THURSDAY, JANUARY 19, 1905.

ZOOLOGICAL BOOKS FROM GERMANY.

(1) *Anthropogenie oder Entwickelungsgeschichte des Menschen; Keimes- und Stammes-geschichte.* By Ernst Haeckel. Fifth revised and enlarged edition. 2 Vols. Pp. xxviii+992; with 30 plates, 512 text figures, and 60 genetic tables. (Leipzig: Engelmann, 1903.) Price 25*s.* net.

(2) *Morphologische Studien. Als Beitrag zur Methodologie zoologischer Probleme.* By Tad. Garbowski. Pp. vii+189; 6 chromolithographic plates. (Jena: Fischer, 1903.) Price 28 marks.

(3) *Untersuchungen über den Phototropismus der Tiere.* By Dr. Em. Rádl. Pp. viii+188. (Leipzig: Engelmann, 1903.) Price 4*s.*

(4) *Graber's Leitfaden der Zoologie für höhere Lehranstalten.* Bearbeitet von Dr. Robert Latzel, k.k. Gymnasial-Direktor. Fourth revised edition. Pp. 232; illustrated. (Leipzig: G. Freytag, 1904.) Price 3.80 marks.

(1) THE first edition of Prof. Haeckel's book appeared thirty years ago, and the fourth edition in 1891. With each reappearance the book has increased in size and in stateliness, and this is particularly true of the new edition. The sequence of editions reads like a developmental process, say in crustaceans; there is some ecdysis, there is addition of new parts, there is a growing beauty, but the essence remains the same. The veteran evolutionist has gone over the whole work again; he has incorporated new discoveries, he has added fresh arguments and illustrations, but the gist of the book remains unaltered. Our familiar old acquaintances—the Monera and the Gastræadæ, the biogenetic law and its helpmate cœnogenesis, dysteleology and monism, and so on—are all as alive as ever, and with much to say for themselves. As Haeckel says, the book may have its faults; but has anyone given a better popular presentation of the concrete facts as to the position of the human organism in its place in nature, or, for that matter, has anyone else ever tried? We may object to some of his embryology and to some of his phylogeny and to all his philosophy, but here is a vivid, picturesque account of man's development and of his plausible pedigree. It is a historic document which will occupy an honourable place among the archives of biology. It is an achievement on the author's part to have made this revision now—adding about 100 pages, three score and ten figures, ten plates, and eight genetic tables; we could not expect him to change his cherished convictions. Nor, as he says, has he seen any reason to do so. The parts we like least are where he brings in new or relatively new discoveries somewhat casually, as we may illustrate by referring to the centrosome which he calls a "nicht färbares Körperchen." What is it, then, that stains so intensely with iron—hæmatoxylin?

(2) Dr. Garbowski has ceased to find satisfaction in the conventional formulæ often used in seeking to interpret phylogenetic advances. He has ceased to believe in the homology of the germinal layers, in the gastræa theory, and in the cœlome theory; and he thinks that the usual application of the so-called biogenetic law is for the most part fallacious. In all this he is not so solitary a sceptic as some of his sentences would lead one to suppose.

There is a branch of ætiological inquiry in which the zoologist interprets the whole organism as a system of adaptations, and seeks to show how the various items in this system may have arisen in the course of variation, and may have persisted by enhancing the survival-value of their possessor. There is another branch of ætiological inquiry which tackles the deeper problems of morphogenesis, which inquires into the formative conditions leading to various big steps in organisation-progress—such as the origin of an enteron, the establishment of metamerism, the development of a cœlom, or the institution of a vertebral axis. It is with these morphogenetic problems that Dr. Tad. Garbowski is mainly concerned, and he wishes to find a *via media* between the use of what he believes to be obsolete verbal formulæ and the extreme of biomechanics.

"Darwin and his school sought to discover the nature of transformation without knowledge of the internal processes, and the 'Entwickelungsmechaniker' are trying to interpret the latter apart from the immanent effects of the former."

It is easy enough to say that sponges are quaintly inverted primitive Metazoa, that annelids represent ancestral Chordates on their backs, that Trochophora have sprung from Ctenophora—the illustrations are the author's—but what we must get at is an observational or experimental knowledge of the actual way in which architectural changes of moment are brought about. In short, we must deepen our physiological-morphology, getting beneath mere form-changes to the functional changes which condition them. This, so far as we can see, is what Dr. Tad. Garbowski is driving at. We are surprised, by the way, that he does not include Rauber's "Formbildung und Formstörung" in his huge bibliography.

The first chapter is devoted to a study—full of interest—of *Trichoplax adhaerens,* with subsections on Treptoplax and Salinella; the second chapter discusses the Mesozoa in general; the third chapter describes various processes of gastrulation, and ends with a rejection of the gastræa theory; the fourth chapter deals with the two primary germinal layers, the mesoderm and the cœlom, and ends with a rejection of the germ-layer theory. In conclusion, the author expounds the scope of physiological morphogenetic studies. There are six fine plates.

Dr. Garbowski is iconoclastic, and his recoil from some familiar theses is thorough-going, but his scepticism is neither unexpected nor unwelcome. The late Prof. Claus had promised to protect him if the Thames caught fire, so to speak, but the author is quite able to look after himself, and his theses will find as much acceptance as opposition. We have all

been having our doubts about the homology of the germ-layers and the like; morphological concepts are every day becoming more kinetic, less static. The only question is how far we can go with the little that we know of physiological morphology. In so far as Garbowski has increased the data his memoir is very welcome.

(3) Dr. Em. Rádl has made many experiments on the phototropism of animals, that is to say, on the manner in which they orientate themselves in relation to light stimuli. Phototropic phenomena have been most studied in plants, but there is already much literature relating to their occurrence among animals, and the author begins with a historical survey. He goes on to the reactions of animals on a revolving turntable, the compensatory head-movements of insects, nystagmus in insects, and phototropic orientation in insects with one eye blackened.

After showing that phototropic orientation or movement occurs widely among animals, *e.g.* in Cœlentera, echinoderms, planarians, annelids, arthropods, and molluscs, and that it may be exhibited in eyeless forms, Rádl discusses various phenomena which cannot be set down as simply phototropic. Thus it cannot be safely said that the movement of pigment in the eye or in the skin is phototropic, and there are many details in the behaviour of butterflies and dragon-flies in relation to light and shade which seem to be more than phototropic. A simple reflex may become complicated by the association of accessory reflexes. In unnatural conditions the established phototropic reflex may lead the animal astray, as when the moth, circling nearer and nearer, finally finds its death in the candle —an interesting and much discussed subject to which Rádl devotes some attention.

Sedentary animals, like plants, orientate themselves to the direction of the light; freely moving animals move into the direction of the light. The author discusses the question whether these two kinds of response are merely different aspects of phototropism, and comes to the conclusion that the two are not directly dependent on one another. He also regards the difference between positive and negative phototropism as a secondary matter; in both there is orientation to the direction of light, but the locomotor muscles are differently stimulated.

In the more general part of his book, Rádl discusses the relations between phototropism and other tropisms —or the more legitimate of these—geo-, stereo-, rheo-, galvano-, chemo-, and thermo-tropisms. There is a chapter, all too short, on the ethological importance of phototropism. The author is clear that organisms are systems of adaptations and that phototropism is a physiological adaptation, but he looks askance at teleological phraseology, and does not follow up the subject. The book closes with a discussion of the general theory of orientation; this must be based on study of tropisms; there is no "Orientierung überhaupt," but the organism seeks for a state of equilibrium in relation to various external stimuli—an equilibrium which consists not merely in the position of the body, but in its functioning.

Dr. Rádl is cautious in stating his own theory of phototropism; he restricts himself to the following propositions:—

(1) Phototropic orientation means the capacity of assuming a definite position of the axis of the body in the field of light.

(2) A phototropically orientated organism is in a state of physiological equilibrium in relation to the light.

(3) The orientation can only be brought about by the operation of paired or coupled forces, which are partly external, partly internal.

(4) In the orientations or tropisms of organisms there is always at least one internal force operative, and this is usually muscular.

The conclusions strike one as disappointing, for they seem to be practically summed up in the conception of "physiological equilibrium"; those who are prepared to advance other theories will find this book of great service. It summarises the subject, describes many new experiments, and criticises many untenable positions.

(4) About twenty years ago we were familiar with a little book, "Outlines of Zoology," by Graber, which had a wide use if not popularity in Gymnasien. Its features were brevity, accuracy, lucidity, and comprehensiveness. We suppose, in the absence of any prefatory note, that the volume before us is our old acquaintance in a glorified edition, in which Dr. Latzel has preserved the characteristics of the original. The book begins with a short introduction on metabolism, the cell, and protoplasm—which must be difficult pabulum for even "höhere Lehranstalten"; it proceeds to the structure and functions of the human body, and thence to a survey of the whole animal kingdom from mammals to the Protozoa. As a systematic summary to be associated with more vital studies in natural history the book is admirable; it is clear, direct, accurate, and most copiously illustrated. It is so ambitiously all-inclusive that we are almost startled to find no mention of Balanoglossus, Peripatus, or the okapi; but these will doubtless find their place in the next edition. A book of this sort, tightly packed with information, without, in many cases, even the padding of verbs to the sentences, must be judged by its intention. If that be, as we charitably suppose, to serve as a terse *index rerum* or synopsis, associated with practical work and open-air studies, it deserves to be encouraged. But if it is meant as a book to be "got up"—and there are unpleasant suggestions of the cram-book about it—then it is emphatically not in the line of progress. It stands in direct antithesis to the natural history text-books for high schools which find favour in America and are securing their place in this country. There is almost no suggestion of the evolution or affinities of the great types; there is almost no hint of initiation into scientific methods of observation and reasoning; and there is very little open-air. It seems to us more like a revisal-book for a student going up for his first professional examination in medicine or natural science than a book for schools. At the same time, it is a very effective book of its sort; the illustrations are admirable, and the coloured plates are as fascinating as the text is dry. J. A. T.

AN AMERICAN TEXT-BOOK OF GEOLOGY.

Geology. By Thomas C. Chamberlin and Rollin D. Salisbury. Vol. i. Geologic Processes and their Results. Pp. xix+654; with 24 plates and 471 figures in the text. (New York: H. Holt and Co., 1904.)

THE work of which this is the first volume, bearing the names of two well known professors in the University of Chicago, is addressed to the mature student, and is designed "to present an outline of the salient features of geology, as now developed." The present instalment, dealing with the nature and results of the processes now in operation upon the globe, will naturally prepare the way for the second volume, to be devoted to tracing the history of past ages. Agreeing with other writers in approaching the science from this side, the authors have been led by their own experience as teachers to depart somewhat from the beaten track in their general plan of treatment, as well as in the relative importance assigned to certain specific subjects. They tell us in their preface that they have laid little stress on the generally recognised divisions of geology, "dynamical," "structural," "stratigraphical," &c., but have tried rather to emphasise the historical element even in the discussion of special themes, thus bringing out the essential unity of the science. Again, some subjects, such as the development of drainage-systems, the ultimate cause of crust-movements, and others, receive here fuller treatment than has been customary in works of this scope.

Most of the original features of the book we heartily welcome. We think, too, that the authors have generally been happy in their treatment of the more dubious and debatable problems of physical geology. Their design in this has been freely to introduce the theoretical element when necessary, and at the same time "to avoid confusing the interpretations based on hypothesis with the statements of fact and established doctrines." Where important differences of opinion exist, the alternative hypotheses are set forth and their consequences compared. In some instances this candour is pushed rather far, as when the cause of vulcanism is discussed on seven distinct hypotheses. Having regard to the class of students for whom the book is primarily intended, we think that the authors have needlessly hampered themselves by trying to make it intelligible to one who has had no previous acquaintance with the rudiments of geology. How far they have succeeded in this it is not easy to judge. Thus the technical terms of the field-geologist, "dip," "anticline," "dyke" and the like, are not formally defined until we reach a late section of the volume, but the conceptions implied have necessarily been introduced much earlier. Such difficulties inevitably confront the writer of an elementary class-book, but they might safely be ignored in a work like the present.

After a preliminary outline of the general scope of geology, the authors proceed to discuss in turn the geological effects of the atmosphere, of running water, of underground water, of snow and ice, and of the ocean. Their clear exposition of the mechanism of rain- and river-erosion, with due regard to the controlling conditions, is an admirable summary of a fundamental part of geology which in most of our text-books receives very inadequate treatment. It is written on modern lines, the fertile conception of the "base-level of erosion," with its important consequences, being introduced at an early stage. The subject is one which American geologists, with their unrivalled opportunities, have made peculiarly their own, and it could scarcely have fallen into better hands. The other geological agents are discussed in the same comprehensive but concise manner, and the chapter dealing with glacial action is, as might be expected from the authors, of special interest.

The chapter on movements and deformations of the earth's body contains much material which is not elsewhere accessible to the student in a connected shape, and some originality appears in matter as well as in treatment. Consideration of the possible causes of the great crust-movements leads to an inquiry into the original and present distributions of temperature in the globe, and to a comparison of the nebular hypothesis with that of "accretion." The comparison is presented in a judicial manner, and the enunciation of the accretion hypothesis is tantalisingly brief; but a fuller discussion is promised in the second volume. Geologists sometimes need to be reminded that cosmogony is a legitimate part of their province, not to be surrendered without good reason shown. At least it is well that students should see just how much of accepted physical principles and how much of arbitrary assumptions go to the building of dogmas which have carried alarm into some quarters.

The treatment accorded to igneous action seems to us in some respects unsatisfactory. Descriptive petrography is, no doubt wisely, represented by a brief summary, an appendix to a generalised account of "the origin and descent of rocks." But what follows seems to lack due proportion. "Vulcanism" is used to include intrusive as well as extrusive action, but the chapter is occupied almost exclusively with the latter. The plutonic and other igneous intrusions, the varied forms which they assume, and their intimate relation to crust-movements and to geological history in general, are dismissed almost without notice. The full and admirable discussion of volcanoes might thus give a student the impression that these superficial phenomena are the only important effects of igneous activity.

The volume concludes with a chapter on the geologic functions of life, and a good index is added. The book is issued in handsome form; but the highly glazed paper, presumably adopted for the sake of the figures, is irritating to the reader. The abundant figures, selected from various sources, are well chosen to illustrate the text, and well reproduced. The subjects are for the most part American. A useful feature is the illustration of various types of topography by actual maps, taken from the beautifully contoured sheets of the United States Geological Survey. A. H.

THE TOPOGRAPHY OF BRITISH INDIA.

India. By Colonel Sir Thomas Holdich, K.C.M.G., K.C.I.E., C.B., R.E. Pp. 375; 8 maps in colours. *The Regions of the World.* Edited by H. J. Mackinder. (London: Henry Frowde, Oxford University Press, n.d.) Price 7*s.* 6*d.* net.

WITH climates varying from the ice-bound deserts of the higher Himalayas and the rain-steeped forests of Tenasserim, to the desolation of Makran, where at one time of the year fire is almost unnecessary, even for cooking, and at another the cold blasts almost defy human endurance; the inhabitants of which number races unsurpassed as brave and stubborn fighters, and races among whom physical cowardice is regarded as no disgrace; where in one part music is produced by stamping on a piece of wood, and in another has been carried to a refinement which requires sixty-four tones to our octave—both extremes, it may be added, equally unmusical to the European ear; where there is found a system of laws so elaborate that the cashier who has confessed to embezzlement may yet succeed in escaping punishment, and a system of government so paternal that it imprisons the husband, whose domestic happiness has been ruined, to prevent his committing the crime of murder; the territories known as British India may be a country for political purposes, but in no proper sense of the word do they constitute a nation, they are hardly even a "region of the world," and the name is nothing but a geographical expression for the area which is administered by the British Government through the agency of the Governor-General of India in Council. To write a description which, in a book of moderate compass, will convey a clear and fairly proportioned conception, requires a master hand; not to have failed is in itself high praise, but Sir Thomas Holdich has done more than this, he has produced a topographical description of the Indian Empire which, in spite of minor errors—such as the reference to the Kasmur bund as intended for the storage of water, and a general inaccuracy where he ventures into geology—is not only interesting to read, but accurate and well proportioned on the whole.

With all its manifold diversity in detail, the Indian Empire is composed of two parts, each of which may be regarded as a geographical unit, and each geographically distinct from the other. The larger and more important of the two may be regarded as India proper, and consists of the alluvial plains of the Indo-Gangetic river system, and the triangular area known, though incorrectly, as the Peninsula. It is cut off from Burma by a tract of mountains, impassable by reason of the deep-cut network of valleys and the dense vegetation with which their slopes are covered, and on the north it is bounded by the mighty range of the Himalayas. Both these barriers have proved effective against either ethnical or military invasion, but on the west are the semi-desert hills and open plains of Afghanistan and Baluchistan, which have repeatedly been traversed by invaders. It is in the description of this region that Sir Thomas Holdich is at his best, partly, no doubt, because it is that of which he has the most intimate personal knowledge, but largely, too, because of the intrinsic interest attaching to it; for across this region came not only the great prehistoric Dravidian and the semi-historic Aryan invasions of India, but also the military invasions of Alexander the Great, and of the successive Mohammedan conquerors of India. Until the improvement of navigation brought in the nations of the west, it was the only way by which invasion and conquest were possible, and it is through this region alone that we need look for a serious attack on India, so long as we hold the command of the sea.

Of this long series of invasions all the historical ones, from Alexander onwards, have been purely military; they have left their impress, more or less deeply marked, on the religion, the administration and the political geography of India, in buildings and in public works, but they have hardly affected the great bulk of the people, who derive their origin from the earlier invasions. In these it was no mere conquering army that came, but nations, with their wives and families, their flocks and herds, their household goods and gods, who absorbed or exterminated the inhabitants of the land, and whose descendants are found over the length and breadth of India, constituting nine-tenths of the total population.

The other unit in the Indian Empire is Burma, which belongs, geographically, rather to Indo-China than to India. Cut off from the latter by a band of forest-clad mountains, which has rarely been traversed even by marauding expeditions, it received centuries ago its religion and philosophy from India, but has remained unaffected in all other respects, and maintained its ethnical distinction untouched. This isolation of Burma is now at an end; the establishment of steamer lines across the Bay of Bengal has rendered it easy of access, the Hindu prejudice against crossing the sea has given way to the stronger claims of pecuniary gain, and the gay, picturesque, pleasure-loving Burman, who had evolved an epicurean philosophy and regarded life merely as something to be enjoyed, is being ousted by the plodding, but joyless and unattractive native of Behar or Madras.

Across the north of the Empire runs the great mountain barrier of the Himalayas, the highest and greatest mountain range of the world, which separates the Mongolians of Thibet from the races of India, and has left its impress on their mythology and folk-lore. This naturally gets a chapter to itself, and it is satisfactory that the author recognises the futility of an attempt to trace any limited number of continuous chains in a mountain range of so great an extent, and wisely abstains from formulating any theory of the Himalayas. We cannot, however, accept the statement, repeated more than once, that the eastern Himalayas are older than the western; it is true that the rocks of which they are composed are older, but the rise of the Himalayas, as a mountain range, belongs to the great period of mountain formation which commenced at the close of the Secondary era, and there is no reason for supposing that the two halves of the range differ materially in the age of their elevation.

The book is provided with a large number of blocks in the text, nearly all maps, in which, with very few exceptions, but one method of representing relief is adopted—that of shaded areas bounded by contour lines. The method is valuable for some purposes, but as a means of representing the form of the ground is, in most cases, inferior to the much abused "caterpillar" method of delineation, and frequently conveys a misleading impression. The figure intended to represent the lower Brahmaputra valley and Gangetic delta is an instance of this, while that intended to represent the orography of the Hindu Kush looks more like an ink-maker's advertisement. In the coloured maps the complete absence of hill shading gives to the Thibetan plateau an air of flatness which it is far from possessing in reality, yet it would be unfair to conclude this notice without a word in their praise. Mr. Bartholomew has accustomed us to a high standard of workmanship, but his map of India, reproduced in this book, has seldom been equalled for intricacy and accuracy of colour printing, and for success in showing the leading features of the relief of the land.

PHYSICAL AND PHYSIOLOGICAL ASPECTS OF LIGHT.

Light Energy; its Physics, Physiological Action, and Therapeutics. By Margaret A. Cleaves, M.D. Pp. xiv+827. (London: Rebman, Ltd., 1904.) Price 21*s.* net.

WHILE this book is written primarily to further our knowledge of the properties and uses of that form of energy called light, in the treatment of disease, yet it will be found of great interest to those whose study is mainly confined to the purely physical aspects of light phenomena. The subject is treated from the modern view of energy in the form of waves of a certain length and direction, but at the same time the emission theory is not entirely ignored on account of the peculiar behaviour of some of the recently discovered radio-active substances, notably radium. About 130 pages are devoted to a description of the various kinds of rays, their origin and physical properties. The part dealing with the electric arc is very complete and clear, and embraces all one could wish to know to ensure an intelligent application of the arc lamp in the treatment of disease.

Following this is a series of chapters dealing with the action of light on the various forms of life, from the most elementary to the highly complex human subject. In this section the action of light from both natural and artificial sources is treated very thoroughly. It is quite evident that the author has devoted herself to a large amount of painstaking experiment, the valuable results of which are recorded in the present volume. According to her, the mercury vapour lamp has not justified the expectations regarding it as a therapeutic agent.

The second half of the book is taken up with the therapeutic applications of the various forms of light. This part will be of special interest to medical men, especially those who are engaged in this line of work. Sun, arc, and incandescent light baths are treated most fully, together with their use in those diseases in which the author has found them respectively useful. The indications are, in every instance, based on spectroscopic analysis, and full details of the proper technique are given for every variety of application. Several forms of bath cabinet are described, as well as arc and other lamps for local treatment with concentrated light.

While the author is rather emphatic on the necessity for employing lamps of large amperage—quantity being as essential as quality—yet she speaks highly of certain small lamps the efficiency of which was such as to necessitate their replacement by lamps of greater power in the light department of the London Hospital. The reason for this praise is seen, later on, to be related to the comparative cost of the lamps—the smaller being sold and maintained at a fraction of the cost of the Finsen, and their efficiency is at least in proportion to this cost. According to the author, the great advantage of a lamp of high amperage, like the Finsen, is that we get not only the short and high frequencies of intense chemical activity, but also the frequencies of long wave-lengths having great amplitude and penetrability—a combination which is essential to ensure the best success. In the smaller lamps these long wave-lengths of great amplitude are not present in such abundance because of the lesser amperage and smaller carbons. The results which the author has obtained in many diseases not generally subjected to light treatment will come as a surprise to those who have not kept closely in touch with modern light therapeutics.

The applications of the various coloured lights, as also those of the invisible spectrum rays, are fully discussed. A short chapter is given to the consideration of *n*-Rays and one to the Alpha, Beta, and Gamma rays of radio-active substances, their physical properties, actions, and therapeutic uses. An interesting chapter is that on fluorescence, fluorescent stimulation, and sensitisation of tissues, and the book closes with a chapter on the pernicious effect of sunlight and the pathological effects of electric lighting. The book can be confidently recommended. It will be found of great interest to most students of natural science.

REGINALD MORTON.

A BOOK ON INK.

Inks: their Composition and Manufacture. By C. Ainsworth Mitchell, B.A. (Oxon.), F.I.C., and T. C. Hepworth. Pp. xiv+251; with 46 illustrations, including 4 plates. (London: Chas. Griffin and Co., Ltd., 1904.) Price 7*s.* 6*d.* net.

LITERA scripta manet; but the permanence of the writing depends upon the quality of the ink. Certain papyri of ancient Egypt, now deposited in the British Museum, contain the earliest ink-written records so far brought to light. A roll dating from 2500 B.C. still bears decipherable characters, and fragments of papyri have been found by Prof. Flinders Petrie in a tomb to which the date 3500 B.C. is ascribed. If the origin of the use of ink is lost in antiquity, at

least one thing is certain—the writing-fluid used by the ancient scribes for such records as the foregoing must have possessed in a high degree the property of durability.

In one form or another, the basis of these early writing-fluids was carbon. For example, Chinese ink, the so-called "Indian" ink of the modern artist, which according to the native historians has been made since 2600 B.C. or thereabouts, was at first a vegetable varnish, and later a mixture of lampblack and glue. Inks containing gallate of iron did not come into use until a much later period. Thus Sir Humphry Davy, examining some documents recovered from the ruins of Herculaneum, "looked in vain amongst the MSS. . . . for vestiges of letters in oxide of iron," and he concludes that the Romans up to the time of Pliny had never used "ink of galls and iron" for writing purposes. Gradually, however, in the early centuries of the Christian era, there came a transition from carbon inks to those containing iron; and Blagden, in "Some Observations on Ancient Inks," communicated to the Royal Society in 1787, records that the writing fluid employed in various MSS. on vellum, dating from the ninth to the fifteenth centuries, was an iron and gall ink. Somewhat earlier than the date of Blagden's paper logwood began to find employment as a constituent of inks, and soon after the middle of last century came the next notable modification, namely, the use of aniline dyes in the manufacture of both black and coloured writing-fluids.

Of these and other matters bearing upon the history, composition, and methods of preparing the various kinds of inks, Messrs. Mitchell and Hepworth have much to tell us in the volume under notice. They have brought together, and made convenient for reference, material that has been hitherto chiefly scattered amongst periodicals and isolated dictionary articles. In so doing they have saved their contemporaries some labour, and earned for themselves much gratitude.

The book is divided into three sections. The first of these deals with writing inks, including those of which carbon, tannin, logwood, and aniline respectively form the characteristic ingredients. It comprises chapters upon the sources of the tannin materials, the chemical nature of iron-gall inks, and the best methods of examining both the fluid itself and the characters on the written page. Printing inks form the subject of section ii., in which an interesting chapter treats of colour work, including three-colour printing and inks for use in the production of cheques and bank-notes. In the concluding section there is a description of inks intended for miscellaneous purposes; these comprise copying, marking, safety, and sympathetic inks, and fluids for writing on glass, wood, ivory, or leather. Many formulæ are given, some of which the authors have personally tested, and the work closes with a list of English patents relating to the subject.

Despite occasional incoherency of style, the two collaborators have produced a useful and attractive little volume. One or two slips may be pointed out; thus the equation on p. 101 is incomplete, and the specific gravity of dilute hydrochloric acid is given wrongly on p. 208. In the historical introduction we are told, *apropos* of a certain document (p. 11), that "it was probably written at the end of the sixteenth century by a man past middle age, who learned to write just about the time that Shakespeare was born (1504)." At first it seems an unnecessarily cautious understatement to call such a man "past middle age," but a little reflection shows that it is those kittle cattle the figures that are to blame.

The book is a serviceable addition to the literature of chemical technology. C. SIMMONDS.

OUR BOOK SHELF.

Naturbegriffe und Natururteile. By Hans Driesch. Pp. viii+239. (Leipzig: Wilhelm Engelmann; London: Williams and Norgate, 1904.) Price 4*s.* net.

THIS book deals chiefly with three topics. Starting on a Kantian basis, it seeks to state the *a priori* principles of pure physical science. (*A priori* is conveniently defined as "independent of the amount of experience.") Next, the leading principles of "energetics" are discussed, and their relation on the one hand to the *a priori* principles of pure physical science, and on the other hand to the ordinary laws of thermodynamics. Incidentally, the "laws" of conservation (of substance and the like) are examined, and entropy has a good deal of attention. Last of all the results attained are carried over to a discussion of biology. The point of view is neo-vitalistic. It would be hazardous to say that the author has run to earth the *x* which is the object of all our search, the vital principle or whatever other name may be applied to it; the term which he uses is the blessed word *entelechy*.

Herr Driesch is well known to be at his best a clear, original and suggestive writer. Much of the present work is excellent, but we doubt if the last eighty pages are either clear or convincing. Perhaps one would require to read the author's other works in order to accustom oneself to his point of view and his independent modes of statement. He is occasionally unsatisfactory as well when dealing with the theories of others, for example, with Prof. Clerk Maxwell's "sorting demon." The discussion occurs under the heading "Declarations of Physicists regarding Biological Subjects," and Herr Driesch almost seems at times to suppose or to imply that the conception may have been formed in order to limit the second law of thermodynamics to inanimate bodies. True, Lord Kelvin's statement of the second law has the words "in inanimate material." But Lord Kelvin's declaration is explicit ("Popular Lectures and Addresses," 1889, vol. i. p. 141):—"The conception of the 'sorting demon' is merely mechanical and is of great value in purely physical science. It was not invented to help us to deal with questions regarding the influence of life and of mind on the motions of matter." On p. 103 the accurate reference to Helmholtz's work is—Ostwald's *Klassiker* Nr. 124, p. 30, Anm.

Higher Text-book of Magnetism and Electricity. By R. Wallace Stewart, D.Sc. Being vol. iv. of "The Tutorial Physics." Pp. viii+672. (London: W. B. Clive, University Tutorial Press.) Price 6*s.* 6*d.*

WE have several times noticed this work as successive editions have appeared, and can speak as appreciatively of it as we have on other occasions. The present volume is based on the older one, but it has been wholly

re-cast, and a very considerable quantity of new matter has been added in view of the rapid advance which has been made in electrical theory in the last few years.

In this edition the author has followed several other text-books in laying stress upon the importance of the electric field as the real seat of the energy of an electric circuit. It should be clearly brought out, however, that part of the energy must flow in the conductor, following there, as elsewhere, the direction of the equipotential surfaces; the forward flow is, however, in the dielectric itself. The figures exhibiting this flow of energy on pp. 344, 525, and 528 are very far from satisfactory. It is sufficient to point out that in every ordinary case of steady transfer the lines of force are convex *forwards;* indeed, if it be borne in mind that in accordance with Poynting's theorem the flow of energy takes place at right angles to the lines of force, there would be energy flowing out from and not into a conductor if the lines were as shown.

Too much care cannot be exercised in the construction of diagrams. They catch the eye; and just as nothing is better than a good diagram for inculcating truth, nothing can be worse educationally than one that is slipshod.

This remark applies equally to a figure illustrating the action of the keeper of a magnet on p. 227, where about twice as many lines of "force" are shown in the keeper as are represented in the magnet itself. Is the keeper supposed to be independently magnetised?

Again, on p. 401, if the equipotential lines on the plate exhibiting the Hall effect were really as shown, some of the current would flow over the edges of the conductor.

This slovenliness is almost wholly confined to the figures. The text is exceedingly lucid and painstaking in the endeavour to give a student a sound knowledge of physics. The large number of worked out examples, which have always been a distinguishing feature of the book, have no doubt contributed largely to the appreciation which it has received, especially from those who are compelled by circumstances to work without a teacher.

Life and Energy—Four Addresses. By Walter Hibbert. Pp. xiv+182. (London: Longmans, Green and Co., 1904.) Price 2*s.* 6*d.* net.

THE thesis of these four addresses—originally delivered at the Polytechnic Institute, London—is that life is not matter, is not energy, but an unceasing non-factorial directive control of energy and its transformations. "Directive control," *i.e.* in the same sense in which "temperature" in the case of heat, or "potential" in the case of electricity, controls the direction in which the energy shall flow. "Non-factorial," because while temperature, potential, and the like are factors of energy, life is not a factor.

Mr. Hibbert puts most of his points clearly, and much of what he says has considerable force. But it is doubtful if the range of ideas within which the book moves is adequate to the problem. The main position is not unassailable, and the deductions from it in regard to morals and religion are occasionally fanciful.

To descend to details. (1) It is difficult to see how the terms factorial and non-factorial describe precisely the difference between the directive control of energy manifested in inorganic and in organic bodies respectively. The discussion on p. 50 rather begs the question. (2) In describing God's directive control as being purely non-factorial, in saying (p. 144), "It is not the office of prayer to seek any direct disturbance of the course of material nature," but "its office is to secure a renewed faith in non-factorial control," Mr. Hibbert lays himself open to the retort, "Then non-factorial control is no control at all." (3) "Provided that life is a physical entity, it must be either matter or energy" (p. 16). "If it is a form of matter, it must weigh something" (p. 17). But what if it were ether? (4) "The living plant opens out a new path in which physical law can operate" (p. 39)—"it has, in a sense, directed the energy into special channels" (p. 38). But is this a differentia of life? Surely to one acquainted only with other manifestations of energy the path opened out by the dynamo is as new as anything can be.

Glossary of Geographical and Topographical Terms. By Alexander Knox, B.A., F.R.G.S. Pp. xl+432. (London: Edward Stanford, 1904.) Price 15*s.*

THIS work, which is intended as a supplementary volume to Stanford's "Compendium of Geography and Travel," is evidently the outcome of a vast amount of industrious research on the part of the author. The amount of labour involved in the collection of some 10,000 geographical terms derived from the most diverse languages all over the world can readily be imagined, and it can only excite our admiration that so much should have been successfully accomplished by a single individual. The book will be a decided boon to readers of works of geography and travel, who, in the absence of deep linguistic attainments, must constantly be puzzled by the terms employed in the place-names of foreign countries. It will also be valuable to the more scientific geographer as supplying a useful basis for the complete dictionary of geographical terms, which has long been felt to be a desideratum. Mr. Knox's book, useful as it is, can hardly be said to supply this need, being concerned rather with the general and popular, than with the scientific and technical usage of geographical terms. It was undertaken in the first instance, as the author explains, with a view to elucidate the terms in use in extra-European countries, and this object it certainly fulfils with success. European geographical terms, which naturally include the majority of those with which the scientific geographer is concerned, are less fully dealt with, and we not only miss many such technical terms as "Karst," "Kar," "Horst," "Schrund," "Aven" (to take a few only at random), but we find little attempt made at discrimination between the terms in use for closely allied features, or at the definition of nice shades of meaning, such, *e.g.*, as are involved in the words "dale" and "dell," both of which are explained merely as a "valley." Many English local terms are missing, and the definition of others is not always quite satisfactory. On the other hand various Spanish topographical terms are carefully explained, and the recent definitions by the International Commission for the Study of the Sea of the main features of suboceanic relief are correctly given.

But the special value lies in the fact that the information supplied is just that which is most out of reach of the ordinary reader, terms derived from the languages of Africa, Asia, and the less known parts of the world generally, being particularly well represented. The introduction includes some useful hints, by Dr. A. H. Keane, on the laws of interchange of letters in various languages.

Blackie's Handy Book of Logarithms. Pp. 128. (London: Blackie and Son, 1904.) Price 2*s.*

Vier- und fünfstellige Logarithmentafeln. Pp. 24. (Brunswick: F. Vieweg and Son, 1904.) Price 0.80 mark.

IN order that mathematical tables intended for common use may serve their purpose, it is essential that great attention be paid to the labour-saving arrangements which authors have from time to time introduced, such as the careful grouping of the figures in rows and columns, the use of varied type or of differently

coloured inks, marginal or thumb indexes, proportional differences, inverse functions, &c. On opening Blackie's "handy" volume, the reader will be disappointed to find that the compiler of the tables has paid little attention to the points enumerated above. A table of six-figure logarithms of four-figure numbers occupies twenty-two pages; the average difference for each row of figures is given, but there is no room found for proportional differences, so that the taking out of the logarithm of a five- or six-figure number involves an irritating calculation. Anti-logarithms are not included, but there is a table of hyperbolic logs. Sixteen pages are allotted to tables of natural and logarithmic functions of angles, for increments of one-sixth of a degree, without differences. Other tables include reciprocals, squares and square roots, cubes and cube roots, circumferences and areas of circles, heights and areas of circular segments, and rhumbs in degrees. There is an appendix giving some simple mensuration rules, some old-fashioned practical geometry, and definitions of the functions of angles, not as ratios, but as lengths.

The German tables are specially suitable for use in the chemical laboratory. The main feature is an eighteen-page table of five-figure logarithms of five-figure numbers, arranged, with proportional differences for each row of figures, like the four-figure logarithms contained in the first two pages. The collection of physical constants at the end is such as a chemist would be likely to require. There are no anti-logarithms, nor is there a marginal index. The size of page is ample, allowing of bold and effective type.

Second Report on Economic Zoology: British Museum (Natural History). By Fred. V. Theobald, M.A. Pp. x+197. (London: Printed by Order of the Trustees of the British Museum, 1904.) Price 6*s*.

THE recent development of British Museum activities in the line of economic zoology, for which the insight of the director is largely to be thanked, is re-expressed in a second report, following quickly on the heels of the first (see NATURE, January 28, 1904, vol. lxix. p. 290). We congratulated Mr. Theobald on his first report, and we repeat our congratulations, for the volume does credit to his energy and ability, and to the expertness of those inside and outside the national museum who have given him assistance. Everyone who has had even a little experience of the amount of work which is often required in order to answer apparently simple questions from outside will appreciate the skill which this report displays. The volume contains a large part of the information furnished by the director of the natural history departments of the British Museum to the Board of Agriculture and Fisheries between November, 1902, and November, 1903, besides replies to other correspondents and some special notes of present-day interest. The British Museum of Natural History is not only one of the greatest world-treasure-houses of scientific material, it has also, in its staff, an almost unrivalled wealth of learning, and we cannot refrain from giving expression to the widespread gratification that these resources of material and knowledge are now being utilised in behalf of the practical queries of the nation. The volume deals with mosquitoes, sheep scab, weevils, aphides, wire-worm, mites, leather-jackets, warbles, ring-worm, liver-fluke, and a hundred other economically interesting pests—and always in a way that leads us to respect Mr. Theobald's wide knowledge and practical shrewdness. We hope that there will be many such reports, for they are of a kind that enrich the nation as well as science. That they also contribute to art may be illustrated by the report on the grubs causing damage at Rye Golf Links.

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 Heterogenetic Origin of Fungus-germs.

AN attempt has been made in NATURE (December 22, 1904, p. 175), by Mr. George Massee, of Kew, to question the validity of my conclusions because of certain observations of his own of a totally different kind, which have little or no bearing upon what I have brought forward.

What he says is this:—*Dematium pullulans* of de Bary produces exceedingly minute colourless conidia which are most widely distributed and are capable of passing through "thick" filter paper. "Under normal conditions," he adds, "these minute conidia on germination form delicate hyaline hyphæ which give origin to a Cladosporium. If cultures of these conidia become infested with bacteria that form Zooglœa, the hyphæ become invested with a comparatively thick, brown cell-wall, and form either compact masses of cells or irregular hyphæ consisting of short cells, constricted at the septa, exactly as shown in Dr. Bastian's Fig. 12." He then refers to an illustrated paper in the *Kew Bulletin* for December, 1898, in which he has shown this process as it occurs in a certain disease of *Prunus japonica*. He thinks his observations exactly illustrate some of the facts which I have brought forward, while I, after carefully reading his paper and studying his illustrations, think they are altogether beside the mark.

He supposes the widely distributed conidia are not only present in the hay infusion (which of course they may be), but that they are able to pass through two layers of very fine Swedish filter paper (not merely "thick" paper, as he loosely puts it). Looking to his Fig. 5 and the size of the conidia there shown, this, I think, is more than doubtful. It is, however, altogether immaterial whether such conidia are present in the original hay infusion and are able to pass through the filter used by me or not, because the next necessary step in his suggested explanation is altogether wanting in my observations. This step is that the conidia assumed to be present shall produce delicate hyphæ, and that these hyphæ, coming into contact with masses of Zooglœa, shall "become invested with a comparatively thick, brown cell-wall, and form either compact masses of cells or irregular hyphæ consisting of short cells constricted at the septa." But I had already privately assured Mr. Massee that all the phenomena which I have described may be witnessed without its being possible to meet with a single hypha of any kind or a single one of the thick-walled, brown cells to which he refers.[1] Yet for his explanation to have any weight "delicate hyphæ" should always be seen in relation with the Zooglœa masses, and as for the "thick-walled cells" which are then formed being exactly like what I have shown in my Fig. 12, I can assure Mr. Massee he is absolutely mistaken. What I have represented in that figure are colourless products of segmentation of a Zooglœa mass (wholly unlike the colourless conidia shown in his Fig. 5) which speedily assume a brownish-black colour, and then, *without any intervention of delicate hyphae*, at once grow out into mycelial filaments of the same colour. In accordance with his explanation, the production of delicate colourless hyphæ should be the commonest thing possible, and should always be met with at an early stage of the changes that I have been describing; but, as a matter of fact, nothing is more remarkable than the rarity with which any of the myriads of Fungus-germs produced in a bacterial scum undergo a further stage of development, with the production of hyphæ either colourless or coloured, and I can assure Mr. Massee that he might work for three weeks or more with such infusions as I have described without finding a single specimen at all comparable with my Fig. 12. It seems deplorable that in regard to such an

[1] This was in reply to a private letter to me very similar to that which he subsequently sent to NATURE. In this reply I asked him to come and examine my specimens for himself, which he did not do.

important subject as the reality or unreality of heterogenesis, persons like Mr. Massee, who could speak authoritatively, should not think it necessary to make personal observations, and should be content to offer in reply to real and prolonged work only loose explanations which will not bear any serious examination.

A further instance of the same lack of care is afforded in the last sentence of Mr. Massee's letter. Referring evidently to my remark (NATURE, November 24, 1904, p. 77) as to the very different products that may be met with in the scum forming on an infusion made from unripe grasses as compared with that forming on an ordinary hay infusion, he says:—"As these fungi only develop on fading leaves it was not to be expected that they would appear in infusions of young grass." This sentence must have been penned without the writer having taken the trouble to look at p. 87 of my "Studies in Heterogenesis," to which reference was made when I directed attention to the differences in question. Had he done so he would have seen how little he had explained the differences noted on that and on the following page, and he would also have seen that the most striking difference recorded is the complete absence of Zooglœa masses (spoken of there as "areas") in the scum forming on infusions of unripe grasses. Of course if the Zooglœa masses are not there it is easy for me to understand the absence of the Fungus-germs which, as I maintain, are produced therefrom.

This point, as well as others in Mr. Massee's letter, shows the great importance of bearing in mind two wholly distinct aspects of my observations, corresponding with different stages in the processes described. We have to do (1) with the growth, the individualisation, and the processes of segmentation taking place in masses of Zooglœa. We have also to do (2) with the question of the ultimate destination, or the transformation, of the products of such segmentation. These are two parts of the subject which are to some extent distinct, and are well worthy of further separate consideration.[1]

In conclusion I would ask, Why do the bacteriologists not tell us what they know about Zooglœa—whether they are or are not aware of its developmental tendencies, and why it should undergo processes of minute segmentation, unless such processes are a result of an organising tendency destined to have some definite outcome? Why, again, should it or its segments so often tend to assume a brown colour, while it is still nothing but Zooglœa, either segmented or unsegmented? Again, why, if the brown Zooglœa does not yield the brown Fungus-germs, should there be this constant association of myriads of brown Fungus-germs (in the absence of hyphæ) in association with brown masses of Zooglœa? How can they explain, other than I have done, the actual organisation of a Zooglœa mass, and the stages by which the brown Fungus-germs seem to be formed therein? What process of "infection" in a filtered hay infusion contained in a closed pot could cause thousands of small Zooglœa masses to go simultaneously through similar processes of this kind—producing myriads of brown Fungus-germs—when not a single hypha is anywhere to be found, and when at first no Fungus-germs are to be met with outside the Zooglœa masses themselves? I trust the bacteriologists will vouchsafe to give us some information on these points, or, if they cannot reasonably explain them, that they may be induced to work at the subject, and satisfy themselves that something important can be learned concerning bacteria, even though it be outside their laboratories and by methods other than their own.

H. CHARLTON BASTIAN.

Compulsory Greek at Cambridge.

As a corrective to much vague discussion, perhaps the following record of facts may be of interest.

Entering the University of Cambridge in 1886, entirely ignorant of the Greek language, I was, of course, obliged to pass the "Little-go" in order to proceed to the natural sciences tripos. The Greek subjects prescribed were the Gospel of St. Mark, the Pluto of Aristophanes, and the usual grammar papers, and, in conjunction with a friend similarly circumstanced to myself, I set to work to "cram" these by as "scientific" methods as we could devise, in order to pass with as little waste of time as possible.

Purchasing a copy of Wordsworth's "Primer of Greek Grammar," we read the nouns, adjectives, and the active voice of τυπτω—no more, and then started on the prescribed books. These we translated by aid of a good lexicon, word by word—thus learning the parts of the irregular verbs, which form a favourite subject in the grammar papers. Having been once through the books by this method, we procured the translations, and read these through five or six times, in order to become so familiar with the subject-matter of the books that we could translate most passages easily at sight after making out the leading words in them.

The actual time expended by us in the preparation of Greek for the examination was carefully recorded, and amounted to 105½ working hours, and we passed the examination in the second class, with, I believe, a considerable margin of safety even in Greek. I need hardly add that my present knowledge of the language is *nil*.

JOHN C. WILLIS.

Royal Botanic Gardens, Peradeniya, Ceylon,
December 28, 1904.

Polyhedral Soap-films.

THE fact that polyhedral wire frames can be used for the purpose of forming films across them is well known, but there are some features of this subject, which I have investigated, which may be of interest.

If a frame of wire representing the edges of one of the simpler polyhedra, such as a cube or octahedron, is dipped into soap solution, then on taking it out it will have films attached to its edges and meeting roughly at a point in the centre of the figure, forming a number of pyramids standing on the faces of the figure. If, however, a more complex figure, such as the rhombic dodecahedron or the eicosihedron, be taken, then the effect will be quite different; the film will then simply cover all the faces except the one which was drawn out of the solution first. The former thing will happen if the area of the $(n-1)$ faces is greater than that required to form the pyramids, while the latter will occur if the reverse is the case.

If, now, in the case of the cube, for instance, after the pyramids have been formed, a film be applied to one of the faces, then a certain amount of air becomes entirely enclosed by film, and the bubble so formed settles in the centre of the frame, forming roughly a cube suspended in the frame by twelve sheets of soap-film. On closer inspection, however, it will be seen that the faces of this cube are convex, thus showing that the air in it is compressed. By inserting a tube this cubical bubble can be inflated or reduced in size, all the time retaining its convexity, so that if thus left in communication with the air it will collapse of its own accord. A little consideration shows the reason for this, namely, that three films meeting one another cannot be in equilibrium unless their planes are inclined to one another at 120°, since the tensions in all three are equal. But since the dihedral angle of a tetrahedron, cube, or octahedron is less than 120°, therefore in these figures the internal polyhedral film must always have convex faces.

From this I expected to get an exact polyhedron with plane faces in the case of the rhombic dodecahedron, since its dihedral angles are all 120°. On trying this it was found to agree remarkably with my assumption, only, as may be gathered from what has gone before, it was not quite so simple to obtain the central bubble as in the former case. After the $(n-1)$ faces had been covered with film the figure was again immersed so as to displace about one-half the air contained in it, and while thus immersed it was turned round so as to cover the one open face with liquid. On withdrawing it there was seen the plane-faced rhombic dodecahedron. The same result can be obtained by applying a film to the nth face and then exhausting some of the enclosed air by means of a tube. By using a tube, as in the former cases, the bubble can be enlarged

[1] My further observations on this subject will be found in the February number of the *Annals and Magazine of Natural History*.

or reduced at will by blowing or suction, and it will retain its size constant when placed in open communication with the outer air by means of this tube. This is, of course, the only plane-faced polyhedron which can thus be formed, faces, edges and vertices being entirely made out of soap films. If, on the other hand, a figure has its dihedral angles greater than 120°, then the internal bubble will have concave faces, and will, if placed in communication with the outer air, increase in size until it coincides with the faces of the frame, and will then be kept in equilibrium by their rigidity. This I verified in the case of the eicosihedron.

There is one important law which must be mentioned. I found a certain irregularity in the behaviour of the films in the case of the octahedron and rhombic dodecahedron. This was due to the fact that two films cannot cross one another at right angles, a law which can be put to the test by placing two plane loops covered with film at right angles, when a small lanceolate film will be formed making two curved lines of intersection with the film on the loops, instead of allowing them to intersect in a single straight line. In the case of the rhombic dodecahedron this slightly modifies the form of the internal bubble, introducing a small edge and a little curvature at each of the acute vertices. This defect causes a serious convexity if the bubble is small, but in general we have double curvatures at the points in question, the remaining portion of each face being plain while the figure retains the form of a rhombic dodecahedron.

W. F. WARTH.

Reversal of Charge from Electrical Induction Machines.

THE reversal of the poles of a Voss machine by giving some turns in the wrong direction, as observed in NATURE of January 5 (p. 221), is not an unknown phenomenon. It is described in my paper "Essai sur la Théorie des Machines électriques à influence" (Gauthier-Villars, Paris, 1898), p. 38, together with a much more trustworthy and simpler means—an improvement, in theory and in fact. This consists in discharging by hand, at the same time, both the inductors of the fixed disc. Then the reversal is invariably observed without stopping the machine.

V. SCHAFFERS.

Louvain (Belgium), 11 rue des Récollets.

THE CONSTRUCTION OF SIMPLE ELECTROSCOPES FOR EXPERIMENTS ON RADIO-ACTIVITY.

THE electrical method, where it is applicable, is now by far the most sensitive method of detecting small quantities of matter; and the recent advances in physical science made by the method of measuring small leakages of electricity, especially in connection with the phenomena of radio-activity, have excited a very general interest in the experimental arrangements employed. The writer hopes that the following account of simple electroscopes for this kind of work will be found to be of a practical nature and of service to those who, though unfamiliar with many of the devices in general use in a physical laboratory, are nevertheless desirous of making quantitative experiments on radio-activity or some other subject where the electrical method is employed.

In general the final shape of the instrument will depend very much on the purpose for which it is required; in fact, it is one great advantage of the gold-leaf electroscope that it can usually be fixed up in any odd corner of the apparatus which happens to be convenient. There is, however, one part of the apparatus which is always the same in sensitive instruments, and that is the gold-leaf system itself. Before describing this it will perhaps make things clearer if we consider for a moment one or two points about the theory of the instrument.

What we observe usually is the rate of decrease of the deflection of a charged gold leaf from a vertical metal support to which it is attached. Now the deflection in question depends only on the shape and size of the leaf and of the metal support, and on the electrostatic potential of the system, so that the rate of collapse of the leaf measures the rate of decrease of the electrostatic potential. But what we wish to measure is the current or rate of alteration of electric charge, and this is equal to the rate of decrease of potential multiplied by the electrostatic capacity of the system. Thus for a given current the rate of movement of the gold leaves is greater the smaller the capacity of the system. For a sensitive instrument it is therefore absolutely necessary to have the parts which are metallically connected with the gold leaf as small as possible.

Cutting gold leaves is a process which requires a considerable amount of patience, especially from the beginner. The process I always adopt is to take a plate of glass and lay a sheet of smooth note paper on it. On this the gold leaf is spread out flat by blowing gently if necessary, and is cut by means of a razor. To do this, all except a narrow strip at the edge is covered with a second sheet of note paper, the straight edge of which is pressed down with the fingers so as to hold the gold leaf. A fine strip outside the edge of the paper is then cut off from the leaf by dragging the razor gently backwards parallel to itself and to the edge of the paper. It is not necessary to exert any great pressure during this operation, but a little practice will be necessary to get into the way of doing the saw-cut stroke at the proper speed. Mr. C. T. R. Wilson has succeeded in this way in cutting uniform strips one-tenth of a millimetre across, but for most purposes strips one millimetre wide are good enough. In working with gold leaf much trouble will be saved by working in a room which is free from draughts and disturbances generally.

For the metal support to which the gold leaf is attached it is convenient to use a piece of wire of about the same diameter as the thickness of the gold leaf. To fix the leaf on to the wire it is sufficient just to moisten the latter at the point of attachment with the tip of the tongue; on allowing the end of the gold leaf to come in contact with the very slightly moist wire it will be found to attach itself sufficiently firmly for all that is required of it. For obvious reasons the cutting and mounting of the gold leaf should be the very last operation in the construction of the electroscope.

In constructing an electroscope it is of the utmost importance to have trustworthy insulation. When the apparatus has not to be raised to a high temperature, and great mechanical strength is not required, sulphur is a long way better than anything else for this purpose. Generally speaking, it is better to have as small a quantity of insulating material as possible in order to diminish irregularities caused by the superficial charging up of the dielectric. Suppose we wish to insulate the wire carrying the gold leaf from another wire which supports it mechanically we should proceed as follows:—Take a porcelain crucible and gently heat a quantity of pure flowers of sulphur in it until it just melts and forms a clear yellow limpid liquid. It is important that it should not be heated so strongly as to become dark coloured and viscous, as this appears to diminish its subsequent insulating properties. The end of one of the wires is then dipped into the liquid sulphur, when a coating of sulphur forms on the wire. This is allowed to cool until it has solidified, and the operation is repeated a number of times until a bead of sulphur like that shown in Fig. 1 A has formed on the end. The end of the other wire is now heated gently in the flame and applied with a slight pressure to the point *a*, when it melts its way into the sulphur;

and if the operation has been successfully carried out the result will be as indicated in Fig. 1 B.

In this sort of work it is often necessary to make sulphur stoppers, &c., of various shapes. To do this it is only necessary to make paper models of the required shape, into which the sulphur is cast. The paper generally sticks to the sulphur, but may be taken off with a clean knife without impairing the insulation. It is advisable to do this, and also any cutting away of the sulphur that may be necessary, immediately after it has set, since it becomes very hard and brittle soon afterwards.

For ordinary work with radio-active substances it is not necessary to employ the most sensitive type of electroscope, and for such work the design shown in Fig. 2 is very convenient. It consists of a brass cylinder of about the proportions shown and 10 cm. high. The top is closed by a flat plate with a narrow tubular opening *a*, into which a sulphur stopper *b*, cast as above, fits fairly tightly. The sulphur is best cast round the wire destined to carry the gold leaf. For examining the properties of various radiations the bottom may be made in the form of a ring, as shown. This is fixed by the slot and pin indicated or some

Fig 1

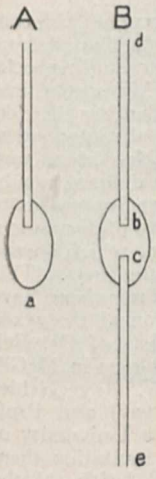
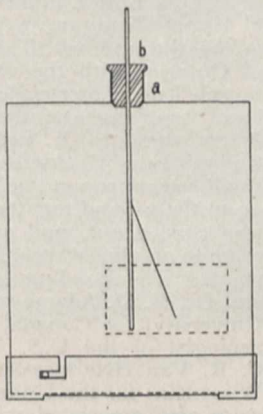


Fig 2



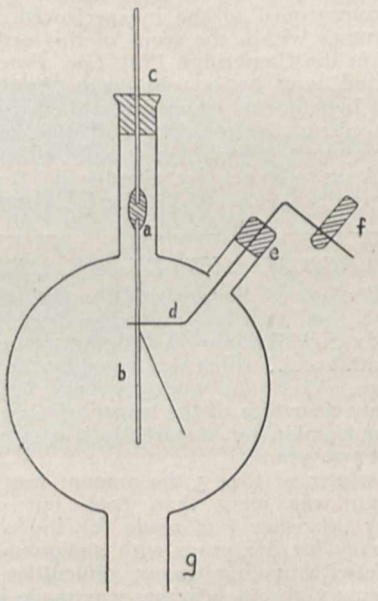
similar arrangement, and the circular hole in the base can be covered with sheets of foil, &c., if it is desired to examine the penetrating power of the rays under investigation. In all these instruments a hole has to be cut in the metal both in front and behind the gold leaf to illuminate it and to read its position. The holes are conveniently of about the relative size shown; they may be covered up with glass, mica, or transparent celluloid, whichever is most convenient. A suitable illumination is obtained by placing a sheet of white paper in front of a paraffin lamp about twelve inches behind the electroscope. The movement of the leaves is most conveniently read by means of a microscope of about 6 cm. focal length furnished with a micrometer eye-piece. It is advisable to have a microscope with as short a focal length as possible to increase the magnification, and therefore the sensitiveness.

The final appearance of the electroscope will depend very much on the appliances at the disposal of the experimenter. An instrument of this character could quite well be made out of a cigarette tin, but it would probably be more satisfactory to have the metal parts made by a competent mechanic.

If cells are not available the above instrument is readily charged by allowing a rubbed sealing wax or ebonite rod to spark to the outside wire. In measuring leaks the gold leaf should always be charged to about the same extent, as the sensitiveness depends a good deal on the amount of the deflection. The instrument will not keep its charge indefinitely, but will show a small leak even if no radio-active substances are present; this is nearly all due to the so-called spontaneous ionisation of the air. There is practically no leakage across the sulphur if the instrument is properly made.

For some purposes a more convenient arrangement is that indicated in Fig. 3, where the figure is drawn so as to exhibit the electroscope in its most sensitive form, *i.e.* with the minimum capacity. A piece about 4 cm. deep is cut off a wide brass cylinder, and the side tubes fitted on as shown. The gold leaf is carried by the wire *b*, and is insulated by the sulphur bead *a*, formed in the manner already described. Thus the insulation leak can only take place to the support *c*, and can be entirely prevented by keeping *c* at the same

Fig 3



potential as *b* by means of cells. The insulation of the wire *c* from the tube which supports it need not be of a very high order; it is sufficient to fix it in with a rubber stopper in the manner shown. So far we have all our charged system enclosed, so that there arises the difficulty of charging it. This is done by means of the wire *d*, which can be rotated about an axis through the centre of the ebonite stopper *e*. It is advisable to remove the wire *d* from the gold-leaf system when once this has been charged. By means of the sealing-wax handle *f* this may be accomplished without discharging the electroscope. The instrument is so far open. It is conveniently closed by two squares of window glass cemented on to the brass cylinder with sealing wax. The whole of the outside is then covered with thin lead sheet or tin foil to obviate effects due to the glass getting charged. Suitable windows must be cut in this to allow the position of the gold leaf to be read.

The above arrangement is as sensitive as this type of instrument can conveniently be made, since its capacity is only that of a short piece of wire and the

gold leaf. Generally speaking, the capacity in electrostatic units is found to be of the same order as the length of the wire. In this or a slightly altered form, the instrument is suitable for experiments on spontaneous ionisation and the radio-activity of ordinary materials.

In experiments on emanations, induced activity, and very penetrating rays it is often convenient to increase the magnitude of the effects by allowing them to ionise a large volume of air. For this purpose the arrangement last described is particularly convenient. It is only necessary to solder a long straight wire upon the lower end of *b* and to fix *g* by means of a rubber stopper into the neck of an oil can. The leak then measured is due to the ionisation produced throughout the volume of the can. The sensitiveness, though greater than before, is not increased in the ratio of the volumes, as would otherwise be the case, owing to the increased capacity produced by the additional wire. This arrangement is especially useful for examining the induced activity which may conveniently be deposited on the wire.

A still more sensitive type of electroscope was recently invented by Mr. C. T. R. Wilson. It does not, however, appear to be an instrument which can be safely recommended to the inexperienced, so that it scarcely comes within the scope of this article. It is described in the Cambridge Phil. Soc. *Proc.*, vol. xii. p. 135, and may be bought from the Cambridge Scientific Instrument Company. Much further information about electroscopes and electrometers for radio-active work will also be found in Prof. Rutherford's book on radio-activity, chapter iii.

O. W. RICHARDSON.

GEOLOGICAL SURVEY OF CANADA.

THE Geological Survey of Canada, which was established in 1842 under the direction of Mr. (afterwards Sir) William E. Logan, commenced its labours with 1500*l.*, which was voted by the Provincial Legislature. The sum seems to have been granted without any clear idea of the length of time which the survey would take, but apparently it was expected to last about two years.

In the winter of 1844–5 the amount was expended, and Logan was more than 800*l.* out of pocket. Eventually provision was made for the continuance of the survey for five years with an annual grant of 2000*l.* Notwithstanding many difficulties and disappointments vigorous progress was made in the field work and office work, and this has been continued for upwards of sixty years under the successive directors, Selwyn, George Dawson, until now, when the survey, under Dr. Robert Bell, is provided for better than at any previous time. Thus the total votes for the present financial year amount to 22,800*l.* for general purposes, and to about 8000*l.* for the salaries of permanent officers.

We gather from the last summary report by Dr. Bell that while the Canadian Geological Survey, like that of the United States, has been engaged in palæontological, zoological, botanical, ethnological, and archæological investigations, by far the largest proportion of the work has been of an economic and practical character. Thus the justification for the increased support given to the survey is amply supplied by the investigations which have been carried on with the view of aiding the development of the mineral resources of the country. Up to the end of 1903 the publications of the survey included about 350 maps, of which 100 relate especially to mining districts; and about 250 reports and bulletins, amongst which nearly 100 are exclusively economic. During the four years of Dr. Bell's directorship, the field parties have been increased, and during the past year they have worked in many interesting districts, from the Yukon and British Columbia in the west to New Brunswick and Nova Scotia in the east, and from southern Ontario and Quebec to Lancaster Sound in the Arctic regions. Their researches have had reference to gold, silver, lead, copper, graphite, corundum and mineral pigments; to coal, peat, petroleum and natural gas; to various building and ornamental stones, clays and cement ingredients. Hitherto unknown sections of the country have been explored and surveyed, and observations have been made on the timber, soils, and water supply, as well as on the general natural history.

The palæontological work of the survey has been carried on by the veteran palæontologist Dr. J. F. Whiteaves, aided in the department of vertebrates by Mr. Lawrence M. Lambe. In the "Contributions to Canadian Palæontology" (vol. iii.), recently issued by the survey, Mr. Lambe has described some remains of the carnivorous dinosaur *Dryptosaurus incrassatus* (Cope), from the Edmonton series of Alberta, in the North-West Territory. The strata belong to the Lower Laramie (Cretaceous) formation. The importance of a more intimate knowledge of the fauna of the Edmonton series is apparent when it is borne in mind that the beds of this series in Alberta constitute the principal coal-bearing horizon of the district.

Dr. Bell himself has been partly occupied, in conjunction with other leading geologists in Canada and the United States, in investigating the crystalline rocks in Upper Michigan, in Wisconsin and Minnesota, and in the Rainy River, Thunder Bay, and other districts of Ontario, with the view of settling disputed questions. The controversies on these rocks have long been occupying attention without any definite result. A few years ago Dr. Bell urged upon the International Committee of Geologists the desirability of forming a small central committee, the members of which should go to the ground together and look at the facts. This was carried out, and as a result the members have come to an almost complete agreement on all the vexed points. The standing committee consists of Dr. Bell and Dr. F. D. Adams (professor of geology in McGill University) for Canada, and Dr. C. W. Hayes (chief geologist of the U.S. Geological Survey) and Prof. C. R. Van Hise (president of the State University of Wisconsin) for the United States. By invitation there were also associated with them Prof. Leith (of the University of Wisconsin), Dr. Lane (State geologist of Michigan), Prof. Seaman (professor of geology in the College of Mines at Houghton, Michigan), Messrs Sebenius and Merriam (geologists of the Iron Ranges), and Prof. W. G. Miller (provincial geologist of Ontario). It is anticipated that the joint report will shortly be published.

RECENT EXPLORATION IN THE MENTONE CAVES.

PROF. MARCELLIN BOULE has recently been studying the deposits in the well known caves of the Rochers rouges (Baoussé-roussé of local patois) near Mentone, and read a paper on his results before the Société géologique de France in the early part of last year, which is published in the society's *Bulletin* (No. 1). Since the original discovery by M. Rivière of a human skeleton in one of these caves, the question of the age of their deposits has been debated with much warmth, but without any satisfactory result. In recent years the caves have been carefully and systematically explored under the direction of the Prince of Monaco, with the result that a great number of fossils have been obtained. Prof. Boule's researches were

conducted chiefly from the geological standpoint with the view of determining the age of the deposits, and of throwing light upon the much debated question of the oscillations of sea-level in recent times on the Mediterranean seaboard.

Prof. Boule's attention was directed in the first instance to the Grotte du Prince, which was almost intact when excavation was commenced. Here the deposits attain a thickness of more than 20 metres, and consist of basal beds of marine origin upon which strata of continental origin are superimposed. The latter can be subdivided into a number of layers, both by their physical characters and by their fossil contents, but the point of importance is that the upper and middle beds contain remains of reindeer (never previously recorded in this region), ibex, marmot, and woolly rhinoceros, that is, the fauna of the cold period of the Quaternary, while the lower beds contain quite a different fauna—*Elephas antiquus, Rhinoceros mercki,* and hippopotamus, that is, species belonging to the lower Quaternary fauna. The last named deposits lie upon an old raised beach which is also discernible outside the cavern, along the shore rocks, at a mean altitude of 7 metres. Almost all the contained fossils belong to the existing Mediterranean fauna, but Prof. Boule has found some beautiful examples of *Strombus mediterraneus,* which has been regarded as characteristic of the raised beaches of the Quaternary period in the Mediterranean area. But the Prince's cave contains other traces of marine action of a much earlier date. In its upper part, at a height of 28 metres, there is a calcareous encrustation due to the action of the waves, below which the wall of the cavern is perforated by boring molluscs. The sequence of events is therefore explained by Prof. Boule as follows:—

The sea formerly stood at the 28-metre level, and then gradually retired until it stood at a height of 7–8 metres. At this level the shell deposit was laid down on the floor of the cavern. Subsequently the movement of elevation was continued. Its extent is difficult to determine, but the oceanographical researches of the Prince of Monaco have shown that there extends along the rochers rouges at a slight depth an extensive submarine platform. This suggests that the movement—whether of the land or of the sea—continued until there was laid bare between the sea and the present irregular shore line a plain sufficiently extensive to become the home of such large animals as elephants, hippopotami, and rhinoceroses, for which the present topography allows no space. It is at least certain, according to Prof. Boule, that the 7-metre beach, described at other parts of the Mediterranean littoral by MM. Depéret and Caizot, and regarded by them as of late Quaternary date, really belongs to a much more distant period, for it is anterior to the subaërial deposits containing fossils belonging to the older period of the Quaternary. If this conclusion be correct, it affords a means of fixing the age of the last oscillation of sea-level in this region. It should, however, be noted that in the discussion which followed the reading of the paper M. Depéret protested against the proposed homologising of the low raised beach (height 5–7 metres) studied by him on the French coast of the Mediterranean (*e.g.* in the Bay of Pierre-Formique) with the Strombus beach in the Mentone caves. The former type of beach contains a fauna very different from that of the Strombus layers, Strombus being absent, and all the fossils belonging to living species.

At the conclusion of his paper Prof. Boule referred to the three new human skeletons which have been recently discovered in the Grotte des Enfants. The first of these has been studied by MM. Gaudry and Verneau, and proves to be markedly Australoid in type. It was obtained in a bed containing *Ursus spelaeus, Hyaena spelaea, Felis spelaea,* &c., and rested upon a bed containing molars of *Rhinoceros mercki.* It must therefore belong to the earlier part of the Quaternary period. The second skeleton was found about 0.60 metre above the first, and was accompanied by remains of the same species of mammals. The third skeleton, on the other hand, found 6 metres above the first, seems to belong to the period of the reindeer, that is, to the end of the Quaternary epoch.

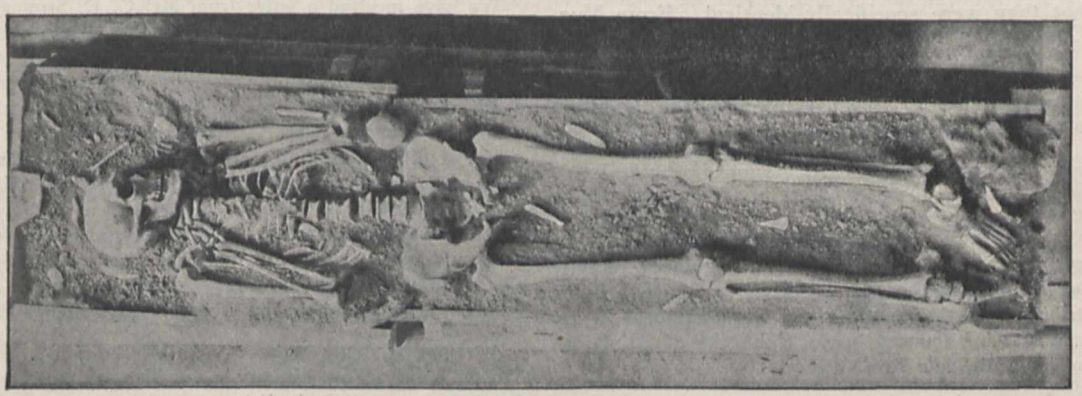


FIG. 1.—Skeleton from the Grotte des Enfants.

THE SCIENTIFIC EXPLORATION OF LAKE TANGANYIKA.

THE committee for the scientific exploration of Lake Tanganyika (consisting of Sir John Kirk, Dr. Sclater, Sir W. Thiselton-Dyer, Prof. Lankester, Dr. Boulenger, and Mr. J. E. S. Moore) has lately received news of the progress of its envoy, Mr. W. A. Cunnington, who left England in March, 1904, under directions to continue the researches carried out by Mr. J. E. S. Moore during his two expeditions to Lake Tanganyika. Proceeding by the Zambesi and Shiré route, Mr. Cunnington was most kindly received at Zomba by Sir Alfred Sharpe, who granted him the assistance of two native collectors. Mr. Cunnington had instructions to devote his special attention to the lacustrine flora and fauna of Lake

Tanganyika, and, as he passed up Lake Nyassa, began his investigations in that lake, in order to be able to compare its products with those of Tanganyika. On Lake Nyassa Mr. Cunnington was able to get a good number of tow-nettings from different parts of the lake's surface, and obtained, on the whole, a large quantity of its characteristic phytoplankton, besides a considerable amount of zooplankton, consisting mostly of Copepoda, Cladocera, and insect-larvæ. The temperature of the water of Lake Nyassa was observed to fall seldom below 70°, while the temperature at 76 fathoms below the surface was ascertained to be about three degrees higher.

Mr. Cunnington arrived at Karonga, at the head of Lake Nyassa, at the end of June, 1904, and travelled on to Tanganyika by the ordinary route of the Stevenson road. His last letters from Tanganyika are dated at Vua, on October 29, 1904. He had obtained a dhow from Ujiji, which enabled him to make his stay at different places on the lake longer or shorter according as he found much or little to collect. A good series of fishes had been preserved, and many freshwater crustaceans. As regards the vegetable life, Mr. Cunnington had been much struck by the near resemblance of all the forms obtained in Tanganyika to those which he had collected in Nyassa, though he could not, of course, say that they were specifically identical. From Vua, Mr. Cunnington had arranged to cross to the east coast of the lake, and to go some distance further north before returning to the western shore. Mr. Cunnington may be expected to return to England before the end of the year.

NOTES.

SIR JAMES DEWAR has presented the proceeds of the Gunning prize, amounting to one hundred guineas, recently awarded to him by the Royal Society of Edinburgh, as a contribution to the fund for the encouragement of research, now being founded in the University of Edinburgh in memory of the late Prof. Tait.

WE regret to learn from the London branch of the Zeiss optical firm that Prof. Abbe, of Jena, died a few days ago. We also announce with regret the death of M. Paul Henry, astronomer at the Paris Observatory. His brother, M. Prosper Henry, with whom he was associated for many years in celestial photography, died about eighteen months ago.

THE Paris Société d'Encouragement pour l'Industrie nationale has awarded the grand prize of the Marquis d'Argenteuil to MM. Auguste and Louis Lumière for their photographic discoveries. M. Héroult has been awarded a grand gold medal for his works on electro-metallurgy.

THE two Antarctic ships *Terra Nova* and *Morning* were sold at Portsmouth on January 11. Messrs. W. Ziegler and Co., New York, bought the *Terra Nova* for 9600*l*., and she will probably be used for North Polar exploration. The *Morning* was sold for 1600*l*. The *Discovery* has been sold privately to the Hudson's Bay Company for 10,000*l*.

M. L. BONNAMÈRE has been elected president for 1905 of the Prehistoric Society of France.

THE death is announced of Dr. Anton Müttrich, professor of physics and mathematics in the Academy of Forestry at Eberswald.

SIR WILLIAM THISELTON-DYER, K.C.M.G., will take the chair at a lecture to be delivered at the West India Committee Rooms, Seething Lane, on Wednesday, January 25, by Mr. W. G. Freeman, superintendent of the colonial economic collections at the Imperial Institute, on "The West Indian Fruit Industry."

THE next competition for the Howard medal of the Royal Statistical Society will take place in the ensuing session. The essays must be sent in on or before June 30. In addition to the medal, a grant of 20*l*. will be awarded to the successful competitor. The subject is:—"A Critical Inquiry into the Comparative Prevalence of Lunacy and other Mental Defects in the United Kingdom during the Last Fifty Years."

THE death is announced of Mr. T. W. Shore, author of a number of papers on geological and archæological subjects. Mr. Shore was for a long time resident at Southampton, where he acted as curator of the Hartley Institution and secretary of the Hampshire Field Club. At the Southampton meeting of the British Association in 1882 he was one of the secretaries of the section of geology. On removing to London, he founded the Balham Antiquarian Society, and became its secretary; he was also secretary of the London and Middlesex Archæological Society.

WE have received a letter from Mr. C. E. Stromeyer, of Manchester, in which he suggests that irregularities of the earth's surface might be detected by special observations for determining the position of the northern and southern limits of totality during the coming total solar eclipse of August next. Unfortunately there are many practical difficulties in the way which the author has not discussed, but he makes one suggestion which might be carried out. He proposes to place soldiers at short distances along the northern and southern borders of the shadow's path, who, by marking the positions where the eclipse was total, might determine with greater accuracy than is known the breadth of the moon's shadow.

A CORRESPONDENT writes:—The death of Dr. Thomas Woods occurred on January 5 in Birr (or Parsonstown). Dr. Woods was born in February, 1815, and graduated as doctor of medicine in Glasgow in 1838. He spent all his long life as a medical practitioner and as medical officer of the union and dispensary in Birr. So it is, perhaps, not to be wondered at that his scientific work belonged largely to a former generation. He was a chemist, and as such took part in the early development of photography, originating in the 'forties a new wet plate process, the "catalysotype," a detailed description of which may be found in Hunt's "History of Photography." In 1852 and 1853 he published in the *Philosophical Magazine* some original observations on the heat developed by chemical combination, and defended with considerable success his claim of priority against Andrews and Joule. He was a man of remarkable ability and astoundingly general scientific interest, and it is much to be regretted that circumstances kept him in a small country town, and that his professional duties prevented him from adding further to scientific knowledge. He continued mentally and bodily fresh to the very end, ever eager to hear of the latest scientific discoveries, and Birr feels distinctly the poorer for his loss.

A REUTER message from Christiania states that at Nesdal, north of Bergen, on Sunday, a mass of rock slipped into the Loenvand Lake. A wave of water twenty feet high, which resulted from the fall, swept the neighbourhood, carrying away houses, people, and cattle.

As supplementary to the paragraph on the recent fall of cliff at St. Margaret's Bay, near Dover (NATURE, January 12), it may be mentioned that the cliffs at St. Margaret's Bay, which rise from 150 to 300 feet, are formed of the Upper Chalk, comprising soft chalk and harder nodular bands, with scattered flints and occasional continuous seams of flint. These beds are surmounted by chalk, with many layers of flint nodules and some continuous bands of flint; and this portion of the chalk forms the mass of the cliffs at St. Margaret's Bay, the lower beds appearing at beach level and rising southwards. The general dip of the chalk is to the north-east, corresponding to some extent with the trend of the coast from East Wear Bay to Dover and St. Margaret's. Numerous falls of cliff have taken place along this coast for many centuries, the greatest losses having occurred above East Wear Bay in the great landslip of the Warren, where notable founders occurred in 1716 and again in 1886. Such slips along the sea-front may serve for a time to protect the cliffs from further waste, until the débris is removed by the breakers. Copious springs issue along the foot of the cliffs here and there, and a powerful spring issues at St. Margaret's Bay. These probably had no direct influence on the recent falls of cliff, but rather would the slips be due to the local feeders of the springs, to their erosive action along joints in the chalk, and to the effects of frost. It is quite possible, as has been suggested, that blasting operations at the Admiralty Harbour at Dover may have accelerated the falls of cliffs at points where they were weakened by natural agencies.

THE *Victorian Naturalist* brings us news of the death, on November 18, 1904, of Mr. J. G. Luehmann, Government botanist and curator of the National Herbarium at Melbourne, at the age of sixty-one. Mr. Luehmann went to Victoria in 1862, and in 1867, on the resignation of Mr. E. B. Heyne, secretary to the late Baron von Mueller, Mr. Luehmann was offered the position, which he accepted, and he remained connected with the botanical department until shortly before his death. For many years he made the preliminary identifications of specimens for Baron von Mueller, becoming an authority on the eucalypts and acacias. His great assistance was acknowledged by Baron von Mueller in the preface to the "Key to the System of Victorian Plants." In the early days of the Field Naturalists' Club of Victoria, before the institution of the *Victorian Naturalist*, he contributed papers on the eucalypts and acacias. In 1896, on the death of Baron von Mueller, he was appointed curator of the National Herbarium, and afterwards became Government botanist. During late years he contributed several descriptions of plants to the club's proceedings, in addition to an interesting paper—observations on pre-Linnean botanists—in which he directed attention to the many valuable botanical works in the herbarium library. He was one of the earliest Victorian fellows of the Linnean Society of London.

IN a paper in the *Lancet* (January 7) Mr. G. C. Chatterjee, working under the direction of Captain L. Rogers, I.M.S., announces that he has succeeded in cultivating trypanosomes from the Leishman-Donovan body or parasite, thus confirming Captain Rogers's previous work in this direction.

WE have received the first number of the new volume of the *Journal of Hygiene* (vol. v., No. 1), which continues to maintain its previous high standard. It contains papers on piroplasmosis by Mr. Bowhill and by Mr. Ross, cultivation of trypanosomata by Mr. Smedley, epidemiology of plague by Mr. Hankin, a leprosy-like disease in the rat by Mr. Dean, &c. An introductory memoir, with a portrait, gives an account of the work of the late Sir John Simon.

MM. SALOMONSEN AND DREYER have conducted some experiments on the effect of the radium emanations on certain Protozoa and on the blood. The material consisted of fifty milligrams of pure radium bromide covered with a sheet of mica. On Nassula the radium had little effect, even with an exposure of six days. Some amœbæ were killed in less than twelve hours, but others survived four days. *Trypanosoma Brucei* was killed in from two to three hours. On blood corpuscles the radium exerted a hæmolytic power.

H.R.H. PRINCESS CHRISTIAN and Mr. Chamberlain were present on Friday last at St. George's Hall, Liverpool, on the occasion of a meeting in connection with the Liverpool School of Tropical Medicine, at which a lecture was delivered by Major Ronald Ross, F.R.S., on "The Progress of Tropical Medicine." Major Ross, in the course of his address, alluded to the discoveries which had proved that yellow fever is conveyed solely by mosquitoes, to the work of Sir William MacGregor in the suppression of malaria in Lagos, and to the anti-malarial measures of the Suez Canal Company, which had resulted in a reduction of the annual rate of malarial fevers at Ismailia from two thousand to two hundred. He also alluded to the fact that the Liverpool School had sent out no less than fourteen expeditions to investigate tropical diseases in various parts of the world.

Naturen for December, 1904, contains some realistic, and perhaps rather ghastly, photographs of a python and its prey, taken from menagerie specimens. In the first of the series we have an unfortunate rabbit "fascinated" and about to be seized by a python, in the second the rodent in the coils of the serpent, and in the third the python commencing to devour the crushed carcase.

THE most important, or at all events the longest and most fully illustrated, paper in the second part of vol. ii. of the quarterly issue of *Smithsonian Miscellaneous Contributions* is one by Mr. C. Schuchert on Silurian and Devonian cystoid echinoderms and the genus Camaracrinus, in the course of which many new forms are described, and some valuable contributions made to the morphology of the group. Among the other contents of this issue, reference may be made to a list of west Indian birds by Mr. J. H. Riley.

THE issue of *Biologisches Centralblatt* for January 1 contains an article by Dr. E. Rádl on the hearing of insects, at the conclusion of which it is pointed out that this sense is much less developed in that group than in the higher vertebrates. The hearing of insects seems, in fact, to be a muscular rather than a nervous sense. The other articles include one by Mr. H. S. Skorikow on the plankton of the Neva, in the course of which several new forms are described, and one by Dr. O. Zacharias on the light-organs of *Ceratium tripos*.

ICHTHYOSAURS, or the extinct marine "fish-lizards" of the Mesozoic epoch, form the subject of an article by Prof. H. F. Osborn in the January number of the *Century Magazine*. After tracing the ichthyosaurian paddle into a limb of the type of that of the existing terrestrial tuatera lizard (Sphenodon) of New Zealand, which is regarded as nearly related to the ancestral stock of the group, the

author proceeds to point out how much we know with regard to the nature of the soft-parts and the life-history of the fish-lizards. We are aware, for instance, that they had a dorsal and a caudal fin, a naked scaleless skin, and a spiral valve to the intestine, similar to that of sharks; while, from the inclusion of skeletons of fœtuses within the ribs of full-grown individuals, we also know that they produced living young. This viviparous condition is, of course, an adaptive modification, similar to that which occurs in the sea-snakes of to-day, rendered necessary by the pelagic habits of these reptiles. The similarity in bodily form existing between sharks, dolphins, and fish-lizards is referred to as another instance of such an adaptive modification. Excellent illustrations—one showing a female ichthyosaur and her progeny—accompany the paper. Apparently the author is unaware that the name Shastasaurus, proposed for a Triassic American ichthyosaur, has been changed, on account of pre-occupation, to Merriamia.

A PAPER upon Mendel's discoveries in heredity, read by Mr. C. C. Hurst before the Leicester Literary and Philosophical Society, gives a succinct account of Mendel's experiments, and the rules which he evolved therefrom; also it contains a list of the chief experiments with different plants and animals which have been carried out subsequently. The paper is published in the *Transactions* of the society, vol. viii. (June, 1904), and in the same part will be found a useful summary prepared by Mr. H. St. J. Donisthorpe of additions to British Coleoptera during the last ten years.

IN the *Comptes rendus*, vol. xxxv., No. 6, of the Imperial Society of Naturalists of St. Petersburg, lists of new plants for the Crimea are given by Mr. K. Golde and Mr. A. Younghé. Two of the most striking mentioned by Mr. Younghé are *Crambe juncea*, a Persian plant, which grows to the height of a man, and *Lythrum nanum*, a dwarf Siberian plant. Both botanists make a special reference to the freshwater plants, which include species so familiar to us as *Zannichellia pedicellata*, *Œnanthe Phellandrium*, and species of Potamogeton.

THE first appendix to the *Kew Bulletin* for 1905, enumerating the hardy shrubs, trees, and herbaceous plants of which seed is available, has been received.

IN our issue of January 12 (p. 255) we referred to the prominent part taken by M. Leon Teisserenc de Bort in the establishment of a Scandinavian station for the exploration of the upper air by means of kites and unmanned balloons. The first results of this important enterprise have been published in a work entitled "Travaux de la Station Franco-Scandinave de Sondages aériens à Hald, 1902–1903," a large quarto volume of 160 pages. The station is situated on an extensive open domain belonging to M. Krabbe, near Viborg, in Jutland, and is due to the exertions of MM. Hildebrandsson, Paulsen, and Mascart, the official meteorological representatives of Sweden (Upsala), Denmark, and France. The necessary subscriptions for carrying out the experiments have been chiefly contributed by private persons—in Sweden, by an anonymous donor, 28,000 francs; in Denmark, 245,000 francs (including a grant of 10,000 francs by the Danish Government); in France, 66,100 francs (of which M. Teisserenc de Bort contributed 50,000 francs, and a further loan of material from Trappes valued at about 12,000 francs). The Danish Government also lent two gunboats for kite experiments; the value of kite ascents from steamers at sea has been more than ever fully established by the results obtained, some of the kites reaching altitudes varying from 3000 to 5900 metres. The difficulty of reaching such heights is well known to persons who have undertaken similar experiments.

PROF. DR. C. UHLIG contributes some notes of a journey from Kilimandjaro to Mweru to Nos. 9 and 10 of the *Zeitschrift* of the Berlin Gesellschaft für Erdkunde. The paper is illustrated by a number of excellent photographs.

THE last issue of the *Mitteilungen aus den deutschen Schutzgebieten* is entirely devoted to the region of the Pacific. Dr. Born records some observations on the ethnography of the Oleaï Islands, Herr Senfft describes a visit to some of the West Caroline Islands, and there are abstracts of meteorological observations for 1903, and maps based on recent surveys.

THE last number of the *Deutsche geographische Blätter* contains reports of two lectures delivered to the Vereinigung für staatswissenschaftliche Fortbildung at its meeting at Bremen in November last. Dr. Tetens discussed the importance of Bremen as a centre of trade, and gave an exhaustive statistical account of its development and a comparison with other seaports; his paper is illustrated by nineteen sheets of diagrams, and should be of great value to students and teachers of commercial geography. Dr. W. Hochstetter lectured on the history of the North German Lloyd.

THE Royal Geographical Society has issued, as an extra publication, a paper on recent contributions to our knowledge of the floor of the North Atlantic Ocean, by Sir John Murray and Mr. R. E. Peake. The new material dealt with consists chiefly of soundings from the telegraph ships *Minia* and *Faraday*, but the chart accompanying the paper has been fully brought up to date, and new measurements of areas at different depths have been made. An interesting correspondence with the United States Hydrographic Office about the origin of the term "telegraphic plateau" appears in the introduction.

THE first place in the January number of the *Geographical Journal* is given to a striking address delivered to the International Congress of Arts and Sciences at St. Louis in September last by Dr. H. R. Mill. Dr. Mill's address is entitled "The Present Problems of Geography," by which the author means not "the whole penumbra of our ignorance, but those problems the solution of which at the present time is most urgent and appears most promising." Many of his conclusions concerning the scope and methods of geography are of profound significance. It seems specially appropriate that the address should immediately precede a paper on geography and education in the same number, in which the recent articles and correspondence in the newspapers are summarised and discussed. Dr. Mill puts his finger on many points which have formed real obstacles to the development of geographical teaching in schools and elsewhere.

A CORRESPONDENT of the *Physikalische Zeitschrift* inquires whether any experimental or other information exists regarding the heeling over of a ship on one side caused by the turning moment on the screw shaft.

PROF. R. W. WOOD describes in the *Physikalische Zeitscrift* a simple experiment for showing the pressure due to sound waves. The waves are made to converge to a focus by reflection, and close to this point is placed a

small horizontal paddle wheel almost exactly like a Crookes's radiometer. If the sound waves converge to one side of the wheel it will spin rapidly in the corresponding direction.

FROM the Volta Bureau of Washington we have received two reprints, one dealing with the so-called "visible speech" alphabet introduced into England by Dr. Alexander Melville Bell in 1865–7, and the other being an essay, by Dr. William Thornton, on teaching the deaf and dumb to speak, published in 1793. The reprints are illustrated by portraits of Drs. Bell and Thornton, and a biographical notice also accompanies Dr. Thornton's paper.

WE have received the report for 1903-4 of the Scientiãc Society of St. Paul (Brazil), and have been able to gather from it that the society was founded in June, 1903, the city already having a historical and geographical, a medical and an agricultural society. It numbered in April last fifty-six effective, four contributing, one corresponding member, and two "socios ouvintes," a total of sixty-three members, of whom twenty-eight were foundation members. The membership list now, however, shows thirteen corresponding members. There have been held two preliminary, one inaugural, fourteen ordinary, and four "economic" meetings, and from the account of these meetings the papers seem to have been interesting and varied. A desirable improvement would be the publication of the reports in one of the international languages.

THE question as to whether the trioxide of nitrogen, N_2O_3, is capable of existence has frequently been discussed, but until recently has remained unanswered owing to the lack of experimental data. When the brown gas produced by the action of starch or of arsenious anhydride on nitric acid is passed through a freezing mixture, it condenses to a blue liquid, which does not solidify at $-90°$. But the determination of its vapour-density shows that the gas is completely dissociated, and Ramsay and Cundall showed in 1885 that no contraction takes place when the monoxide and dioxide are mixed. The blue solution might therefore be regarded merely as a solution of NO in N_2O_4. The actual existence of the trioxide has recently been demonstrated by Wittorff (*Zeit. anorg. Chem.*, vii., 209), who has investigated the freezing point of mixtures of different composition. A liquid having the empirical composition N_2O_3 solidifies to a blue crystalline solid, which melts at $-103°$ C., and is undoubtedly the pure trioxide. As the proportion of N_2O_4 is increased the freezing point at first falls to a eutectic temperature at $-112°$ C., and then rises to the freezing point of the peroxide. In this way, by accurate work at low temperatures, it has been possible to solve one of the long-debated problems of inorganic chemistry.

IT has long been suspected that in solution the dichromates might perhaps be dissociated into neutral chromates and free chromic acid, thus,

$$K_2Cr_2O_7 \rightleftarrows K_2CrO_4 + CrO_3.$$

Purely chemical methods have given but little information as to the nature of the dissolved salt. As the result of an ingenious application of physicochemical methods, the problem has recently been solved by Abegg and Cox, and these authors have been able actually to determine the proportion of free chromic acid in dichromate solutions of different concentrations. The method, which is described in the *Zeitschrift für physikalische Chemie* (vol. xlviii. p. 725), depends on saturating a solution of a dichromate with neutral and basic mercuric chromates, $HgCrO_4$ and $HgCrO_4.HgO$. In presence of these two salts the concentration of free chromic acid in the solution is maintained constant at 0·706 mol. per litre at 50° and 0·456 mol. at 25°, and any excess of chromic acid must be combined either as chromate or as dichromate. It is calculated that in the case of potassium dichromate complete dissociation occurs at a dilution of 1000 litres, whilst at 100 litres 99 per cent. of the salt is dissociated, at 10 litres 91 per cent., and at a dilution of 1 litre 62 per cent. Even in the strongest solutions, therefore, the greater part of the dichromate is dissociated into chromic acid and normal chromate.

MESSRS. WHITTAKER AND CO. will shortly publish a new book entitled "The Insulation of Electric Machines," by Mr. H. W. Turner and Mr. H. M. Hobart.

MESSRS. GEORGE BELL AND SONS have published parts i. and ii. of "Elementary Algebra," by Messrs. W. M. Baker and A. A. Bourne, in one volume at 4*s.* 6*d.* The book may be had with or without answers.

THE twenty-fourth volume of the *Geographical Journal* has now been published. It contains the monthly numbers from July to December, 1904. As usual, the volume is richly illustrated by means of blocks and a profusion of well executed maps. The volume should be added to the library of every geographer and teacher of geography.

MESSRS. NEWTON AND CO.'s new supplementary list of lantern slides includes several sets which should prove very valuable to science teachers and lecturers. Among these instructive slides we notice photographs by Mr. W. M. Martin illustrating the embryology of a chicken; British birds and nests photographed by Mr. R. B. Lodge; photographs of insects and other small forms of animal life; photomicrographs of rock sections; and photographs of diseases of the bone, by Dr. C. T. Holland.

A REVISED and enlarged edition of Dr. Arthur Keith's "Human Embryology and Morphology" has been published by Mr. Edward Arnold. This edition differs from the last in several particulars. The chapters dealing with the early development of the human embryo and the formation of the placenta and membranes have been re-written. Much of the chapter dealing with the urogenital system has been amended, and numerous additions have been made in other sections of the book.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF COMETS 1904 *d* AND 1904 *e*.—The results of several observations of comets 1904 *d* and 1904 *e*, respectively, are published in a supplement to the *Astronomische Nachrichten*, No. 3987.

The latter object was observed at Bamberg by Prof. Hartwig on January 1 and 2, and was seen as a circular patch about 2′ in diameter, having a nucleus which was not symmetrical. The magnitude of this comet has been variously estimated. In the above observation Prof. Hartwig recorded it as 11·0, but Prof. Nijland, observing at Utrecht on January 1, estimated it as 9·5, whilst Prof. Ambronn, observing at Göttingen on January 2, found it to be 10. The brightness at the time of discovery, as given by M. Borrelly, was equal to the tenth magnitude.

The following is an extract from the daily ephemeris of comet 1904 *d* published by Herr M. Ebell:—

12*h.* (*M.T. Berlin*).

1905	α (true) h. m. s.	δ (true) ° ′	log *r*	log Δ	Brightness
Jan. 20	17 57 38	+44 57	0·3253	0·3437	0·98
,, 24	18 13 1	+47 5	0·3299	0·3446	0·95
,, 28	18 29 11	+49 10	0·3346	0·3465	0·93
Feb. 1	18 46 10	+51 9	0·3394	0·3495	0·89
,, 5	19 3 58	+53 3	0·3443	0·3535	0·86

Brightness at time of discovery = 1.

EPHEMERIS FOR COMET TEMPEL, 1904 *c*.—In No. 3986 of the *Astronomische Nachrichten* M. J. Coniel gives a daily ephemeris for Tempel's second comet extending from January 3 to March 2, which is a continuation of the ephemeris published by him in No. 3971 of the same journal. Although the southern declination of the comet is decreasing, its R.A. is so near to that of the sun, and the object itself is so faint, that observations will be difficult, and only possible immediately after sunset.

The comet's position on January 21 will be

R.A. = 22h. 37m. 47s., dec. = −16° 19′.

SEASONAL DEVELOPMENT OF MARTIAN CANALS.—A further contribution of observed phenomena, in support of his theory concerning the causes which produce the seasonal development of the canals on Mars, is published by Mr. Lowell in the January number of *Popular Astronomy*. The particular canal therein discussed is Brontes, which is 2440 miles in length and connects along a great circle, in nearly a north and south direction, the two important points Linus Titanum and the Propontis.

From a study of ninety drawings made during the period January-July, 1903, six of which are reproduced on the plate accompanying the paper, it was seen that the visibility of the canal increased after the summer solstice in the northern hemisphere, and, further, on dividing the canal into five nearly equal sections from north to south, the section nearest the north polar cap became strengthened first, and the others followed in order of their north polar distance. This is plainly shown on the visibility "cartouches" given by Mr. Lowell, who considers the phenomena as a further proof of his theory that the visibility of a canal is due to vegetation, quickened by the water loosened at the melting of the polar snows and flowing towards the equator. The extension south of the equator is considered as a probable proof of intelligent artificial interference in the propulsion of the water.

VARIABLE STARS AND NEBULOUS AREAS IN SCORPIO.—An examination of thirty-three plates exposed on the large nebulous regions mentioned in previous *Circulars* has led Miss H. S. Leavitt to the discovery of 105 new variable stars in the constellation Scorpio.

The positions of these, for 1900, their greatest and least observed magnitudes, and their magnitude ranges are given in No. 90 of the Harvard College Observatory *Circulars*.

The most striking result of this research has been the revelation of vast areas of diffused nebulous matter, so faint as to be beyond visual observation. One of these areas extends over a number of square degrees in the constellations Ophiuchus and Scorpio, and, like the Orion nebula, it attaches itself to individual stars, the principal condensation being about the quadruple star ρ Ophiuchi. The region is marked by an absence of faint stars, and dark lines may be traced beyond the confines of the nebulosity as yet seen on the plates.

REPORT OF THE NATAL OBSERVATORY.—The report of Mr. E. Nevill, Government astronomer of Natal, for the year 1903, gives a brief *résumé* of the work accomplished at the Durban Observatory during the period with which the report deals, and contains a mass of information respecting the meteorology of the colony.

The time signals have been sent out as in former years, and Borrelly's comet was observed regularly during its appearance, the orbit deduced from the observations agreeing with those obtained at other observatories.

It is proposed to utilise the tide observations made during the years 1884–8 in order to provide the port authorities with tide-tables, but, owing to the constructional changes in the harbour during the last few years, it will be necessary to reduce the more recent observations and this will require additional computing assistance.

In former years it has been customary to issue the meteorological data compiled from the returns of the subsidiary stations once each month, but in future the returns will be published daily. Among the numerous tables given in the report there occurs, for the first time, a summary of the meteorological observations made at the Botanical Gardens, Durban, during the period 1873–1883 inclusive, before the institution of the Government observatory.

THE JESUIT OBSERVATORY AT BELEN, HAVANA.—An interesting illustrated account of the observatory attached to the Jesuit College at Belen, Havana, has been written, in Spanish, by Father Mariano Gutiérrez, S.J., the sub-director, and contains a history of the installation of the institution in 1857, and its proceedings since that date.

The meteorological section was first founded under the direction of Father Antonio Cabré, S.J., in the year named, but its position was not secured until the installation of Father Vines as director, in 1870, to the memory of whom the author of the history pays a high tribute, and laments his death in 1893 as an irreparable loss.

The equipment of the observatory is fairly complete, and includes meteorological, seismological, magnetic, and astronomical instruments, most of which, including the 6-inch Cooke equatorial, are illustrated in the present volume.

THE DISCOVERY OF JUPITER'S SIXTH SATELLITE.

THE addition of a sixth satellite to the system of Jupiter marks another triumph in Prof. Perrine's employment of the modified Crossley reflector. As mentioned in a note published in "Our Astronomical Column" last week, Prof. Perrine first suspected the existence of the newly discovered body from observations made during December, 1904, but it was not until January 4 that a further observation confirmed his suspicion, and enabled him to open the new year with the announcement of this important discovery.

The new satellite, so far as one may gather from the meagre news yet to hand, is situated at a much greater distance from its primary than any of the five previously known. The telegram announcing the discovery gave this distance, on January 4, as 45′, whilst that of the outermost of the four satellites discovered by Galileo never exceeds 10′·5, and the fifth, the innermost of all, is not quite half the distance from Jupiter that the moon is from the earth.

Assuming, for the moment, that the above distance is the outward limit of the satellite's orbit, it should make one revolution about its primary in about half a year, whereas the time occupied by the fourth satellite is only 16·7 days; thus we see there is an immense gap between the two bodies which, according to precedent, may contain other satellites as yet undiscovered.

The recent discovery raises the number of satellites in the solar system, discovered during the past thirty years, to five, and it is worthy of note that the discovery of a satellite has usually occurred at times when a new instrument has been installed or old instruments or methods have been improved. This fact calls to mind, although beyond our thirty years' limit but still dealing with the Jovian system, that Jupiter's four moons, Io, Europa, Ganymede, and Callisto, or i., ii., iii., and iv. as they are usually designated, were the first members of the solar system to be *discovered*, resulting, as they did, from Galileo's first use of the telescope in January, 1610.

After these, and within the past thirty years, came Deimos and Phobos, the lilliputian attendants to Mars, which were discovered by Prof. Asaph Hall at Washington in August, 1877, and were the first fruits of the then recently mounted 26-inch refractor of the U.S. Naval Observatory.

The fifth satellite of Jupiter was discovered by Prof. Barnard on September 9, 1892, with the nearly new giant refractor of the Lick Observatory. It is, comparatively, a minute object and can only be seen with the largest telescopes under the most favourable conditions. Its diameter can scarcely be greater than 100 miles, whilst the diameters of the other four, in order of their distance from the planet, are 2400, between 2000 and 2200 (about the size of our own moon), 3000, and 3600 miles respectively. This object revolves between

Io—the first satellite—and Jupiter in a period of 11h. 57m. 22·6s.

Following this discovery came the addition, to an already numerous family, of the ninth satellite of Saturn, which was found by Prof. W. H. Pickering. The search was commenced in 1888 with the 13-inch Boyden telescope of the Harvard College Observatory, but was not successful in bringing to light any previously unknown attendant on Saturn. On the installation of the new 24-inch Bruce telescope in the clear atmosphere of Arequipa the search, which was photographic throughout, was renewed, and on examining the plates taken on August 16, 17, and 18, 1898, Prof. Pickering was rewarded by the appearance of a short trail which apparently partook of the planet's motion among the stars, and was, therefore, to be considered as part of its system. The story of the subsequent doubts and difficulties has been too recently told (Harvard College *Annals*, No. 3, vol. liii.) to need re-telling here, but it may be recalled to mind that the subsequent observations showed that the satellite revolves in an orbit which is far more eccentric than that of any other satellite, or of any major planet, in the solar system, and that its motion in that orbit is opposite in direction to the orbital motions of the remaining eight of Saturn's moons. Like the fifth satellite of Jupiter, this object can only be observed visually with the largest telescopes and under the best conditions. As a matter of fact, it was not *seen* until its position was accurately known, and even then Profs. Barnard and H. H. Turner, using the 40-inch refractor at Yerkes Observatory, in August last, could not feel certain that they had really observed the object which had up to that time remained invisible to human eyes.

Whilst our knowledge of the most recently discovered satellite is as yet very scanty, Prof. Perrine's message tells us that on January 4 its position angle was 269°, and the daily rate of its apparent approach towards Jupiter was 45″, *i.e.* about 100,000 miles.

The magnitude, 14, ascribed to it is one magnitude fainter than that of Barnard's fifth satellite, and this primarily suggests that the diameter may be less than that of the fifth, although a smaller reflecting power, or "albedo," may account for the relative faintness. Its distance from Jupiter on January 4 would probably be about 6 million miles. The statement that the motion was "retrograde" refers, of course, to the apparent motion in the sky, and must not be confounded with a retrograde orbital motion similar to that followed by Phœbe, Saturn's ninth satellite. W. E. R.

ATMOSPHERIC AND OCEANIC CARBON DIOXIDE.

THE carbonic acid of sea-water is usually supposed to be present in combination with certain bases, which constitute the *alkalinity* of the water, partly in the form of normal carbonate and partly in the form of bicarbonate, the total amount present being insufficient to convert the whole of the base into the bicarbonate. Thus the water of the North Atlantic has been found to contain 49 c.c. of carbonic acid gas per litre, whilst 54 c.c. would be required to convert the base completely into bicarbonate. That this view is not quite correct has been shown by Dr. A. Krogh, of Copenhagen, in a series of investigations on the carbon dioxide of the air and ocean.[1]

The reaction between carbonic acid and a normal carbonate to form a bicarbonate is, like so many chemical reactions, reversible, and equilibrium is established while a certain amount of the carbonic acid is still free. This free carbonic acid exerts a definite gaseous pressure, which varies with the total amount of carbon dioxide present and with the alkalinity of the water. This pressure can very readily be determined by simply shaking the water with a small volume of air and then ascertaining by direct analysis the pressure of the carbon dioxide in this air, which is, of course, equal to the pressure of that in the water, since the two have been brought into equilibrium by the shaking. This process gives excellent results both with fresh- and sea-water, and can be carried out very rapidly by the aid of the apparatus of Haldane or Petterson and Sonden for the estimation of small quantities of carbon dioxide. As the result of a careful study of the behaviour of sea-water in this respect, it appears that a comparatively large amount of carbon dioxide may be absorbed, whilst the corresponding pressure only undergoes a very small absolute change, provided that the alkalinity remains constant. A water, for example, which has the alkalinity 23, and contains 36·7 c.c. of carbon dioxide per litre, is capable of absorbing 4·3 c.c. of the gas per litre, whilst the pressure, measured as described above, only rises from 0·015 per cent. to 0·0295 per cent. of an atmosphere. This means that the air shaken up with the original water would be found to contain 1·5 parts of carbon dioxide per 10,000, whilst after the further absorption the air similarly treated would contain 2·95 parts per 10,000.

Owing to this pressure of carbon dioxide constant interchange takes place between every water surface, whether of sea-water or of fresh-water, and the air above it, resulting in evolution from the water or absorption by it according as the pressure of carbon dioxide in the water or the air is the greater. The effect of this is that the ocean acts as a regulator on the amount of carbon dioxide in the air, tending to compensate for any deviation from the normal proportion. The pressure of carbon dioxide in the air is at present about 0·03 per cent. of an atmosphere (3 volumes per 10,000), the absolute amount in the whole atmosphere being calculated as $2{\cdot}4\times10^{12}$ tons, whilst the quantity contained in the entire mass of the sea may be taken as twenty-seven times as great as this.

In order to increase the proportion of the atmospheric carbon dioxide to 0·04 per cent. it would be necessary, of course, in the first place to add one-third of the amount already present. The pressure thus attained would, however, be gradually decreased by absorption by the sea, and it follows from the author's experiments that in order to bring the ocean into equilibrium with the altered atmosphere a further addition of twice the amount originally present would be required, a total change involving the production of $5{\cdot}6\times10^{12}$ tons of carbon dioxide! A calculation of this kind goes far to explain the constancy of composition of the atmosphere, which at first sight appears so remarkable, and to indicate the enormous changes required to produce any considerable variation in it.

The interchange of carbon dioxide between sea and air, moreover, is by no means a slow process, but takes place with remarkable rapidity. Thus a pressure difference between sea and air of only 0·001 of an atmosphere, *i.e.* the presence in the air of an additional 0·1 part of carbon dioxide per 10,000, leads to the absorption of 0·525 c.c. of this gas per square centimetre of ocean surface per year, or a total annual absorption of $3{\cdot}85\times10^{9}$ tons.

The author considers from this point of view the effect on the composition of the atmosphere of the combustion of coal, which annually throws into the air about one-thousandth of the carbon dioxide already present in it, so that, apart from any regulating action of the sea, in a thousand years—if the coal lasted—the percentage proportion would be doubled, rising from 3 to 6 volumes per 10,000, and rendering the air almost unfit for continued respiration. Before the proportion rose to 3·1 volumes per 10,000, however, the sea would be able to absorb the gas as fast as it was produced, and, owing to the large volume required to bring the ocean water into equilibrium with the air, it is probable that at the expiration of the thousand years the proportion of carbon dioxide in the air would not be more than 3·5 volumes per 10,000.

Many other interesting questions of great importance in the economy of nature are capable of being attacked from this point of view and subjected to experimental investigation. Such are the rate of deposition of calcium carbonate from hard waters, the rate of solution of limestone and chalk in natural waters, the absorption of carbon dioxide by rocks and soils, &c.

On the great question as to whether the production of carbon dioxide is on the whole greater or less than its decomposition nothing certain is known. Indications are not wanting, however, that this constituent of the atmosphere is increasing in quantity. The chief evidence to this effect is derived from the fact that over the sea the pressure of

[1] "Meddelelser om Grønland," vol. xxvi. pp. 333, 409.

this gas is distinctly lower than over the land. This would appear to be most easily accounted for on the assumption that the pressure of carbon dioxide in the sea is constantly lower than that in the air, and that, therefore, the air must be steadily deriving supplies of the gas from some source, by means of which this difference of pressure is maintained.

A. HARDEN.

CONFERENCE OF PUBLIC SCHOOL SCIENCE MASTERS.

THE annual meeting of the Public School Science Masters' Association was held for the second time at Westminster School on January 14, by kind permission of Dr. Gow, who had undertaken the duties of president and occupied the chair. A letter was read by the honorary secretary, Mr. W. A. Shenstone, from Sir Michael Foster explaining why he had not been able to act as president. The meeting then occupied itself with business matters, and Sir Oliver Lodge was unanimously elected president for the ensuing year.

In the short address with which Dr. Gow opened the conference, he expressed the opinion that every boy should be taught natural science, and this pronouncement, coming as it does from a classical headmaster, is of very great importance at the present moment, as Prof. Armstrong was not slow to point out. It was no doubt elicited by the subject of the first paper, namely, the importance of including both Latin and science in a scheme of general education. This was read by Mr. Douglas Berridge, of Malvern College. In the paper the necessity of a general education was discussed, and the report of the committee upon the education of army officers was taken as a guide. In this it is laid down that English, mathematics, one modern language, Latin, and science are essential to a sound general education; but what is very strange, the framers of the report proceed to propose that all future officers of our Army should be debarred from obtaining what was considered necessary by the proposal that Latin and science should be optional and alternative subjects. In addition to the injury which a one-sided education inflicts upon the individual, Mr. Berridge pointed out a greater and more far-reaching danger to our nation as a whole. He urged that the present trend of education, as represented by London University (in its matriculation and school leaving examination), by Oxford and Cambridge (in their school leaving examinations), and by the Civil Service Commissioners and the Army entrance examinations, is sharply to divide Englishmen into two classes, the one trained on literary lines, leavened only by a modicum of mathematics, the other on scientific lines, leavened only by a smattering of French. Could it be, Mr. Berridge asked, to the advantage of any nation that its future rulers and organisers should thus be grouped into two opposing camps, of which, while they mutually despise one another, neither is able to understand the very method of reasoning adopted by the other? Mr. Berridge was able to support his contention by figures, for on application to all our public schools he had found that for the Army and matriculation examinations 45·6 per cent. of the boys now learn Latin and 54·4 per cent. learn science.

The discussion showed that while the need of a literary as well as a scientific training was thoroughly recognised, many speakers did not agree with Mr. Berridge that Latin was the best means of acquiring the former. It is true that Father Cortie (Stonyhurst) found that the best classical boys were most successful in science, but Prof. Armstrong said that no honest attempt had ever been made in this country to afford a literary training through any other language, and though Latin had proved very efficient in a few instances, in the vast majority of cases it was not. He maintained, also, that Latin translation did not give style. Finally, Prof. Armstrong characterised the making of science alternative to Latin in Army examinations as illogical and preposterous. Dr. Gow said that he never regarded Latin as a literary training, but as a scientific one, and referred to his opening remarks, in which he had characterised the words as typical and exceptional genera and species, and parsing as scientific classification.

The paper dealing with recent proposals for school leaving certificates, by Mr. C. I. Gardiner, of Cheltenham, dealt with what has been done on the Continent, and afterwards with the regulations at present suggested to the Board of Education by its consultative committee. The paper welcomed, as did many of the speakers afterwards, what is not very happily expressed as State interference. Many of the Board of Education's proposals were characterised by Mr. Gardiner as too vague, upon very good grounds. In the discussion, surprise was expressed that Mr. Gardiner had not mentioned what has been done recently in Ireland. It was recommended, also, that the Board of Education should get to know the schools before it suggested too much, and that its interference should be taken in small doses. Mr. W. A. Shenstone fancied he saw the edge of red tape in some of the proposals, while Father Cortie thought there was a danger that education might become stereotyped, so that special traits of certain schools would not be given free play. He hoped that inspectors with fads or insufficient knowledge would not interfere as they had done in elementary schools, and would not say, for instance, "your 'labs' are not so good as those in the primary schools (which are built with the ratepayers' money), you must erect new ones."

The third paper dealt with the use and misuse of terms in science teaching. It was contributed by Mr. T. L. Humberstone, of Toynbee Hall, who took exception to the loose way in which words, law, theory, hypothesis, and so on were used. He pointed out what the real meanings of the words were, and objected strongly to the idea that the experiments in practical mathematics "proved" the laws that they were intended to illustrate. Prof. Tilden agreed with Mr. Humberstone in regard to the misuse of terms, and said that professional scientific men were just as much to blame as schoolmasters. He thought that if boys were taught a little logic before they left school many mistakes would be prevented. He was amazed at the statement incidentally made by Mr. Humberstone as to there being too much laboratory work done in schools, and he pointed out that every discovery of the organic chemists was additional evidence in favour of the atomic theory which Mr. Humberstone thought was tottering. Mr. Fletcher, of the Board of Education, said that there was a widespread misapprehension as to the place of practical work in geometry. It was not possible to prove anything by the experiments used, but it was most important to get approximations which could be idealised into conceptions. They were necessary to create a state of mind and to commend postulates to common sense. Mr. Sanderson thought that some of the practical work set to boys was superfluous, and might well be replaced by good experiments shown by the master. Mr. Humberstone, in answer to a question from Mr. Shenstone, said that he thought ten or twelve hours a week was longer than was required for laboratory work, and he further said, with regard to superfluous work, that when a boy had learned how to obtain one gas properly it was not necessary for him to produce all the others.

The last paper was by Mr. F. B. Stead, of Clifton, and was on the possibility of teaching scientific method to boys whose education is almost entirely literary, and who have no time for a regular course in chemistry and physics. It was suggested that older boys in the Vth form should be given some definite piece of work to be carried out in detail, in order that they might understand (1) the method of experiment and observation by which facts are ascertained; (2) the process of reasoning from particular instances to general laws; and (3) the use of explanatory theories and their verification.

Prof. Armstrong considered the paper to be one of very great value, and suggested that the term "experimental" should be used instead of "scientific," bearing in mind what Dr. Gow had said in connection with Latin as scientific training. He also asked what place there would be in the near future for boys who only had had a literary education.

WILFRED MARK WEBB.

PRIZE AWARDS OF THE ROYAL SOCIETY OF EDINBURGH.

AT a meeting of the Royal Society of Edinburgh on January 9 the prizes awarded by the council were presented by the chairman, Prof. J. Geikie. We have received the following particulars of the awards:—

The Gunning Victoria Jubilee prize for 1900–4 was awarded to Sir James Dewar, LL.D., D.Sc., F.R.S., &c., for his researches on the liquefaction of gases, extending over the last quarter of a century, and on the chemical and physical properties of substances at low temperatures, his earliest papers being published in the *Transactions and Proceedings* of the society.

In 1867 Mr. James Dewar read a paper to this society on the oxidation of phenol to oxalic acid. This, his first contribution to the aromatic compounds, was followed by a more important one on the oxidation of picoline, which he gave to the British Association in 1868, and in a fuller form to this society in 1870. In this he proposed a graphic formula of pyridine, which expresses the relation between the constitution of benzene and that of pyridine, now universally recognised.

Dewar's experiments on the liquefaction of gases extend over the last quarter of a century, and have culminated in the production of liquid and solid hydrogen in large quantities, so that as thirty-five years ago he studied the chemical and physical properties of hydrogenium solidified in palladium, he has now given us the properties of the solid element, hydrogen itself. Having thus in his hands the means of preparing large quantities of liquefied gases, and having devised most ingenious arrangements for keeping these very volatile liquids for a long time with only a small loss from evaporation, he made good use of the opportunity for examining the chemical and physical properties of substances at extremely low temperatures. The results of these inquiries are of the highest interest and importance. For this long series of investigations in chemistry and physics, characterised by ingenuity, skill, and perseverance, and crowned with success, the council has awarded to Sir James Dewar the Gunning Victoria Jubilee prize.

The Keith prize for 1901–3 was awarded to Sir William Turner, K.C.B., LL.D., F.R.S., &c., for his memoir entitled "A Contribution to the Craniology of the People of Scotland," published in the *Transactions* of the society, and for his "Contribution to the Craniology of the People of the Empire of India," parts i., ii., likewise published in the *Transactions* of the society.

These memoirs, important as they are, form a comparatively small part of the work which Sir William Turner has done in the field of physical anthropology. More especially should notice be taken of the two elaborate reports which he published on the crania and other bones of the human skeleton which were collected by the *Challenger* Expedition. These reports are not only valuable on account of the information which they convey regarding the physical characters of many races of mankind, but also because they establish methods of craniological and anthropometrical research which have very generally been accepted in this country by workers in the same field.

Four great leaders have been chiefly instrumental in developing that branch of science which has received the name of physical anthropology: Broca in France, Huxley and Flower in England, Turner in Scotland.

The Makdougall-Brisbane prize for 1902–4 was awarded to Mr. John Dougall, M.A., for his paper on an analytical theory of the equilibrium of an isotropic elastic plate, published in the *Transactions* of the society.

The problem of the deformation of an isotropic elastic plate under given forces has occupied the attention of mathematicians from the time of Lamé. The solution given by Lamé himself is merely formal; the integrals by which that solution is expressed are not only very complicated, but are not convergent, and they do not lead to the approximate theory.

In his memoir Mr. Dougall makes a new departure, and develops a method that has important applications in other branches of applied mathematics. By an exceedingly skilful use of Cauchy's theory of contour integration, certain integrals, which in Lamé's solution are not convergent, are transformed into highly convergent series, and the modifications which are necessary to secure convergence lead at once to the most significant terms of the solution. The theorem of Betti is applied to develop a method, analogous to the method of Green's function in the theory of the potential, by which the properties of the solution for a finite plate can be deduced from that for an infinite plate, and here, as elsewhere throughout the memoir, numerous results are obtained which have great value both for pure and for applied mathematics. The memoir confirms the ordinary approximate theory, but extends it in various directions; for example, the edge conditions given by Kirchhoff in correction of Poisson are found directly from the mathematical investigation, without the aid of any special physical hypothesis, and are carried to a higher degree of approximation than by Kirchhoff himself. The memoir contains much acute analysis, and strikes out a new method of treating the problems of mathematical physics that seems likely to be of great value in future investigations.

The Neill prize for the period 1901–4 was awarded to Prof. John Graham Kerr, M.A., for his researches on *Lepidosiren paradoxa*, published in the *Philosophical Transactions* of the Royal Society, London.

This work includes an account of the embryological material collected during an expedition specially organised for the purpose to the Grand Chaco of South America in the years 1896–7. The general biology and habits of Lepidosiren are described, the external features of development are fully dealt with, and in a discussion of the general bearings of the phenomena considered reference is made to, amongst other things, the relations of the protosoma to the body of the vertebrate, to the origin of the spiral valve, and to the morphological significance of the external gills which it is suggested are the persisting representatives of the organs from which the limbs of vertebrates have been evolved.

After the presentation of the prizes, Sir James Dewar gave a lecture on the properties of liquid air, with special reference to charcoal vacua, being a sequel to a paper communicated to the society by Prof. Tait and himself in 1875 (see NATURE, vol. xii. p. 217). Many of the familiar properties of liquid air were demonstrated by a series of experiments. Of particular interest were its use as a calorimeter and its employment in cooling charcoal in a vacuum tube so as greatly to diminish the density of the rarefied gas. By this means the tube gradually passed through all the well known stages from the ordinary bright discharge to the condition of evident striation and so to the Röntgen ray stage, and finally to the non-conducting state. When the liquid air was removed the charcoal gradually heated up to the ordinary temperature, and the tube passed back again through the stages in the reverse order. The phosphorescence at very low temperatures of certain substances not phosphorescent at ordinary temperatures was also demonstrated; also the production of luminous effects due to the electrification of a certain crystal on being cooled down to the temperature of liquid air.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. H. Lock has been appointed assistant curator of the herbarium for four years from January 1. He succeeds Mr. Yapp, who was some time ago elected professor of botany at Aberystwyth.

Prof. Sorley has been appointed chairman of the examiners for the moral sciences tripos.

The Sedgwick Museum Building Syndicate has issued a final report, from which it appears that the total cost

of the building and fittings is 49,389*l.* 2*s.* 3*d.*, of which sum 26,125*l.* has been furnished by the Sedgwick memorial trustees, besides 1050*l.* appropriated to the bronze statue sculptured by Mr. Onslow Ford.

In connection with the recently established diploma and final examination for the degree in geography, the Board of Geographical Studies has issued a list of eight lectures which amply cover the syllabus for these examinations. Besides the lectures on geography in general by Mr. Yule Oldham, Mr. Hinks is lecturing on geographical surveying, Dr. Marr on geomorphology, and Dr. Haddon on anthropogeography.

The recently established board of anthropology announce some thirteen courses of lectures which seem to embrace the world, ancient and modern. Prof. Ridgeway deals with Greek and Roman numismatics, Mr. Green with Egyptology, Mr. Johns with Assyriology and the social customs of Babylonia, Mr. Chadwick with those of the Anglo-Saxons, whilst Dr. Haddon lectures on the ethnology of Southern Asia, Baron von Hügel on the Melanesians and Polynesians, and Mr. Minns on the ancient ethnology of eastern Europe. Special courses on the sacred character and magical functions of kings in early society, and on physical anthropology, are to be delivered by Mr. J. G. Frazer and Mr. Duckworth.

LONDON.—The Drapers' Company has voted to University College the sum of 400*l.* a year for the next five years towards assisting further the statistical work and higher teaching of the department of applied mathematics. The Mercers' Company has voted the sum of 1000*l.* for providing for the chair of physiology at the college. Dr. Atkinson has been appointed an honorary demonstrator in the department of organic chemistry.

EDINBURGH.—The Senate has submited a resolution to the University Court expressing the view that the time has come for the recognition of geography as a subject for graduation in arts and science, and requesting that the court should take steps as soon as possible to obtain such alteration of the ordinances as may be necessary to that end. It was agreed that when the framing of a new and amending ordinance in arts comes before the court, the question of giving an adequate position to geography shall be given due consideration.

DUBLIN.—The Provost and senior fellows of Trinity College have accepted an offer made by Sir John Nutting, of St. Helens, county Dublin, to endow for a period of five years ten annual entrance exhibitions each of the value of 100*l.* (50*l.* per annum for two years). The exhibitions are to be awarded without further examination, and at the discretion of the Board of Trinity College, to ten young men or women who have competed with success at the senior or middle grade examinations of the Board of Intermediate Education in Ireland. The exhibitions will be confined to pupils of Irish secondary schools (Protestant and Roman Catholic) which have no other endowment than the "results fees" of the Intermediate Board, any other endowment to act as a disqualification.

MR. STANLEY H. TURNER, assistant in political economy at Glasgow, has been appointed lecturer in political economy in the University of Aberdeen, and a full qualifying course of lectures will in future be given by him.

DR. KARL BOEHM, of Heidelberg, and Dr. Hugo Kaufmann, of Stuttgart Technical College, have been appointed extraordinary professors for mathematics and chemistry respectively.

MRS. MACLOGHLIN, of Southport, recently made an offer to the Royal College of Surgeons of England to found scholarships in memory of her husband, the late Mr. E. Percy P. Macloghlin. Mrs. Macloghlin proposes, in five years from the date of her husband's death, to give to the college a sum of 10,000*l.* for the purpose of endowing these scholarships, which are intended to assist young students in need of financial help to proceed with their professional studies. The council of the college has accepted Mrs. Macloghlin's munificent offer, and has agreed to administer the trust.

THE president of the Board of Education has appointed the Right Hon. R. B. Haldane, K.C., M.P., to be chairman of the departmental committee which is inquiring into the present and future working of the Royal College of Science and Royal School of Mines, South Kensington, in succession to Sir Francis Mowatt, G.C.B., who will, however, remain a member of the committee. It may be remembered that the terms of reference to the committee are as follows:—To inquire into the present working of the Royal College of Science, including the School of Mines; to consider in what manner the staff, together with the buildings and appliances now in occupation or in course of construction, may be utilised to the fullest extent for the promotion of higher scientific studies in connection with the work of existing or projected institutions for instruction of the same character in the metropolis or elsewhere; and to report on any changes which may be desirable in order to carry out such recommendations as they may make.

THE annual meeting of the Incorporated Association of Headmasters was held at the Guildhall on January 11 and 12. In his presidential address, the Rev. James Went said that, speaking broadly, the difference between the English and the German educational ideal has been that the Germans have recognised the paramount importance of secondary education and the English have not. It is, however, being recognised gradually that the word "secondary" connotes, not a social distinction, but one of attainment. The recognition of this fact is, Mr. Went believes, largely due to boys of ability and good character who, under the name of exhibitioners or county council scholars, have during the last thirty years been admitted freely into grammar schools, and of whom many have afterwards won the highest distinctions at the universities. It appears likely that the number of boys of this class will be increased as time goes on. The address also dealt with the education of pupil teachers at secondary schools and with the recent regulations for secondary schools issued by the Board of Education. The following resolution was adopted:—"That this association regards the new regulations for secondary schools with satisfaction in general, but regrets that the Board of Education does not provide (*a*) for the calculation of grants upon terminal attendance; (*b*) for the recognition of advanced courses to follow upon the existing four-years' course; (*c*) for ensuring comparative freedom of curricula to schools satisfying certain tests of a higher liberal education; (*d*) for an elastic percentage division of the whole school time when prescribing for groups of subjects, in place of the existing rigid minima of hours or periods in each week. A rider was adopted also declaring that the financial basis on which grants are calculated is not at all adequate, and protesting against any application of the new regulations to secondary schools hitherto earning grants from the board, which would result in such schools receiving grants on a lower basis than in the past.

AT the second day's meeting of the Incorporated Association of Headmasters the following resolutions were adopted after discussion:—(1) That in the opinion of this association it is desirable that the universities should institute a twofold entrance examination (*a*) for candidates proceeding to degrees in arts, in general as at present, but with a higher standard in literary subjects; (*b*) for candidates proceeding to degrees in mathematics and science, with a modern language, including translation at sight, composition, and an oral test, as an alternative for Greek. (2) That the provision for papers in English and history, and for the omission of Paley's "Evidences" from the Cambridge previous paper as laid down in the first report of the Cambridge Studies Syndicate, should be insisted upon in examinations under both (*a*) and (*b*) above. (3) That a new degree in mathematics and in science should be instituted, differing in title from the degree in arts, but of precisely the same university standing. The Rev. R. D. Swallow, in moving the resolutions, said he would not add anything to the arguments on either side of the vexed question as to whether the study of Greek is to be compulsory for students who sought admission to the ancient universities. It is a

question which has often been debated by the association, and now in later years, as the subject has assumed a more prominent place in all questions about the curricula of the universities and the secondary schools, the association has gradually focussed its view of it in favour of relaxation for candidates for admission at the university who are able to prove themselves worthy of high honours in mathematics or natural science.

MR. ARNOLD-FORSTER, Secretary of State for War, attended on Monday the first lecture of a course on military history and strategy at the University of London; and at the conclusion of the lecture spoke on army education. In the course of his remarks, he said:—If we have had one thing more than another to admire in the great military example in the Far East, it is the way in which the officers' corps of a great and friendly nation have succeeded in combining the maximum of devotion with the maximum of intelligence in the effective service of their country. In our Army we can find officers in every rank and branch of the service who will challenge comparison with the officers of any army in the world; but the diffusion of intelligence and education throughout the officers of the Army is not so great as it ought to be. This is not peculiar to the Army; it is characteristic of every profession in the country; and what this country is now feeling acutely is that we have so long subsisted on an educational basis inadequate to the needs of modern life. The time has come for the public schools to render to the Army greater service than they do now. Numbers of young men come up for the Army from the public schools with a totally inadequate knowledge of the language of every country but their own, and with an inadequate knowledge of the history and literature of their own country, as well as of the history and literature of every other country. That must all be changed. Young men ought to come up from the public schools instructed in the great science of geography. Now they are practically without any knowledge whatever of one of the sciences which, more than any other, is the reasonable foundation for the studies of an officer in the Army. There is an extraordinary lack in this country—which of all others ought to be well posted in this branch of science—of a proper knowledge of geography. We might be compelled to establish in this country for the Army schools like those which have been already established for the Navy, or like the college at West Point in the United States. The time has almost come when it would be wise to establish a great college like West Point, where the equipment, staff, and method should be as complete as possible, and where candidates should be taken not only for the Army, but for all the great departments of the State, and where even those who have no intention of entering the service of the State may be allowed to receive instruction.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, January 9.—M. Troost in the chair.—The external or superficial conductivity representing for a given body the cooling power of a fluid current: J. **Boussinesq.**—The micrographical study of the meteorite of the Diablo Canyon: H. **Moissan** and F. **Osmond.** The micrographical study of this meteorite has shown that the metallic parts, apparently homogeneous, frequently contain irregular microscopic nuclei formed of superposed layers of phosphide and carbide of iron. A detailed examination of nodules which have not been submitted to external oxidation made it clear that they are formed of sulphide of iron surrounded by successive layers of iron phosphide and carbide. In certain cases the laminated structure of the nodules showed that they had been submitted to very considerable pressures.—Trypanosomiasis and the tsetse-fly in French Guinea: A. **Laveran.** Specimens of Glossina, or the tsetse-fly, have been found in all parts of French Guinea, and in places where the existence of diseases due to trypanosomes has been already demonstrated. These trypanosomes attack horses as well as human beings, and a detailed account of the course of the disease in a horse, together with the results of a *post-mortem* examination of the animal, are given.—Observations on the Borrelly comet (December 28, 1904) made with the large equatorial at the Observatory of Bordeaux: G. **Rayet.** Two sets of observations were made on December 31, 1904, and one on January 2. On the latter evening the sky was clear, and the comet appeared as a nearly round nebulosity of about 1′ in diameter, possessing a stellar nucleus of the thirteenth magnitude.—On a method of reading large surfaces of mercury: A. **Berget.** A collimator with a well illuminated very narrow slit is placed behind the column to be read, and an ungraduated thermometer tube in front. A luminous line, the focal line of a cylindrical mirror, is formed, and ends with great sharpness at a fixed point, which can be read off in a cathetometer with an accuracy of 0·01 mm.—The attraction observed between liquid drops suspended in a liquid of the same density: V. **Crémieu.** Drops of olive oil, suspended in a mixture of alcohol and water of as nearly as possible the same density as the oil, ascend or descend in a vertical straight line, with extreme slowness, if precautions against changes of temperature and shaking are taken. If two or more drops are present in the dilute alcohol at the same time, there is an attraction between the two drops which is manifested by their following curved paths instead of vertically straight ones.—On the photogenic radio-active properties of calcined coral placed in a radiant vacuum and submitted to the influence of the kathode rays: Gaston **Séguy.** Amongst various substances examined calcined coral (carbonate of lime and magnesia) gave the most intense phosphorescence as measured by the action on a photographic plate. Phosphorescent coral excites the fluorescence of barium platinocyanide screens, and is very rich in ultra-violet rays.—Concerning the action of very low temperatures on the phosphorescence of certain sulphides: F. P. **Le Roux.** The maximum potential light energy which can be induced in a given phosphorescent body by a given light is independent of the temperature. Variations of temperature can only have an influence on the velocity of transformation of the potential into the actual light energy.—On a supposed demonstration of the existence of the *n*-rays by photographic methods: M. **Chanoz** and M. **Perrigot.** The authors have repeated an experiment of M. Bordier's on the photographic detection of the *n*-rays emitted by tempered steel, with contrary results. They find that two equal masses of lead and tempered steel, placed identically on screens comparable as to thickness and insolation, never give different halos, whatever may be the duration of the exposure.—The special sensibility of the physiological ear for certain vowels: M. **Marage.**—On the fluorides of indium and rubidium: C. **Chabrié** and A. **Bouchonnet.** The fluoride of indium was prepared by dissolving the hydroxide of the metal in hydrofluoric acid, and was found on analysis to possess the composition $In_2F_6.18H_2O$. It emits acid vapours, and is completely decomposed on ignition to redness. On treating rubidium carbonate with hydrofluoric acid and evaporating to dryness the acid fluoride RbF.HF is obtained.—The limit of the reaction between diazobenzene and aniline: Léo **Vignon.** Aminoazobenzene does not react with diazobenzene either in aqueous or alcoholic solution. Aniline reacts with diazoaminoazobenzene chloride in presence of potassium carbonate giving a diazoamine.—Camphene, camphenylone, isoborneol, and camphor: L. **Bouveault** and G. **Blanc.** The tertiary alcohol, methylcamphenylol, was prepared from camphenylone by Grignard's reaction. The reaction of this alcohol with pyruvic acid at 140°–150° C. has been studied.—On the diastatic coagulation of starch: J. **Wolff** and A. **Fernbach.**—The estimation of carbon monoxide in confined atmospheres: Albert **Lévy** and A. **Pécoul.** The authors utilise the reaction first indicated by M. Gautier between carbon monoxide and iodic anhydride at 80° C., modifying the method by receiving the vapours of iodine in a small quantity of pure chloroform. The amount of iodine set free is ascertained calorimetrically by comparison with a set of sealed tubes containing known quantities of iodine. It is possible in this way to measure in four litres of air only down to 1/200,000 of carbon monoxide by volume. A test analysis with an artificially prepared atmosphere is given to show the accuracy of the method.

—On the rational estimation of gluten in wheaten flour: E. **Fleurent.** It is shown that by taking certain precautions as to the temperature and lime contents of the wash water, and fixing the time of washing, it is possible to obtain results by the mechanical method which agree well with the chemical method.—Physicochemical researches on hæmolysis: Victor **Henri.**—The comet *e* 1904, discovered December 28, 1904, at the Observatory of Marseilles: M. **Borrelly.**—The provisional elements of the new Borrelly comet (1904 December 28): G. **Fayet** and E. **Maubant.**—On the isochronism of the pendulum in the astronomical clock: Ch. **Féry.** For an amplitude between 2° 13′ and 2° 29′, that is, for a variation of amplitude of about 9 mm., the variation of the rate was nil, or there was a minimum for the time of oscillation. This result is probably due to a want of isochronism of the escapement.—On the value of the magnetic elements on January 1: Th. **Moureaux.**—Osmotic communication in fishes between the internal and external media: Jean **Gautrelet.** Referring to a recent paper by M. Quinton, the author directs attention to a paper of his bearing on the same subject published in 1902.—On the infection of *Padda oryzivora* by *Trypanosoma paddae* and by *Halteridium Danilewskyi*: M. **Thiroux.**

INDIA.

Asiatic Society of Bengal, December 7, 1904.—The lizards of the Andamans, with the description of a new gecko and a note on the reproduced tail in *Ptychozoon homocephalum*: N. **Annandale.** Out of the nine geckos recorded from the Andamans, five or possibly six would seem to have been carried thither by man. The remaining three are indigenous. One of the three is very nearly related to forms on the nearest mainland, the second has Malabar affinities, and the third Madagascan. The author describes *Gonatodes Andersonii*—a new species. The scales of the reproduced part of the tail, dorsal and ventral surfaces, of *Ptychozoon homocephalum* are slightly smaller than those of the uninjured part, and the dorsal tubercles are absent; also the loose membrane is narrower, asymmetric, and not lobed. This last point is important, as Müller had thought the lobes of specific importance.—The occurrence of an aquatic glow-worm in India: N. **Annandale.** A glow-worm larva of aquatic habit has been found in a tank in the neighbourhood of Calcutta. The only other aquatic glow-worm recorded was found in Lower Siam.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—The Dual Force of the Dividing Cell. Part i.: The Achromatic Spindle Figure illustrated by Magnetic Chains of Force: Prof. M. Hartog.—Note on the Effects produced on Rats by the Trypanosomata of Gambia Fever and Sleeping Sickness: H. G. Plimmer.—Further Histological Studies on the Localisation of Cerebral Function. The Brains of Felis, Canis, and Sus, compared with that of Homo: Dr. A. W. Campbell.—Experiments on the Nature of the Opsonic Action of the Blood Serum: Dr. W. Bulloch and E. E. Atkin.

LINNEAN SOCIETY, at 8.—Botanical Collecting: Dr. A. Henry.—On the Cranial Osteology of the Families Osteoglossidæ, Pantodontidæ, and Phractolæmidæ: Dr. W. G. Ridewood.

SOCIETY OF ARTS, at 4.30.—The Gates of Tibet: Douglas W. Freshfield.

FRIDAY, JANUARY 20.

ROYAL INSTITUTION, at 9.—New Low Temperature Phenomena: Sir J. Dewar, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Some Impressions of American Workshops: A. J. Gimson.—Waterworks Pumping Engines in the United States and Canada: J. Barr.—Some Features in the Design and Construction of American Planing Machines: A. Kenrick, Jun.: Engines at the Power Stations, and at the St. Louis Exhibition: A. Saxon.

MONDAY, JANUARY 23.

SOCIOLOGICAL SOCIETY, at 8.—Civics: as Applied Sociology, Part ii: Prof. Patrick Geddes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Great Zimbabwe and other Ancient Ruins in Rhodesia: R. N. Hall.

SOCIETY OF ARTS, at 8.—Reservoir, Stylographic and Fountain Pens: J. P. Maginnis.

TUESDAY, JANUARY 24.

ROYAL INSTITUTION, at 5.—The Structure and Life of Animals: Prof. L. C. Miall, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Notes on the Working of the Shone System of Sewerage at Karachi: J. F. Brunton.—The Sewerage of Douglas, Isle of Man: E. H. Stevenson and E. K. Burstal.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Annual General Meeting. President's Address, &c.

WEDNESDAY, JANUARY 25.

SOCIETY OF ARTS, at 8.—London Electric Railways: Hon. Robert P. Porter.

THURSDAY, JANUARY 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Boring of the Simplon Tunnel, and the Distribution of Temperature that was Encountered: Francis Fox.—On the Comparison of the Platinum Scale of Temperature with the Normal Scale at Temperatures between 444° and −190°C., with Notes on Constant Temperatures below the Melting Point of Ice: Prof. M. W. Travers, F.R.S., and A. S. C. Gwyer.—On the Modulus of Torsional Rigidity of Quartz Fibres, and its Temperature Coefficient: Dr. F. Horton.—On a Method of Finding the Conductivity for Heat: Prof. C. Niven, F.R.S.—Exterior Ballistics. "Error of the Day" and other Corrections to Naval Range-Tables: Prof. G. Forbes, F.R.S.—The Theory of Symmetrical Optical Objectives. Part ii.: S. D. Chalmers.—On the Drift produced in Ions by Electromagnetic Disturbances, and a Theory of Radio-activity: G. W. Walker.—Coloration of Glass by Natural Solar and other Radiations: Sir William Crookes, F.R.S.—On the "Blaze-Currents" of the Gall Bladder of the Frog: Mrs. Waller.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Fuel Economy in Steam Power Plants: W. H. Booth and J. B. C. Kershaw. (Conclusion of discussion.)

FRIDAY, JANUARY 27.

ROYAL INSTITUTION, at 9.—The Life-History of the Emperor Penguin: Dr. Edward A. Wilson.

PHYSICAL SOCIETY, at 5.—Action of a Magnetic Field on the Discharge through a Gas: Dr. R. S. Willows.—Action of Radium on the Electric Spark: Dr. R. S. Willows and J. Peck.—The Slow Stretch in India-rubber, Glass, and Metal Wires when subjected to a Constant Pull: P. Phillips.—Determination of Young's Modulus for Glass: C. A. Bell.—Some Methods for Studying the Viscosity of Solids: Dr. Boris Weinberg.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Concrete-Making on the Admiralty Harbour Works, Dover: T. L. Matthews.

CONTENTS.