, eighty-three distinctions were obtained in science. It is justly pointed out that "this grudging admission of the claims of experimental science does not satisfy anyone who has realised the importance of educating the nation, especially the upper and middle classes, so that the future may find us not wanting in men of scientific intelligence."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 14, 1907.—"The Thermomagnetic Analysis of Meteoric and Artificial Nickel-iron Alloys." By S. W. J. **Smith.** Communicated by Sir A. W. Rücker, F.R.S.

As the result of purely magnetic researches, the author comes to the conclusion that a typical octahedral meteorite (containing about 7 per cent. Ni and about 93 per cent. Fe, and exhibiting very regular Widmanstätten figures) consists mainly of an alloy of the two constituents containing about 6½ per cent. Ni. This alloy is kamacite. The thin intervening bands of more nickeliferous material (taenite) are shown in the same way to contain about 27 per cent. Ni, but, further, to be a mixture of nickel-richer and nickel-poorer constituents.

The view most commonly accepted hitherto, as the result of many careful chemical analyses, has been that taenite contains at least 36 per cent. Ni. A critical examination of these analyses shows, however, that they are in accord with the more certain conclusion derived from thermomagnetic data.

In the investigation of a problem of this kind chemical methods lead to ambiguous results, because it is impossible to isolate (from a material like meteoric iron) the secondary constituent (taenite) chemically without fear of partial solution. On the other hand, the taenite can be studied *in situ* by means of the change of its magnetic properties with temperature, because these properties vary in a markedly different way from those of the main constituent kamacite. Thus it can be shown that its properties correspond with those of the artificial 27 per cent. alloy, just as those of the kamacite correspond with those of the artificial 6½ per cent. alloy.

The inference from the experiments that taenite is a eutectic mixture (of coarser structure originally than the artificial 27 per cent. alloy, which is proved also to be a mixture) is shown to be in accord with all that is known concerning nickel-iron alloys, and to afford an adequate conception of the way in which the characteristic structure of meteoric iron has arisen.

The behaviour of "irreversible" nickel-iron alloys during changes of temperature is shown also to be closely analogous to the behaviour of the metastable and labile fluid solutions studied by Prof. Miers.

An explanation is given of the important fact that an artificial nickel-iron alloy containing about 27 per cent. Ni is a "magnetic invar," of which the magnetic quality remains practically constant over a range of about 300° C. after the alloy has been cooled to the temperature of liquid air.

Further development of the thermomagnetic method is to be looked for in cases in which chemical and micrographic methods either fail to remove ambiguity or are inapplicable; meanwhile, if the interpretation of the thermomagnetic data considered is held to be established, a good many doubtful points in the relationship between iron and nickel in their alloys have been made clear.

January 23, 1908.—"Dietetics in Tuberculosis: Principles and Economics." By Dr. N. D. **Bardswell** and J. E. **Chapman.** Communicated by Sir T. Clifford Allbutt, K.C.B., F.R.S.

February 13.—"The Decomposition of Ozone by Heat." By Prof. E. P. **Perman** and R. H. **Greaves.** Communicated by Principal E. H. Griffiths, F.R.S.

The rate of decomposition of ozone has been measured under various conditions, with the following results:—

(1) In a glass vessel the reaction is approximately of the second order.

(2) The relation between the rate of decomposition and temperature may be expressed by the formula $\log k = a + bt$.

(3) The rate of decomposition is very largely influenced by the extent of the surface with which the ozone is in contact.

(4) The reaction is of the first order when the ozone is in contact with a porous substance (clay-pipe stems) or some oxides.

(5) Metallic surfaces have but little effect on the decomposition.

(6) Water vapour accelerates the decomposition, and the acceleration is proportional to the amount present.

(7) Nitric oxide greatly accelerates the decomposition.

(8) The rate of decomposition is a linear function of the oxygen pressure. A greater effect is produced by diluting with nitrogen than by simply reducing the pressure of the oxygen.

(9) At 100° the reaction appears to be very slightly reversible.

(10) Finally, the decomposition appears to take place mainly (if not entirely) at the surfaces with which the ozone is in contact, and pressure measurements give no indication of the number of molecules reacting.

Mineralogical Society, March 17.—Prof. H. A. Miers, F.R.S., president, in the chair.—The occurrence of metamorphic minerals in calcareous rocks in the Bodmin and Camelford areas: G. **Barrow** and H. H. **Thomas.** The pneumatolytic action is not contemporaneous with the thermo-metamorphism produced by granite intrusions; the gaseous intrusions are later, and often produce their greatest effect beyond the zone of "contact action." The species of mineral produced depends on the nature of the rock penetrated by the gases. In killas, tourmaline is commonly produced, but in calcareous rocks, axinite and a variety of other minerals result from the pneumatolysis. In the Bodmin area the minerals formed by pneumatolytic action in the calc-flintas are axinite, hedenbergite, epidote, yellow garnet, actinolite, and another amphibole occurring in minute dark-brown needles. In the Camelford area the minerals are mainly due to contact metamorphism. The most conspicuous are yellow garnet, epidote, and idocrase, a mineral which has not hitherto been recorded from Cornwall.—A protractor for use in constructing stereographic and gnomonic projections: A. **Hutchinson.** A short historical account was given of the stereographic projection, and a protractor designed to facilitate its construction was shown. By the aid of this protractor the radii of both great circles and small circles can be readily determined. It can also be applied to the construction of the gnomonic projection, and to measuring the angles between planes and zones.—Supplementary notes on the

mineral kaolinite: A. B. **Dick.** Further observations on the optical characters of kaolinite from Anglesea lead to some alterations in the data given in a previous paper. The refractive index is about 1·563 for sodium light, and the optic axial angle, 2V, is about 68° instead of 90°. The double refraction is very low. Kaolinite from limestone at Hambleton Quarry, Bolton Abbey, Yorkshire, and from sandstone near Newcastle-on-Tyne were described.—An attachment to the goniometer for the measurement of complex lamellated crystals: H. L. **Bowman.** The apparatus, consisting of a small screen pierced by a pin-hole, can be attached to a goniometer, and is capable of adjustment so that minute portions of a crystal face can be successively illuminated.—A new form of quartz-wedge, a modification of the Wright-wedge: J. W. **Evans.** A quartz-wedge cut parallel to c is placed over a gypsum-plate parallel to a showing red of the first order, and extending beyond the thin end of the wedge, so that the projecting portions can be used as an ordinary gypsum-plate. The region where the wedge overlies the gypsum is graduated at the position of exact compensation, and at each thousand micromillimetres of relative retardation. If, when placed over a mineral in the diagonal position, the black band is moved towards the thin end of the wedge, the direction of insertion is that of the vibrations which traverse the mineral with the smaller velocity; if towards the thick end, the direction is that corresponding to the greater velocity.—Calculation of the chance that the double refraction of a crystal section cut at random shall exceed a particular fraction of the maximum: H. **Hilton.** The problem is soluble completely for a uniaxial, and partially for a biaxial, crystal.

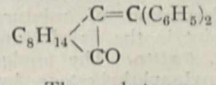
Physical Society, March 27.—Dr. Charles Chree, F.R.S., president, in the chair.—Notes on the plug permeameter: Dr. C. V. **Drysdale.** In the instrument a drill is employed to cut a conical hole in a casting or forging, leaving a pin one-tenth inch diameter standing in the middle. A wrought-iron plug carrying a bobbin with magnetising and search coils completes the magnetic circuit, forming a miniature permeameter. Investigations have been made showing that the amount of the end effect can be compensated by correcting the value of H in the same ratio for all specimens. Curves were given showing the results obtained by the plug permeameter when the instrument had been empirically calibrated.—The use of shunts and transformers with alternate current measuring instruments: Dr. C. V. **Drysdale.** The paper deals mathematically and experimentally with errors in the magnitude and phase of the current. With shunts, the condition for accuracy at all frequencies is that the time constants of the instrument and shunt should be equal. For current transformers the best results are obtained by keeping the magnetising and core-loss currents as small as possible.—Dynamometer wattmeters: Dr. C. V. **Drysdale.** An investigation of the theory of the wattmeter, including the effects of shunt inductance and capacity, mutual inductance, eddy currents, wave-form and of iron. It is pointed out that the theory of the wattmeter is much obscured by the use of the correction factor. The correction of a wattmeter should be applied as a difference, and not as a ratio. A description of single and double forms of standard wattmeter and of deflectional wattmeters containing iron was given.

Institution of Mining and Metallurgy, April 9.—Mr. Bedford McNeill, vice-president, in the chair.—The electrical equipment of gold mines: H. J. S. **Heather.** A review of the present application and future possibilities of the application of electric power to mining operations, with practical notes of installations that have been made under the author's supervision. He points out the relative advantages or otherwise of the continuous and alternating current systems for the purposes of gold-mining work.—Addendum to paper on earth temperatures on Witwatersrand gold fields: Hugh F. **Marriott.** A matter dealt with in a previous paper by the same author centred round the mean earth temperatures at the surface in the vicinity of the Rand. This addendum records subsequent investigations tending to settle the point in dispute in connection with the attempt to establish a rule for the average increase of temperature with depth.—The carat weight: E. J. **Vallentine.** A concise account of the origin and present position of the carat weight as used by dealers in gold and precious stones, with records of the steps taken to establish a standard metric carat for universal adoption.—An electromagnet for testing the suitability of an ore for magnetic separation: L. H. L. **Huddart.** A description of a hand apparatus designed by the author for use abroad. It is suitable for the quantitative determination of the separation to be expected in treating a given ore by means of a powerful magnet.—The gold alluvials of the river Drau in Hungary: A. **von Gernet.** A brief account of the subject of the title, with comparisons of the relative efficacy for determining values obtained by panning small samples and counting "colours."

Royal Astronomical Society, April 10.—Mr. H. F. Newall, F.R.S., president, in the chair.—Description of a 24-inch long-focus cœlostat reflector: J. H. **Reynolds.** The instrument has been constructed for use in spectro-heliographic work, but is also arranged for taking celestial photographs. The focal length is 38 feet, and the diameter of the plane mirror of the cœlostat 28 inches. Specimens of photographs taken with the instrument were shown on the screen.—Dr. A. W. Roberts's method of determining the absolute dimensions of an Algol variable star: Rev. J. **Stein.** Dr. Roberts had attempted to deduce from the light curve of such a variable the dimensions of the orbits of its components, but Mr. Stein showed that it is theoretically impossible to determine the absolute dimensions of the orbit in this manner.—Note on the newly discovered eighth satellite of Jupiter: **Astronomer Royal.** The moving object near Jupiter, found by Mr. Melotte upon photographs taken at the Royal Observatory, had been again photographed on March 27, 31, and April 3. It had also been photographed by Dr. Max Wolf at Heidelberg and at the Lick Observatory. It now appeared that the new object is a satellite of Jupiter, much more distant from the planet than the sixth or seventh satellites.—First approximation to the orbit of J. VIII.: A. C. D. **Crommelin.** The hypothesis of retrograde motion for the new satellite appeared at present most probable; from the preliminary elements obtained the sidereal period would probably be between three and four years, and the distance from the planet about three times that of Satellite VII.—Variable-star work at Rousdon Observatory: C. **Grover.**—A new "spanner" sextant: Captain **Gadsden.** The arrangement consisted of an attachment to a sextant to enable observations to be made when the horizon is obscured or hazy.—Note on the conditions for the passage of the earth through the plane of Saturn's ring: H. H. **Turner.** The late Mr. Proctor had given a general account of the manner in which the earth may pass through the plane of the ring, either once or three times at each favourable opportunity. The present paper gives the explanation in a more compact and complete form.—Retrogradation of the sun's shadow: M. E. J. **Gheury.**—Series of photographs of the Milky Way taken with a small lens of $5\frac{3}{8}$ inches focal length: Dr. Max **Wolf.**—Experiment illustrating the gradually increasing red colour of the sun as it approaches the horizon at sunset: S. L. **Fletcher.**

PARIS.

Academy of Sciences, April 6.—M. H. Becquerel in the chair.—An isomer of diphenylcamphomethane and the conditions of its formation: A. **Haller** and E. **Bauer.** Details are given of the best method of reducing



in alkaline solution. The substance obtained, diphenyl-camphomethane, is isomeric with the substance obtained by carrying out the reduction in acid solution, and can be obtained from the latter by boiling with alcoholic potash, and in other ways. Various attempts have been made to elucidate the constitutions of these two isomers, but hitherto without success.—A new mineral species from the French Congo: A. **Lacroix.** The new mineral is a silicate of copper, differing from dioptase in being attacked with difficulty by acids, and in its composition,

$$Si_{12}O_{44}Cu_{15}H_{10} \text{ or } 12SiO_2.15CuO,5H_2O.$$

The name plancheite is proposed for the mineral.—The perception of relief and of depth in the simple image of ordinary photographs. Conditions and theory of this perception: A. **Chauveau.** By a suitable adjustment of the prisms of a stereoscope, the effect of relief can be obtained from a single photograph just as well as if the latter were replaced by the usual double stereoscopic photograph. The effect can be produced without any apparatus; the examination with one eye alone of a well-lighted photograph after some time causes the stereoscopic effect. To reduce this to the usual plane effect the other eye is required. The theory of these phenomena is considered in detail.—The acceleration and retardation of the coagulation of the blood in capillary tubes: Ch. **Bouchard.**—The Coal-measures of the southern Oran: H. **Douvillé** and M. **Zeiller.** A detailed description of the fossils met with is given, and the analogy with the Carboniferous deposits in England pointed out. This is the first time that a Westphalian flora has been discovered in such a low latitude.—The subgroups of the homogeneous linear group of four variables, and the systems of partial differential equations which correspond to them: M. **Le Vavasseur.**—The persistent conjugate networks comprising a family of minimum lines: L. **Raffy.**—The maximum useful weight that can be raised by an aëroplane: M. **Girardville.** It is shown that the maximum useful weight carried by an aëroplane depends upon five variables, and possibilities of improvement may be sought for in modifying each of these.—The conditions of utilisation of balloons capable of being steered, as existing at present: M. **Bouttieaux.** An account of modifications introduced with the view of economising ballast.—The spectroscopic study of flame of various kinds: G. A. **Hemsalech** and C. **de Watteville.** The method of feeding a flame with particles of metal obtained electrically, described in an earlier paper, has been applied to flames of hydrogen alone, coal gas and oxygen, hydrogen and air, and hydrogen and oxygen. Details of the results obtained with the pure hydrogen flame are given in the present communication.—The presence of spark lines in the arc spectrum: Ch. **Fabry** and H. **Buisson.** All the spark lines (the enhanced lines of Lockyer) are emitted in the arc spectrum of iron, but only by certain portions of the arc. Similar effects have been obtained with nickel and copper.—A new method of estimating the vapour of mercury in air: P. **Ménière.** The air is aspirated through boiling nitric acid in a special apparatus figured, and the minute proportions of nitrate of mercury treated with diphenylcarbazide. This gives distinctive colours in proportions of mercury varying from 1/100,000 to 1/5,000,000. The paper is accompanied by a plate showing twelve gradations of tint obtainable.—The combustion by incandescence of gases in presence of oxidisable and incombustible bodies: Jean **Meunier.**—The variations of composition of ammonium phosphomolybdate: application to the estimation of phosphorus in iron and steel: G. **Chesneau.** The author regards a double precipitation as absolutely necessary if the precipitate is to have a constant composition, and gives detailed instructions for carrying out the process.—The ammoniacal chlorides of dimercuriammonium: H. **Gaudechon.**—Arbutine and some of its derivatives considered from the point of view of their rotatory power and their hydrolysis by emulsin: Em. **Bourquelot** and H. **Hérissey.**—Comparative study of the dehydration of atrolactic and *p*-methoxyatrolactic acids. *p*-Methoxyatropic and di-*p*-methoxyatropic acids: J. **Bougault.**—The formation of mixtures of isomers of constant melting point in the Friedel and Crafts reaction: G. **Perrier** and H. **Caille.** The product obtained in the preparation of phenylnaphthylketone by the Friedel and Crafts reaction had a definite melting point, which was unchanged after several re-crystallisations. It was shown, however, to consist of a mixture of the α and β isomers.—The constitution of the membrane in diatoms: L. **Mangin.**—The action of the hygrometric state in respiratory exchanges: J. **Cluzet.**—The action of the alcoholic extract of normal human urine on the arterial pressure: J. E. **Abelous** and E. **Bardier.**—The possible effects of carbon monoxide in poisoning by tobacco smoke: C. **Fleig.** The conclusion is drawn that the amounts of carbon monoxide given off during the smoking of tobacco can contribute nothing to the effects of tobacco poisoning.—The action of brewers' yeast on the amido-acids: J. **Effront.**—Some artificial peroxydiastases: the important part played by iron in their action: J. **Wolff.**—The formation of acetaldehyde in alcoholic fermentation: E. **Kayser** and A. **Demolon.** The conclusion relating to the origin of acetaldehyde in alcoholic fermentation, described in a recent note by M. Trillat, confirms the conclusions published by the authors a year ago.—The preparation and properties of crystallised oxyhæmocyanine from the snail: Ch. **Déré.**—Bile and the biliary pigments: M. **Piettre.**—The canine origin of *kala-azar*: Charles **Nicolle** and Charles **Comte.**—The *rôle* of positive torsion in propulsive screws and aëroplanes: P. **Amans.**—The variations of temperature of the spring of Sainte-Baume (Var): E. A. **Martel.** Another instance of the variation in temperature of springs. The spring described has on numerous previous occasions shown a temperature of 10°.5 C.; in October, 1907, after an exceptionally rainy month, the temperature rose to 13° C.

PRETORIA.

Transvaal Biological Society, January 17.—Dr. Theiler, C.M.G., in the chair.—A new species of tick found in the Transvaal: Mr. **Howard.**—Viscosity of blood: Dr. **Frei.**—Demonstration of a diseased skull of *Papio porcarus* (Bodd): Dr. **Gunning.**—Demonstration of some stages in the life-history of *Strongulus contortus*, Rud.: Dr. **Gough.**—Further transmission experiments with East Coast fever: Dr. **Theiler.**—(1) Some additions to the Transvaal flora; (2) new plant species from the Transvaal and Swaziland; (3) notes on drabok poisoning; (4) the application of Mendel's law of heredity in the breeding of maize: Mr. **Burtt-Davy.**

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