THURSDAY, DECEMBER 26, 1907.

ELECTRIC TRACTION.

Electric Traction. By Prof. Ernest Wilson and Francis Lydall. Two vols. Vol. i., Direct Current, pp. vii+475; vol. ii., Alternating Current, pp. vii+328. (London: Edward Arnold, 1907.) Price 15*s.* net each.

THERE is no announcement on the title-page that this work is a second edition of a book which appeared in 1897. This omission, however, is fully justified, for although technically the present work may be considered a new edition, it is in reality a new work. Progress during the last ten years has been so great that to bring the work up to date it had practically to be re-written and very greatly enlarged. Even in its present form of two handsome volumes, comprising together some 760 pages, the authors have not treated the subject exhaustively. This statement is not meant as a reproach, but simply as an illustration of the fact that the application of electric traction to tramways and railways has become so many-sided that an exhaustive treatise of the subject can hardly be expected. All that can be expected is that the authors should make a judicious selection of types and systems, and this expectation is on the whole fulfilled in the present work.

There is, however, one rather important omission, namely, the use of the three-wire system on direct-current railways, as suggested by Krizik and carried out by his firm on the Tabor-Bechyne line in Bohemia. It is true that the authors give on p. 416 a sketch of the circuits and a short description of the system adopted on the City and South London line, which is a three-wire system in the sense that the trains in one direction are worked from a positive 500-volt trolley and the trains in the other direction from a negative 500-volt trolley, but this is a far less advantageous system than that devised by Krizik, where the positive and negative side of the three-wire system are utilised in the same train, and the earth or rail return is only called into requisition in the event of a breakdown on one side of the system.

Of the two volumes the first is devoted to direct-current and the second to alternating-current railways. The treatment is mainly descriptive, without much criticism on the authors' part, and on the whole there is a tendency to give prominence to American designs or to English designs of American origin. This favouring of American work goes so far that the authors, whilst referring to standardisation of tramway motors as determined by the American Institute of Electrical Engineers, completely ignore the standard rating adopted by the International Association at the Milan Congress last year. Possibly they may think the American standard better, but that is no reason why they should keep their English readers in ignorance of the fact that there is a standard in use on the Continent of Europe which will have to be complied with by those firms who secure contracts on the Continent.

A little more than half of the first volume is given up to tramway work, and deals in succession with the motor, the controller, resistances, trolleys and bows, rolling stock including brakes, the track, overhead equipment, slot and contact systems, feeders, generating stations, car sheds, storage-battery traction and regenerative control. Approximately the same order in the treatment of details is followed in the part devoted to railways, with the addition of a chapter on substations. Then follows a chapter on cost of tramway work, which, being taken from actual practice, should prove very useful when getting out preliminary estimates, also a chapter on working expenses, traffic receipts and tramway accounts in general, and finally there is an appendix giving all the Board of Trade regulations.

As already remarked, the treatment is mostly descriptive, but not always complete. Thus the suspension of tramway motors is dealt with in only four lines on p. 78, and in the description of magnetic brakes we miss the magnetic friction brake on the axle, although magnetic track brakes are not only well described but also critically compared. The tables relating to turn-out, cross-over and transition curves on pp. 112 to 116 are well arranged, and will be found very useful in laying out the track. Also the details of overhead equipment are well represented, but we miss the bridge wire round the ears which has of late years been introduced as a precaution to avoid the trolley wire coming down in the event of its breaking, which, as is well known, takes place generally close to the ear.

As regards buffer batteries, the authors seem to be under the impression that Mr. Highfield made their use possible by his automatic reversible booster. This is not so. Buffer batteries have first been suggested by Dr. Edward Hopkinson in 1893 in a paper read before the Institute of Civil Engineers on the City and South London Railway, and very shortly after, the first buffer battery was installed by the Tudor Accumulator Co. in the power house of the Zurich tramways, the economic success being so remarkable that buffer batteries had become a quite regular feature in tramway power houses on the Continent long before Mr. Highfield designed his very ingenious system of boosting.

On p. 197 the authors show a diagram (Fig. 144) and call it a negative booster wrongly connected. In this case the booster is supposed to be a series machine driven at a constant speed. There is nothing wrong about its connection; the only wrong thing in the diagram is the direction of the current as marked by arrows. A moment's consideration will show that if the machine is run at the critical speed in relation to the resistance of the return feeder, it is the very best possible negative booster, since it will relieve the rails from return current to even a greater extent than the booster with excitation from the positive feeder.

The authors' treatment of the complicated subject of controllers is excellent. They always give first a diagram showing the principle and then the actual arrangement of circuits and contacts, thus rendering the study of an intricate subject comparatively easy. The same praise may be given to their way of working out running diagrams and the determination of the

best acceleration. They show that although high acceleration means low energy per ton-mile, it does not necessarily mean low running cost, because the cost of substations and feeders increases considerably with the acceleration provided for. All these matters are treated from a thoroughly practical point of view.

The second volume begins with a chapter on the theory and design of the polyphase railway motor, with useful examples of such motors as applied to the Valtellina and other lines; then follows control, overhead equipment, rolling stock, energy consumption, and other details. In view of the increasing importance of single-phase working, the authors have done well to restrict the three-phase part of the book and to devote the space saved to the more recent single-phase system. Here they break new ground by going at some length into the question of single-phase commutator motors, both with and without commutating poles, compensating winding, and other refinements. There is, however, a certain ambiguity about the motors described, and the reader will not find it easy to know what particular type is meant, especially as diagrams of windings and vector diagrams are too sparingly used. Neither will he find mention of the designers by the names of which particular motor types have become known; there is no mention of Lamme, Fynn, Winter-Eichberg, Richter, Latour, and so on, yet each of these men have produced distinct types. To give an instance of the ambiguity: we are told that the London Bridge to Victoria line is being equipped with "compensated repulsion motors," but nothing is said of the particular type being the Winter-Eichberg.

The chapter on overhead work is distinctly good, both as a theoretical treatise and as a collection of examples from the best modern practice, whilst the chapters on feeders, inductive drop in rails, energy consumption, and capital outlay on single-phase railways will repay careful study on the part of the engineer who has work of this kind to design.

GISBERT KAPP.

VETERINARY ANATOMY.

The Surgical Anatomy of the Horse. Part ii. By John T. Share-Jones. Pp. xii + 190. (London: Williams and Norgate, 1907.)

WHY do British veterinary anatomists adhere so tenaciously to a nomenclature which is absolutely indefensible? Many of the terms at present employed in the various English text-books on the anatomy of the domestic animals are admittedly unsatisfactory; yet British veterinary writers persist in their use, with the result that a Continental reader wishing to consult an English work is put to an infinity of profitless trouble. Not only are the English names incompatible with comparative anatomy; sometimes they are strikingly absurd. No more deplorable instance of misdirected ingenuity is to be found than in the names given to the three phalanges. The first phalanx rejoices in the name of "*os suffraginis.*" Not only is this an unknown expression in scientific anatomy, it is also the outcome of error. Its inventor—possibly a French writer, be it said—completely mistook the meaning of the Latin word *suffrāgo* (*suffragĭnis*), which is generally defined as "the ham or hough of a quadruped's hind leg," and is used by Pliny and others as opposed to *armus*. If, then, an *os suffraginis* is to be recognised, it seems more reasonable to regard it as the femur. It certainly is not the first phalanx.

The second phalanx is known to the quasi-scientific veterinarian as the *os coronae*, a term which may be passed over by saying that the only defence for its use is the application by the stable-man of the name *coronet* to the region of the limb in which the bone is situated. To speak of the third phalanx as the *os pedis* is to subvert the meaning of the word *pes* as used in anatomy. The *pes* of the scientific anatomist includes the tarsal, metatarsal, and phalangeal regions of the posterior or pelvic limb; and has its parallel in the *manus* of the anterior or thoracic member.

In no part of the body are objectionable terms applied so frequently as in the limbs. This is doubtless due to the extreme degree of modification from the mammalian type which has been produced during the evolution of the modern horse, a modification so marked as to lead the original inventors of veterinary anatomical nomenclature to devise terms which to them seemed fitting, irrespective of their incompatibility with anatomical terminology in general. The time has come, however, when there is little excuse for aberrations. The BNA was devised with the intention that it should make the writings of an anatomist easily intelligible to his brother men of science. Works on anatomy, whether they be purely anatomical or partly surgical, should embody the universal nomenclature. If thought necessary, as is doubtless the case in books written largely for the practitioner, the customary English equivalents might be set down side by side with their Latin synonyms.

Mr. Share-Jones, in the volume before us, employs exclusively the undesirable names found in other English text-books, with the result that he cannot expect to appeal to a wider circle of readers than those who speak the English tongue. What exactly the aim of Mr. Share-Jones may be is difficult to determine. He certainly cannot claim to have produced a surgical *anatomy*, since he deals at some length with fractures and other traumatisms, diseases, symptoms, and even treatment. How far he was justified in including such subjects as "sore-shins," "breakdown," "speedy-cutting," &c., in a work entitled "The Surgical Anatomy of the Horse" is doubtful; but it is beyond question that microscopic structure is out of place in such a production.

Reputable books on anatomy—surgical or otherwise—are now produced with illustrations which may be termed artistic without doing violence to the English language. Indeed, the illustration of scientific works in general is now an art in itself. This being so, a work the value of which depends mainly upon its plates is apt to be judged by a fairly high standard. Most of Mr. Share-Jones's figures would not stand such a judgment. Apart from their execution, it is difficult to see why some of them are printed on so large a scale as to require quarto plates. It is, further,

not easy to decide on the value to the surgeon of large plates showing merely the bones of the shoulder and elbow joints, or figures of the various bones of the limb, or purely diagrammatic representations of the arterial arches and veins.

As the surgeon is well aware, veins are very much larger than the arteries they accompany. Figures of sections, therefore, should show this; and, in order that they may do so in a serviceable manner, should be made from formol-hardened bodies. Again, in the limbs, not infrequently two veins accompany an artery; and this is especially common in the region illustrated in plate ix. Figures of sections, furthermore, should be accompanied by some key to the precise level at which the cut has been made. In some regions, as, for example, about the carpus, a very small deviation in the level of two sections produces an appreciable difference in their appearance. The relationship of the vessels, &c., in plate xxi. may be correct, but where is the tendon of the flexor carpi radialis? Plate xxv., though semi-schematic, should show the slip passing from the tendon of the extensor communis to that of the extensor digiti minimi.

It is evident that the writer has been too ambitious, and has endeavoured to display encyclopædic knowledge in an utterly inadequate space. Consequently some subjects have had to be treated in a manner all too brief. A description of the nerve to the latissimus dorsi in three lines and two words, or of the subscapular nerve in two and a half lines, is of little value to the surgeon and none at all to the student.

The volume before us forms the second part of the complete work, and deals with the anterior limb. The printers and publishers are to be commended for their share of the work.

THE ROMANCE OF SAVAGE LIFE.

The Romance of Savage Life, describing the Life of Primitive Man, his Customs, Occupations, Language, Beliefs, Arts, Crafts, Adventures, Games, Sports, &c. By G. F. Scott Elliot. Pp. 384. (London: Seeley and Co., Ltd., 1908.) Price 5*s*.

A POPULAR yet accurate account of savage life would supply an obvious want; and though Mr. Scott Elliot's contribution is interesting and readable, it still leaves the field open to some more competent writer. The model for a book of the kind is the "Anthropology" of Prof. Tylor, a volume popular and at the same time truly scientific, with which Mr. Elliot does not seem to be acquainted. Like this it might dispense with a bibliography and footnotes. Mr. Elliot, however, professes to give references, but these and his list of authors are inadequate. If authorities are to be quoted full references should be given, and it is worse than useless merely to name without further detail books like Gibbon's "Decline and Fall" or the "Polynesian Researches" of Ellis.

A bibliography, again, which ignores Messrs. Spencer and Gillen and Dr. Howitt's last book on Australians; Col. Dalton, Sir J. G. Scott and Mr. Thurston on Indian forest tribes; Catlin and Schoolcraft on North American Indians; Dr. Rivers on the Todas; Miss Kingsley and Col. Ellis on West Africa; Dr. Haddon's "Cambridge Expedition to Torres Straits"; the Journal of the Folk-lore Society; and last, but not least, the works of Dr. Frazer when totemism, death rites, and savage religion are discussed, is obviously of little value. The ethnographical chapters are naturally the best part of the book; but when the writer deals with the theory of the ghost as affecting methods of disposal of the corpse, with the belief in a future life, and with savage animism generally, he is evidently on unfamiliar ground.

It may seem hard to tax a popular writer with inaccuracies and omissions such as these. But if, as he might reasonably have done, he frankly declined to quote authorities, the case would have been different. When he professes to write in a scientific way he is bound by the laws which govern scientific work; and this is the more necessary in the case of anthropology, which claims to be an exact science. Finally, the time is past when a book like this can be illustrated by fancy drawings of prehistoric men attacking a bemired mammoth, or of a young lady of the Swiss Lake-dwelling period doing up her back hair. It would have been much more instructive to supply photographs of modern savages at home, of the horses of La Madelaine Cave, or the man and bison from Laugerie Basse.

Even with all these drawbacks the book is a readable contribution to the excellent series of which it forms a part. Mr. Scott Elliot, without any pretensions to style, writes pleasantly, and though his personal experience of wild men seems to be confined to a part of Africa and Madagascar, he possesses a sufficiently vivid imagination to grasp the relation of the savage to his environment. From a comparison of their mode of life with that of Fuegians and Tasmanians, he is able to give a vivid sketch of life in the Cro-Magnon and Lake-dwelling periods, and his accounts of savage war and weapons, boats and huts, cookery and dancing, are often well done. The book will supply excellent reading to an intelligent boy, and may lead him to study the scientific literature of the subject.

OUR BOOK SHELF.

Die Vegetation der Erde. VII., Die Pflanzenwelt von West Australien südlich des Wendekreises. By Dr. L. Diels. Pp. xii+413. (Leipzig: W. Engelmann, 1906.)

THE Australian flora is of extraordinary interest, not only by reason of the complex problems connected with its origin and development, but also on account of the wonderful range of adaptation to their environment displayed by so many of its constituent species. It is with special pleasure, then, that we welcome the appearance of Dr. Diels's treatise on the flora of the south-western part of the continent. The method of treatment pursued by the author is a good one. He gives a fairly full historical account of the investigations of his predecessors, and incidentally criticises the "Flora Australensis," in common with other colonial floras, on account of the frequently insufficient data as to locality of a species. It must, however, be remembered that much of the material for these floras is collected through channels which

would render it impossible to furnish such data, and it is better to have the description of the plants, even if their habitats cannot be ascertained from the collectors.

The author, who spent many months going over the ground himself, gives a very good account of the physical and chief geological features of the country, and then discusses the general character of the flora, its chief geographical subdivisions, the latter of course depending on the amount and on the periodic distribution of the annual rainfall, and he then touches on the ecological side of the vegetation, and finally gives his views as to the relationship of the south-west Australian flora to that of the rest of the continent and thence to those of other lands.

He divides the flora into eastern, Eremæan (including the central regions), and western provinces. Of these, the eastern shows strongest affinities with the plants of other lands, *e.g.* with Indomalayan on the north and Antarctic in the south; whilst the Eremæan, though largely peculiar, yet betrays north-eastern relationship. The south-western region is far the smallest region, and also is the most peculiar. Dr. Diels considers, in opposition to the views advanced by some other writers, *e.g.* A. R. Wallace, that the flora of this region is a derived and specialised one rather than the starting point whence the typically Australian plants have arisen and spread over the rest of the continent.

It is impossible in a notice of reasonable length to deal at all fully with the contents of the book. It is one that should interest not only botanists, but all who can appreciate the bearing of plant distribution on geographical problems. The illustrations are good and the sketch-maps useful, though, perhaps, the inclusion of a general map in the volume might have rendered them more convenient for purposes of reference.

Das inneralpine Becken der Umgebung von Wien. By Dr. Franz X. Schaffer. Pp. viii+128. (Berlin: Gebrüder Borntraeger, 1907.) Price 2.40 marks.

THIS little work, truly a book for the pocket, is one of the latest additions to Borntraeger's "Sammlung geologischer Führer." It guides the pedestrian to the excavations in the flat land close to Vienna, and shows how the sections in sands and marls illustrate the later phases of the struggle of central Europe against the old Mediterranean Sea. The history of successive marine invasions, penetrating the hollows of the rising mountain-chains, is well and succinctly expressed in three pages (pp. 7–9) quoted from the author's "Geologie von Wien." The Vienna basin results from the falling in of the area after the Middle Miocene uplifts and foldings. The south-eastern European sea then invaded it for the last time (p. 117), depositing in a gulf the marine Leithakalk, with a fauna partly tropical, and ultimately the Sarmatian and Pontic strata, which show increasingly brackish-water conditions. The boundary of the sunken area is still marked by hot springs and outflows of mineral waters, those of Baden occurring where the western margin of the basin is crossed by dislocations that follow the strike of the limestone Alps (p. 121).

The Vienna basin has a charm of its own, and a scientific visitor may well spend a few days in it with this little volume as his companion. He should, of course, also read the story of the larger area around the city in the monumental "Bild und Bau Österreichs" (see NATURE, vol. lxx., p. 49), which is not a book that anyone could possibly carry in the field. We can soon escape from the noise of the very ill-paved suburbs, and at Schwechat are out along the quiet reaches of the Danube, making perhaps for the purple "horst" of Hainburg, where the towers still climb up the rock, as a memory of invasion from the east. Or we go south along the main "Bruchlinie," under sombre wooded hills, until we penetrate the Alpine zone at Gloggnitz; or south-east across the Goldene Lacke, where the great Hungarian cattle plough the plain, which spreads here, as the result of subsidence, close against the mountain-spurs. The Leithagebirge that rises gently in the south actually lies in Hungary; and the line of Miocene fracture may still be perceived, when we attempt to carry the German language into the Slav and Magyar villages beyond it.

The British Journal Photographic Almanac and Photographer's Daily Companion for 1908. Edited by George E. Brown. Forty-seventh year. (London: Henry Greenwood and Co., n.d.) Price 1*s.* net.

THIS is the forty-seventh issue of an indispensable publication. Year by year the volume makes its appearance, and on each occasion it is found to contain just that collection of photographic matter which is so useful and valuable to the everyday photographer.

The arrangement of the material is on similar lines to that of its immediate predecessors, but we are glad to see that all indices to advertisers, text, &c., are placed together at the end of the volume, undoubtedly the proper place for easy reference.

Naturally, the new Lumière colour process of photography, the chief topic of the year and a wonderful advance in colour photography, is referred to at some length, and this by the editor, who includes it under the heading "Screen-plate Processes of Colour Photography."

The section entitled "Epitome of Progress" will be found as useful as ever, summarising as it does in abstracts, papers, communications, articles, &c., which have appeared in either home or foreign journals, adding—and this is a valuable feature—the full reference.

In "Recent Novelties in Apparatus" we have a very useful section. The editor only describes those articles which have come under his own personal examination, and only those introduced since the last issue of the almanac.

The approved formulæ, tables of chemical and optical data, lists of photographic societies, &c., have all been brought carefully up to date, and the mass of advertisements is, as usual, an important feature of the publication.

In addition to numerous illustrations, the frontispiece is an example of the autotype carbon tissues, 25,000 copies of which were printed by the Autotype Co., and mounted by the Adhesive Dry Mounting Co., Ltd., on paper provided by Messrs. R. T. Tanner and Co. An excellent coloured plate is reproduced by the Sanger Shepherd Colour-printing Syndicate, while another coloured plate is shown, the three-colour blocks and printing of which are the work of Messrs. Hood and Co., Ltd.

It may be stated in conclusion that the volume is a marvellously cheap shillingsworth, and will no doubt find its usual place on the shelf of every photographer's work-room.

Science of Nature-History. By Nasarvanji Jivanji Readymoney. Pp. 103. (London: *Times of India* Office, 1907.) Price 4*s.*

THE author provides what he describes as "A guide showing how or where to think on events or collect facts in nature-history order so as to describe and define events from nature-history point of view." It will serve to define the author's object if some of his technicalities are explained. Nature-history is a short, less luminous name for the practical study

of nature. To record an event according to nature-history is to fix its place in nature; and to assist the student in his record a series of skeleton classificatory schemes is provided. These tabular statements contain many terms new to orthodox science, and serve to illustrate the compiler's predilection for classification.

Nietzsche in Outline and Aphorism. By A. R. Orage. Pp. viii+188. (Edinburgh and London: T. N. Foulis, 1907.) Price 2*s.* 6*d.* net.

AFTER a short introduction dealing with Nietzsche's works, a few pages of "definitions" and a sketch of the philosophy formulated by the champion of nihilism, the compiler brings together a series of his author's aphorisms classified under such headings as "Philosophers and Philosophy," "Morality," and so on. As indicative of the searching character of the maxims, one may be quoted from each of the sections mentioned:—"The doer alone learneth"; "Education ruins the exception for the sake of the rule."

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 Photoelectric Property of Selenium.

I HAVE lately constructed small seleno-aluminium *bridges* for the electrical measurement of starlight, and it occurred to me to put these bridges into a vacuum to see whether their sensitiveness to light is thereby increased or diminished. One of them, formed, of course, with conducting selenium, had a resistance of 61×10^6 ohms in air and great sensitiveness to light. It was placed in a glass tube connected with an air-pump. About twelve hours after the tube was exhausted to a pressure of about 0·01 mm., the resistance of the bridge had dropped to 61 ohms! From this it fell gradually, and it has now (three days after exhaustion) a resistance of 17·5 ohms.

I conclude, after repeating the result with three bridges, that conducting selenium when placed in vacuo drops in resistance about four million times, and possibly still more. Also it loses completely its sensitiveness to light.

Other things connected with this strange result are under investigation. I use the term "bridge," in preference to "cell" or "resistance," at the suggestion of Dr. A. A. Rambaut. These bridges are far more simple and easily used with a telescope than the "cells" which I used in the observatory of Dr. W. E. Wilson in Westmeath. The selenium employed was specially purified by Prof. Threlfall, who very kindly gave me a supply.

GEORGE M. MINCHIN.

The Electrical Laboratory, Oxford, December 21.

Early Chinese Description of the Leaf-Insects.

"YUEN-KIEN-LUI-HAN," a Chinese encyclopædia completed in 1703, tom. cdxlvi., fol. 9, b, has the following quotation from the "Tau-hwang-tsah-luh," written *c.* ninth century:

"In Nan-hai a peculiar manner of bees (or wasps) live on the *kan-lan* tree (*Canarium pimela* or *C. album*). They look as if this tree's leaves were grown with hands and legs, wherewith to grasp branches and so deftly adpress themselves thereto that they are quite indistinguishable from the foliage. Therefore, to collect them the southern people used to fell the tree first and await the withering and falling of its leaves; and only then they are enabled to discern and gather the insects, which they employ as philter."

Nan-hai, literally "Southern Sea," was anciently the appellation of a province, the present Kwang-tung, but sometimes it was applied to the Indian Archipelago (Bretschneider, "Botanicon Sinicum," part iii., p. 579).

But for specifying them as bees or wasps, this Chinese account of the mimetic articulate would appear fairly to tally with that of the leaf-insects (Phyllium). Probably it is a very early, if not the earliest, description of these Orthoptera.

KUMAGUSU MINAKATA.

Tanabe, Kii, Japan, November 14.

THE SALMON.[1]

WE have no hesitation whatever in advising all persons interested in the salmon, whether as fishermen, naturalists, or legislators, to add this book to their libraries. The blue and grey covers of the official reports of the Scotch Fishery Board and the Irish Department of Agriculture contain a great deal of most valuable information bearing upon the life and habits of the salmon, and, so far as Scotland is concerned, Mr. Calderwood has now collected into the book under review the information spread over a series of reports. In the case of Ireland the reports of salmon-marking experiments are now published separately in pamphlet form, and deserve a far wider circulation than they possess.

Mr. Calderwood, we think wisely, confines his book almost exclusively to the life-history of salmon in Scotch waters, but is careful to direct attention to points in which the habits of the same fish in some or all Irish rivers appear to differ in points of detail. He would have us, in the first place, regard the salmon as essentially a marine fish, and in this he may be right, though we see no real reason why an anadromous species need be definitely relegated to the category of either fresh-water or marine forms. We are, however, quite in agreement with his view that the Salmonidæ are derived from originally marine ancestors, and would even hazard the suggestion that the presumably herring-like stock from which the Salmonids and Alepocephalids are derived may have been driven in the struggle for existence either to adopt an anadromous life or fresh-water habitat (as in Osmerus, Salmo, Thymallus, and Coregonus), or to retire into the deep sea like the Alepocephalids, Argentina, Microstoma, and Bathylagus found off our own coasts.

We must, in any case, look upon the salmon as a fish growing and feeding in the sea, resorting to fresh waters when feeding ceases on the approach of the spawning season, and spending the early part of its life near the place of its birth until strong enough to venture seawards; this is the standpoint from which we must regard and seek to explain the known phenomena of its life-history.

It is now more than forty years since the discovery was made that the first two years of the salmon's life are normally spent in the parr stage, while a few parr may move seawards in the first year and a certain proportion may spend three years in fresh water. Mr. Calderwood attributes this discovery to the Stormontfield investigations, but we fancy he is so far in error here that the percentages he quotes were really derived from Dunbar's Thurso experiences, communicated by him to Archibald Young when Commissioner of Scotch Salmon Fisheries.

At a length (in the Tay) of five or six inches, the parr assumes the silvery livery of the smolt, and passes seawards, in Scotland, so far as observed, always in spring. The second late summer or early autumn migration of smolts, noted annually in some Irish rivers, and intermittently in others, has not yet been observed in Scotland, and accordingly is not here dealt with.

On reaching the sea the smolt for a time eludes the ken of man, or, at all events, all fishing gear ordinarily employed by him, until it reappears as a grilse. This, hitherto little known, period of the fish's history is admirably handled by Mr. Calderwood. The few British and Irish records of young salmon between the lengths of six inches and two feet are carefully examined, and Dahl's Norwegian researches are cited

[1] "The Life of the Salmon; with Reference more especially to the Fish in Scotland." By W. L. Calderwood. Pp. xxiv+162. (London: Edward Arnold, 1907.) Price 7*s.* 6*d.* net.

to show that this period is normally spent in offshore waters, as occasional captures in mackerel nets would suggest. The marking of Tay smolts and control observations of the rings upon the scales of grilse have now shown that the first fish re-appear in the estuaries as grilse twelve to fifteen months after leaving the river as smolts, and that some fish may spend a further summer in the sea before seeking fresh water, then to re-appear as small spring fish. It would, however, be premature to assume that no fish re-ascend in the year of their descent as smolts.

This observation leads us naturally to the second essential fact of a salmon's life-history, that of the distinction between the "short migration" and the "long migration"; that is between the fish which return to fresh water in the summer or as spawners in the autumn or winter of the year of descent as kelts, and those which spend a longer period in the sea and return as clean fish early in the following spring. The difference may be well illustrated by the cases of two Irish fish of the same sex (female), weight (5 lb.) and length (2 feet 1 inch), marked as slats on the same day, January 18, 1902, and at the same place, one of which was re-captured on July 22, 1902, weighing 11 lb. and 2 feet 5 inches long, while the other was re-captured on June 16, 1903, weighing 18 lb. and 2 feet 11 inches long. It is possible that in some cases the "long migration" period may extend over two years, and it by no means follows that any individual fish is either always a short-period fish or always a long-period fish. A remarkable fact shown by results published up to date is the preponderance of short-period fish in Ireland and of long-period fish in Scotland.

Another problem is raised by the winter and spring fish of some rivers; do such fish merely ascend a short distance and then drop back again to the tide-way for further feeding before finally running to spawn, or do they ascend to the head-waters of the river they enter so soon as the physical conditions admit? The unfortunate sacrifice of the Lismore Weir marking experiments to the objections of certain anglers has undoubtedly deprived us of an opportunity of reaching some conclusion upon this most important point; so far as the experiment went it certainly pointed to such fish not remaining in the Blackwater until the following spawning season, but dropping back to the estuary before ascending to the redds. Mr. Calderwood, in former papers, has adduced evidence of what he terms a "pausing habit" of winter clean fish in the lower waters of the Spey, but he now states that "in Scotland we have not evidence that clean fish are in any sense temporary visitors to fresh water or habitually drop back into the sea" He moreover notes that the spring fish entering the Ness have already reached the Garry by early in February, while the Tay fish are not found above Loch Tay until May or later. This question is closely connected with the further one, why are some rivers early rivers and some late rivers? To the latter question Mr. Calderwood devotes considerable space, and his remarks, whether accepted as providing an answer or not, are well worthy of attention.

A male salmon in full spawning livery, fresh from the sea in November. The fish has just been marked on the dorsal fin before its return to the river Tay at Almondmouth. From "The Life of the Salmon."

We can but briefly allude to many other points of interest touched upon by this book, such as the causes prompting a salmon to seek fresh water, the effects of temperature on a run of fish, and the question of fish "changing rivers."

Of the salmon's life in the sea until it comes coastward we can but assume at present that it is spent in pursuit of the shoals of herring or mackerel, while noting that the drift-net fishery for salmon off the west and north-west coasts of Ireland is conducted in late spring and early summer, sometimes as much as ten miles from the coast.

We reproduce an illustration showing a November fresh-run male salmon in full spawning livery, photographed before its return to the Tay after marking; the silver marking plate is seen on the dorsal fin. The Irish marks are similar in form and similarly

affixed, but oxidised in place of being left bright. Recently a new mark has been introduced in Ireland, consisting of a small numbered tag attached to the base of the dorsal fin by means of a ring; marks of this pattern are made of various size to suit any fish from a smolt upwards.

ENTOMOLOGY FOR THE YOUNG.

THIS book is not a scientific treatise; it is intended, as the author tells us in the preface, "to encourage the intelligent life-study of insects by our younger folk, to discourage collecting, and to stimulate the profitable employment of one's eyes and ears in town or country." This object is a very estimable one, and the author has done much to produce a book admirably adapted for this purpose.

It is divided into seven chapters, each containing many stories of insect life. The general introduction

Green-veined White Butterfly resting. From "The Story of Insect Life."

deals with all manner of subjects in a clear and very simple way, such as structure, eggs, metamorphosis, fertilisation of plants, the story of the wild arum, resemblance of plants to insects, &c. Then follows a chapter on beetles, some of our common forms being simply described. Earwigs, cockroaches, crickets, and grasshoppers form the theme of chapter iii., and dragon-flies, May-flies, &c., that of chapter iv. Now and again the author, unfortunately, pounces on scientific names. For many reasons, in a book for young people, these are best left out, particularly if wrong ones are used, as on p. 104, where the steel-blue wood wasp (*Sirex juvencus*) is called *Sirex noctilo*!

Some of the stories form delightful reading, such as the story of the hive bee, p. 207.

Seventy-six pages are devoted to butterflies and moths, and then the final chapter gives a few brief notes on bugs, frog-hoppers, gnats, and other flies that may attract the young person's attention.

The illustrations from photographs are mostly excellent, and some beautiful pictures are reproduced of localities where water insects abound. The author, unfortunately, in one has made a grievous error, for in Fig. 119 he gives the head of a male mosquito, *Theobaldia annulata*, as that of a female gnat, and refers to this in the text. For the young we should be just as careful to be accurate as for people more matured.

The eggs of the vapourer moth are not in a natural position in Fig. 17, and, again, a badly set and damaged tortoiseshell butterfly is clumsily stuck on an iris blossom (Fig. 86) in a very unnatural way. There are also many entomological errors.

The plates will be sure to attract the young mind, and they are excellently reproduced, but the artist appears to have a quaint idea of some of the insects, such as the blow-fly on plate viii., and also the water boatman. In spite of such faults, the book is one that may be recommended to all young folk, as it not only supplies a want, but fills that want in a clear and pleasant style. FRED. V. THEOBALD.

[1] "The Story of Insect Life." By W. P. Westell. Pp. 339; illustrated. (London: Robert Culley, n.d.) Price 5s. net.

LORD KELVIN.

IN NATURE for September 7, 1876, there was published, with the engraved portrait by Jeans, in the series of "Scientific Worthies," an account of Lord Kelvin, then Sir William Thomson, and of the scientific work, extending then over more than thirty years, by which he had rendered himself illustrious in physical science. Thirty-one years have elapsed since that appreciation was written, and now we have to mourn that this life of wonderful activity has come to its natural close. At the ripe age of eighty-three, as full of honours as of years, Lord Kelvin has passed away. To say that his eye was not dimmed, nor his natural force abated, would be scarcely strictly true, yet he retained to the last the exercise of his intellectual powers. The vigour and keenness with which he entered into the discussions at the British Association meeting at Leicester in August last were truly remarkable at his advanced age. It was in the course of making experiments in a corridor in his country house, Netherhall, Largs, that he contracted the chill which brought about the fatal end.

The article of 1876 gave in some detail those scientific achievements which had then made him famous; and a glance at its contents will show in brief what these were. While still an undergraduate at Cambridge, he had made valuable mathematical investigations in relation to Fourier's theorems, and in their applications to the motion of heat and to hydrodynamics. In these investigations will be discovered the foundation of the method of evaluating geological dates from underground temperatures upon which subsequently he built his famous conclusions as to the age of the earth. In the years which followed, during his early occupancy of the chair of natural philosophy at Glasgow, Lord Kelvin was largely occupied, in constant association with Joule, with the development of thermodynamics, to which not his least contribution was the theory of the dissipation of energy. This was followed by investigations into electrostatics and the theory of magnetism, contact electricity, thermo-electricity, the mechanical energies of the solar system, the calculation of the tides, the size of atoms, and vortex motion. That which, however, directed popular attention to his scientific attainments was not so much these deep investigations as his connection with the more practical problems of ocean telegraphy. The pos-

sibility of an Atlantic cable was in the early 'fifties a much-discussed question: and the mathematical investigation which Lord Kelvin made of the conditions governing the propagation of signals in long submarine cables proved to be the most important contribution to the practical solution of that problem. He showed that the retardation must be proportional to the square of the length of the cable; and, further, he applied the theorems of Fourier to predict the degree of attenuation of the impulses on their arrival at the distant end. This was followed by the invention of the mirror galvanometer, and later by the siphon recorder, with both of which instruments his name will ever be associated. The final success of the Atlantic cables of 1865 and 1866 was a triumph for his inventive ingenuity no less than for his mathematical skill and insight. He had likewise been brought intimately into nautical matters, leading him to devise the method of taking flying soundings, and to publish a set of tables for facilitating the use of Sumner's method at sea. To heighten his public fame he also re-modelled the mariner's compass by radical improvements which quickly established its superiority to all earlier forms.

All this was duly recounted in the article of 1876, and might well suffice to place him in the very first rank of physicists had he achieved nothing more. Von Helmholtz, summing up his intellectual attainments at that date, had remarked upon his method of treating the problems of mathematical physics how he had "striven with great consistency to purify mathematical theory from hypothetical assumptions which were not a pure experience of facts." He maintained that "the gift to translate real facts into mathematical equations, and *vice versâ*, is by far more rare than that to find the solution of a given mathematical problem"; adding, "And in this direction Sir William Thomson is most eminent and original." Happily for science this gift continued to be exercised for thirty years after von Helmholtz penned this appreciation of his friend. As the years went on Lord Kelvin continued with marvellous activity of mind and body to add to his long list of scientific labours.

It has been noted above at how early a date, namely, in 1842, Lord Kelvin had published the germ of his theories about the age of the earth. This was in a paper on the linear motion of heat which appeared in the *Cambridge and Dublin Mathematical Journal*. This same subject he had made the topic of his inaugural lecture in 1846 on taking up his professorship at Glasgow. He returned to it in 1876 as the theme of his address as president of the Physical and Mathematical Section of the British Association at Glasgow. To the geologists who demanded unlimited time for the operation of these formative actions, which, on the abandonment of catastrophic notions, they had assumed to proceed with constant uniformity, Lord Kelvin announced with the utmost confidence that they must hurry up their phenomena, since the age of the earth as a habitable planet, so far from being unlimited, could not possibly exceed four hundred millions of years, and was more probably within twenty millions of years. The proposition was supported by several converging lines of argument. The surface temperature could not be what it was, considering the average conductivity of rocks and the gradient of temperatures found underground, if the cooling process had proceeded from an unlimitedly long anterior date. The heat of the sun itself must be constantly dissipated, and its temperature sinks; and with the cooling of the sun the earth also cools. Its form, in relation to centrifugal forces, was incompatible with the hypothesis of an unlimited time since it was a fluid mass. The controversy which arose, as the biologists and geologists endeavoured to combat these arguments, lasted for a quarter of a century; and the end is indeed not yet.

Hydrodynamics is a branch of natural philosophy in which the Cambridge school under Stokes has always been strong; and Lord Kelvin, as a pupil and friend of Stokes, worked much at it. Hydrodynamics was indeed continually in Lord Kelvin's thoughts. His brilliant speculation of the vortex-atom remains—if we are to except recent electric theories of matter—the one and only hypothesis of the ultimate structure of matter that has yet been found to hold its own against destructive criticism. It has not yet been shown to be impossible or self-contradictory. Apart from this, his other investigations into hydrodynamics have been most fruitful. He discussed the conditions of stability of fluid motion in a large number of cases, some of them of practical importance. Within the past two years he contributed to the Royal Society of Edinburgh a series of papers on deep sea waves, papers which are full of characteristic applications of Fourier's theorems, and show unabated keenness in following out an intricate analysis. In elasticity and the kindred problems of dynamics, the influence of the master's hand is no less evident. The article which he contributed to the "Encyclopædia Britannica" on elasticity will remain a classic of science for many years. Those who are intimate with Lord Kelvin's work generally will know how much in this article there is that lies behind his other studies. His continual reference to the analogies which he found between the phenomena of magnetism and of electricity and those of elastic solids shows the working of his mind, and the fundamental views which he held on elasticity dominate alike his Baltimore lectures of 1884 and the papers on molecular physics of his latest years.

To the science of electricity, Lord Kelvin's contributions have been no less notable. Imbued with admiration for Faraday's experimental work, Lord Kelvin early set himself to ascertain whether the phenomena of electromagnetism can be explained on an elastic solid theory. Although it was left to Maxwell to carry to fruition this part of the subject, it was Kelvin's merit to have first applied mathematical analysis to the facts revealed by Faraday's researches. It was in 1847 that he first proposed a mechanical representation of magnetic force; and to this subject he returned in 1890, in an article first published in the third volume of his collected mathematical and physical papers. It was in the early days, too, that he investigated the conditions of the discharge of a Leyden jar in circuits possessing self-induction, predicting mathematically the fact that under certain conditions these discharges would be found to consist of electric oscillations. This discovery was published in 1853. Later, Fedderson and others observed these oscillations experimentally; and in the 'eighties this abstract research of Lord Kelvin's became the starting point of the investigations of Sir Oliver Lodge and of the lamented Heinrich Hertz, leading directly to wireless telegraphy.

In 1851 Lord Kelvin, impelled by the characteristic precision of his scientific character, and urged by the needs of exact measurement in telegraphy, had already adopted the absolute system of measurement initiated by Gauss, and extended by Weber. In Lord Kelvin's hands the absolute system of measurement, and with it the adoption of the metric system of standards, became almost an article of creed. In season and out of season he urged the superiority of the decimal measures over the ordinary British ones; and, consistently, he strove to bring all scientific measurements into terms of the fundamental metric

units of length, mass and time. Moreover, toward the end of the 'fifties, electric measurement, in the hands of the cable engineers, had become much developed, and instruments of a precision exceeding anything known then in the physical laboratory had been devised for practical use. In 1861 Lord Kelvin secured the appointment by the British Association of a committee on electrical standards, a committee of which also Wheatstone, Matthiessen, Fleeming Jenkin, and, later, Siemens, Clerk Maxwell, Joule, and Carey Foster were members. Year after year this committee, with younger men added, has produced its reports with little intermission, and the system of units which it evolved is practically that which is internationally recognised and of legal force. Twice Lord Kelvin gave public expositions of the system in set addresses, at a South Kensington conference in 1876, and before the Civil Engineers in 1883. The latter of these discourses is in Lord Kelvin's most characteristic style, and even now, after twenty years, some of it is hard reading for any but a professed physicist. But mere hardness never daunted Lord Kelvin. In the same lecture, speaking of a particular point in the system of absolute measurement, he said :— "It may be hard to accept, but the harder it is the more it is worth thinking of." The acceptance and rapid development of the international system, based on the centimetre, the gram, and the second, is due to Lord Kelvin more than to any other man.

After the adoption of the new units by the International Congress at Paris in 1881, Lord Kelvin devoted much attention to the production of commercial instruments for the measurement of current, potential, and electric power. Relying confidently on the rightness of abstract principles, he produced a series of ampere-balances for currents of different strengths, thus putting into the hands of practical engineers a set of instruments of remarkably great accuracy and of remarkable range. When occupied with the tides, in the 'seventies, he had devised a machine for analysing the harmonic components of the periodic tidal variations, the essential part of this harmonic analyser being a mechanical integrating device of globe, disc, and cylinder, first suggested by his brother, Prof. James Thomson. It seemed a bold thing to apply such mechanism to evaluate the integrals indicated by Fourier's analysis; but Kelvin's machine justified the hardihood of the conception. When in the 'eighties he had before him the problem of constructing an electricity meter which should continuously integrate the varying product of current and voltage of an electric supply, he again had recourse to the same integrating mechanism. And, here, it may be remarked in passing that it is to Lord Kelvin's evidence before the Parliamentary Committee in 1879 that we owe the circumstance that the Board of Trade adopted as its official unit of electric energy the value of one thousand volt-ampere-hours. It was once upon a time proposed to denominate this unit—now universally employed—by the name of one "kelvin." Lord Kelvin's innate modesty caused him to reject the suggestion. Surely the time has now come for the final incorporation of his name into the international system, thus linking it with those of Volta, Ampère, Ohm, Coulomb, Watt, Faraday, Joule, Henry, and Gauss.

Lord Kelvin had a peculiar predilection for illustrating recondite notions by models. He once said that he could never understand a thing until he could make (or conceive) a model of it. His chain of gyrostats to illustrate the rigidity of the ether, his systems of crystal models made of little wooden rods and balls held in stable equilibrium by india-rubber bands, are but two examples of a mode of using the concrete to realise the abstract that he practised continually. He was fond of introducing into abstract dynamics terms derived from other sciences, geodesy, and crystallography. Amongst the bye-products of his genius may be found enshrined in the Proceedings of the Royal Society a short paper containing the essentials of the theory of the designing of wall-paper patterns; its title, however, is "The Homologous Partition of Space."

Of Lord Kelvin's later work on molecular physics, the "tactics of a crystal," the problems of æolotropic elasticity in relation to optical as well as magnetic and electric phenomena, it is less easy to speak. The lectures which he gave at Baltimore in 1884 to "his twenty-one coefficients," the members of the group of accomplished physicists who then sat at his feet day after day, while he led them through the mazes of the elastic-solid theory and the newly-invented spring-shell molecule, remain a witness to his extraordinary fertility of intellectual resource. All his life he had been endeavouring to discover a rational mechanical explanation for the most recondite phenomena—the mysteries of magnetism, the marvels of electricity, the difficulties of crystallography, the contradictory properties of ether, the anomalies of optics. And during the preceding decade he had been confronted with a great generalisation which did not fit in with this method of intellectual apprehension, which had become to him instinctive. While Kelvin had been seeking to explain electricity and magnetism and light mechanically, or as mechanical properties, if not of matter, at least of ether, Maxwell had boldly propounded the electromagnetic theory of light, and had drawn all the younger men after him in acceptance of the generalisation that the waves. Lord Kelvin had never accepted Maxwell's theory. It is true that in 1888 he gave a nominal adhesion; but later withdrew it, preferring still to think of things in his own way. Kelvin's Baltimore lectures of 1884, abounding as they do in a host of brilliant and ingenious points, and ranging from the most recondite problems of optics to speculations on crystal rigidity and molecular dynamics, leave one with a sense of being a sort of protest of a man persuaded against his own instincts, and struggling to find new expression of his thoughts so as to retain his old ways of regarding the ultimate dynamics of physical nature. During the last few years of his life Lord Kelvin himself revised these lectures, enriching them with a variety of new materials, and coordinating the old. He was intensely interested in the new problems raised by the discovery of radium; and in its astonishing property of continuously emitting heat. He combated strenuously the hypothesis of Rutherford that this was to be explained by a spontaneous decomposition of the atom; and to the very last he was seeking for other explanations.

At the present time, when so much of the new knowledge is in a state of flux, it would be entirely premature to attempt to evaluate the ultimate importance of Lord Kelvin's later writings on radium and on the "electrons." Suffice it to say that he brought to bear on these things the same illuminating genius, the same keen analytical instincts, that he had shown throughout his long career.

To two generations, if not three, of scientific men his work, his presence, his mathematical genius, his enthusiastic faith in first principles, and his unfailing gentle courtesy have been an inspiration and a perpetual stimulus. So he rests from his labours, and his works do follow him. SILVANUS P. THOMPSON.

LORD KELVIN'S FUNERAL IN WESTMINSTER ABBEY.

The decision taken by the Dean of Westminster to accord to Lord Kelvin burial in Westminster Abbey met at once with a warm and responsive echo of satisfaction on the part of men of science and the com-

munity generally. In the Abbey he has joined a noble company of departed worthies—Newton, Herschel, Lyell, Spottiswoode, Darwin—names that perpetuate some of the most glorious and imperishable achievements in natural knowledge. Especially gratifying must it be to the Royal Society to feel that the remains of their illustrious past-president find a resting-place side by side with those of Sir Isaac Newton.

The representative gathering that filled the Abbey on Monday, December 23, afforded ample testimony to the wide and varied interests, apart from pure science, that dominated the career of Lord Kelvin. Not only a brilliant moving figure in the hierarchy of science, he was also a great citizen, ever mindful of the best traditions of English public life.

The funeral service, which commenced at noon, was of the most impressive character. The King was represented by His Grace the Duke of Argyll, K.G.; the Prince of Wales by Lt.-Col. Sir Arthur Bigge, G.C.V.O.; and the Duke of Connaught by Major L. Green-Wilkinson. The Princess Louise (Duchess of Argyll) was present, attended by a lady and gentleman in waiting. Seats in the choir stalls were occupied by :—

Lady Rayleigh, the Russian and Italian Ambassadors, Mr. J. Ridgely Carter, representing the American Ambassador; Baron von Stumm, representing the German Ambassador; and Mr. Ijiuin, representing the Japanese Ambassador; the Lord Mayor of London (who was robed), and the Master of the Clothworkers' Company. The First Lord of the Admiralty, Lord Tweedmouth, accompanied by his secretaries, attended to represent the Board of Admiralty. The Lord President of the Council was represented by Mr. Almeric FitzRoy.

At the Chapter House a procession was formed, which, headed by the choir and officiating clergy, slowly wended its way from the Chapel of St. Faith through the cloisters, and, while the hymn "Brief life is here our portion" was being sung, to the nave, and thence to the lantern, beneath which the coffin was temporarily deposited. The order was as follows :—

Clergy and choir; bier; pall bearers; chief mourners; Institute of France, M. G. Lippmann, For.Mem.R.S., M. Henri Becquerel, in addition to M. Darboux, For.Mem.R.S., perpetual secretary, who took part as a pall bearer; Lord Mayor of London; Master of Clothworkers' Company; the Royal Society; the Royal Society of Edinburgh and other British and foreign learned societies; Universities of Cambridge and Oxford; University of Glasgow and other Glasgow delegations; University of Edinburgh and Corporation of Edinburgh; other British universities.

A guard of honour of the Electrical Engineer Volunteers, of which Lord Kelvin was Colonel-in-Chief, lined the cloisters, Colonel R. E. B. Crompton, C.B., commanding. The guard fell in at the end of the procession, and took up a position in the nave.

The pall bearers and chief mourners were as subjoined :—

Pall Bearers.

Lord Rayleigh, O.M. (President of the Royal Society).
Mr. J. Morley, O.M. (Secretary of State for India).
Sir Archibald Geikie, K.C.B., Sec.R.S. (President of the Geological Society).
Prof. A. Crum Brown, F.R.S. (Royal Society of Edinburgh).
The Master of Peterhouse, Cambridge (Dr. A. W. Ward).
Sir J. Wolfe-Barry, K.C.B., F.R.S. (Institution of Civil Engineers).
Sir Edward H. Seymour, O.M. (Admiral of the Fleet).
M. Gaston Darboux, For.Mem.R.S. (Perpetual Secretary of the Paris Academy of Sciences).
The Lord Strathcona and Mount Royal (High Commissioner for Canada).
Sir George Darwin, K.C.B., F.R.S. (University of Cambridge).
Dr. MacAlister (Principal of the University of Glasgow).
Dr. R. T. Glazebrook, F.R.S. (Institution of Electrical Engineers).

Chief Mourners.

Dr. J. T. Bottomley, F.R.S.
Mr. G. King.
Mr. James Thomson.
Mr. W. Bottomley.
Sir Alex. Brown.

Mr. W. Crum and two others, with four grand-nephews, Mr. D. King, Mr. J. F., Mr. W., and Mr. G. Bottomley.

On the part of the Royal Society, in addition to pall bearers and other Fellows who also represented universities, there were present Mr. A. B. Kempe (treasurer), Prof. Larmor (secretary), Sir W. Crookes (vice-president), Sir J. Stirling, Sir John Evans, Major MacMahon, &c., and Mr. R. Harrison (assistant secretary).

It is unfortunately impossible to find space here to print the long list of representatives of British universities, scientific societies, and institutions present at the funeral, and we are only able now to state that the following foreign societies were represented in addition to the Paris Academy of Sciences already mentioned :—

Imperial Academy of Sciences of Vienna, Lord Rayleigh; Accademia dei Lincei, Rome, Sir Norman Lockyer, Prof. J. J. Thomson, Sir David Gill, and others; the Elektrotechnischer Verein of Berlin, Mr. A. Siemens; Societá Italiana di Fisica, Associazione Elettrotecnica Italiana, and Phys. Verein Frankfurt a.M., Prof. Silvanus P. Thompson, &c.

NOTES.

We announce with deep regret the death of Dr. Janssen, director of the Meudon Astro-Physics Observatory, at eighty-three years of age.

A Reuter message from Copenhagen states that experiments made by the Amalgamated Radio-Telegraph Company of London and Copenhagen, owners of the Poulsen system of wireless telegraphy and telephony, show that wireless Poulsen telegrams between Newcastle and Copenhagen and Berlin and Copenhagen can be written directly from the receiver with ink as in the case of telegraphy by wire.

The Royal Statistical Society's Guy medal in gold has been presented to Prof. F. Y. Edgeworth for his services to statistical science.

Dr. Thomas Annandale, Regius professor of clinical surgery in the University of Edinburgh, died on December 20 at sixty-nine years of age.

On Saturday next, December 28, Sir David Gill, K.C.B., F.R.S., will deliver the first of the annual course of juvenile lectures at the Royal Institution on "Astronomy, Old and New." The remaining lectures will be delivered on December 31, January 2, 4, 7, and 9.

Mr. Elihu Thomson, writing from the General Electric Company, Lynn, Mass., U.S.A., comments upon the description of the exhibition of globe lightning in West Australia described in our issue for October 31 (vol. lxxvi., p. 671), and provides particulars of another case brought before his notice by a friend. The phenomenon referred to by Mr. Thomson is said to have appeared as a ball of yellow flame continuously in motion with a central nucleus rose-red in colour, and to have exhibited many points of similarity with the globular lightning seen in Australia on the occasion mentioned in our previous note. From Mr. Thomson's letter it is not clear whether the report made to him relates to globular lightning or to a fireball.

In the report of the Bristol Museum and Art Gallery for 1907 the committee announces that the success of the combined institution during the period under review has been very pronounced, the total number of visitors considerably exceeding half a million. A new departure is the

installation in the museum of a section devoted to economic biology, galls and gall-flies, together with the various animal and vegetable pests infesting orchards and forests, forming the main exhibits at present before the public.

THE luminiferous properties of the brittle-star, *Amphiura squamata*, and other echinoderms form the subject of an article by Irene Sterzinger in vol. lxxxviii., part iii., of *Zeitschrift für wissenschaftliche Zoologie*. The light is displayed at the summits, and not, as hitherto supposed, at the bases, of the "feet," where it emanates from slime secreted by the epithelium. There is, however, a luminiferous and a non-luminiferous slime. Similar slime-glands occur in certain other echinoderms. Both kinds of slime are soluble in hydrochloric acid.

WE have received a copy of Bulletin No. 72 of the U.S. Entomological Bureau, in which Messrs. W. D. Hunter and W. A. Hooker record the results of investigations into the life-history of the North American fever-tick (*Margaropus annulatus*), and the best modes of keeping the species in check. In parts of Texas and some of the other southern States cattle-breeding is almost impossible owing to this pest, which is estimated to cause an annual loss of one hundred million dollars.

AN important addition to the somewhat scanty literature of galvanising is made by Mr. Alfred Sang, who has published in the Proceedings of the Engineers' Society of Western Pennsylvania an elaborate monograph on old and new methods. The hot process of galvanising dates from Crauford's patent of 1839, and the origins of electro-galvanising, or cold galvanising, as it is often called, are also remote, but commercially it is a new process. In 1902 Mr. Sherard Cowper-Coles patented his process for galvanising metal goods by packing them in zinc dust in an air-tight retort, and heating the retort to a temperature below the melting point of zinc. This process is known as sherardising. The first attempt to coat metals by means of zinc vapour was made by Jean Pierre Chambeyron in 1864. Mr. Sang's investigations on the volatilisation of zinc from zinc dust at low temperatures have led him to important improvements in the vapour process, and there is every reason to hope that this method will soon take its place in the metal industries as a powerful antidote to corrosion. Undoubtedly the proper place to search for further improvements in protective coverings for iron and steel is in the study of the true causes of corrosion.

IN the Bulletin of the Moscow Imperial Society of Naturalists for the year 1906, Prof. E. Leyst, director of the meteorological observatory of that place, contributes an important article on the estimation of the amount of cloud. The matter at first sight would appear to be one of the simplest of meteorological observations, but very few stations are so placed as to have a clear horizon, especially when situated in towns or in valleys. Prof. Leyst has submitted the Moscow observations for several years to a careful discussion, dividing the whole sky into three zones of 30° each. Taking the zenithal zone 60°–90° as the unit of comparison, he finds that in the lower zone the yearly mean of cloudiness is twice as great as in the zenithal zone, and that for the whole of the sky the yearly amount of cloud is 43 per cent. greater than in the zenithal zone, the amounts differing according to the season and to the time of observation. All things considered, the results seem to show that observations of amount of cloud in the zenithal zone are to be preferred; the author also considers that observers should be instructed how to divide the area under observation, so as to estimate cloud in tenths.

THE physiology and habits—the "behaviour," as it is now the fashion to call these factors in the life-history—of a common American starfish, *Asterias forrieri*, are discussed at considerable length by Mr. H. S. Jennings in a paper issued as one of the zoological publications of California University. The modes by which the creature manages to hold its own in the struggle for existence, the way in which it obtains its food, and kindred subjects, are in turn discussed, and the results of the investigation of all these factors will, it is hoped, afford an insight into the complex life of the sea-shore generally, and manifold inter-relations of the numerous organisms which make this zone their home.

IN vol. xxi., art. 11, of the Journal of the College of Science of Tokyo University, Mr. S. Hatta concludes his account of the gastrulation of the ovum of the lamprey (Petromyzon). In the neighbourhood of Sapparo the species during the spring spawning season resorts in numbers to the streams, and thus affords abundant working material, which was developed by means of artificial fertilisation. The author considers that the ovum exhibits a kind of belated development, the blastulation and gastrulation stages overlapping one another, so that what should be the blastula appears to be really an old morula stage. The prime cause of this belated development is indisputably due to delay in segmentation, owing to the accumulation in the ovum of a great amount of yolk.

THE culture of marine fishes and crabs and lobsters in America, by Mr. G. M. Bowers, U.S. Commissioner of Fish and Fisheries, forms the subject of an illustrated article in the November number of the *National Geographic Magazine*. The United States, according to the author, is a long way ahead of any other nation in the matter of marine fish-culture, the only country coming anywhere near it in this respect being Norway, which was, indeed, the pioneer. This, in the author's opinion, is accounted for by the fact that in many countries it is believed to be an impossibility to make any marked increase in the numbers of sea-fishes by artificial culture, as it is seriously to diminish them by fishing. This, however, is far from being the view entertained by the Government of the United States, which carries on fish-culture, and crab and lobster propagation, to an enormous extent in species hatcheries and laboratories. The fishes regularly cultivated —by collecting and artificially fertilising the spawn—are cod, flounders, pollak, and, to a less degree, mackerel, bass, &c., while lobsters are reared at several stations, more especially the one recently established at Boothby Harbour. The general plan of operations is described very graphically by the author.

A MEMOIR by Mr. David Heron on the statistics of insanity and the inheritance of the insane diathesis has been issued by Messrs. Dulau and Co. for the Francis Galton Laboratory for National Eugenics, University of London. The material on which the memoir is based was provided by Dr. A. R. Urquhart, physician superintendent of the James Murray's Royal Asylum, Perth, and consisted of 331 family trees of asylum patients, giving very full details of the brothers and sisters, parents, and in some cases grandparents and children of the patient. The general results are very similar to those of the memoir, previously issued, by Prof. Karl Pearson on pulmonary tuberculosis. The inheritance of the insane diathesis is very marked, the correlation-coefficient between parent and offspring (as calculated by Prof. Pearson's method) lying between the values 0·52–0·62. The figures are bound to be somewhat uncertain, for they involve an estimate of the proportion of the inhabitants of Scotland who have been at any time certified as insane; the census and the Lunacy Commissioners' returns, of course, can only

give the number of patients at a given time or during a given period. Taking the figures for tainted stocks only (pedigrees of asylum patients), 21 per cent. of the offspring were insane when both parents were sane, 24 per cent. when one parent was insane, and 50 per cent. when both parents were insane, the last figure being, however, somewhat doubtful, as it is based on very few cases. There does not appear to be any lack of fertility in the tainted stocks, the mean size of family in 331 families containing at least one insane member being 5·97; eighty-seven matings in which one parent was insane gave a mean of 5·18 children, matings which were not necessarily completed.

MR. T. SHEPPARD, the curator of the Hull Museum, continues his useful work of issuing bulletins at the cost of one penny each, describing the collections under his charge. The most recent issues are devoted to "Notes on the more Important Discoveries in East Yorkshire," and to an account of a British chariot burial discovered during the present year at Hunmanby, in the same district. In the first pamphlet he has collected records of the most notable discoveries, adding useful references to the publications in which they are described. Many valuable relics have passed into other museums or into the hands of private collectors, while several have altogether disappeared. Now that a suitable building has been provided, the collections are rapidly increasing. The British chariot burial at Hunmanby presents many features of interest. The bottom of the grave was occupied by a great wooden shield, apparently of oak, ornamented with thin plates of bronze. The greater part of the woodwork was, unfortunately, destroyed in the landslip which directed attention to the interment. The bones were in a state of decay, but the recovery of two teeth of a horse indicates that the animal was buried with its master. Considerable portions of the chariot were recovered; and while in other Yorkshire burials of this class the bridle-bit is usually of iron coated with bronze, here it is of bronze throughout. The date of the interment is fixed in the first or second century B.C. In more than seven hundred early British burial mounds excavated by Canon Greenwell, Mr. Mortimer, and others, only about half-a-dozen chariot burials were discovered. The "find" at Hunmanby is thus of considerable archæological importance.

THE first appendix to the *Kew Bulletin* for 1908, being the list of seeds of hardy herbaceous plants and of trees and shrubs available for exchange with botanic gardens and correspondents of Kew, has been received.

PROF. W. TRELEASE contributes to the annual report (No. 18) of the Missouri Botanical Garden a note on the genus Yucca, supplementing his monograph published in a former report (No. 13). Under the group of Sarcoyucca the author revises the species allied to *Yucca valida*, making a new species, *Yucca decipiens*, and indicates their distribution on a map. Characteristic illustrations of *Yucca periculosa*, and a new species, *Yucca Endlichiana*, are given. The latter, sent under the vernacular name of "pitilla," is said to yield good fibre; it is acaulescent, and bears very small, often dark, flowers.

AN account of the chemical examination, by Mr. E. A. Mann and Dr. W. H. Ince, of certain West Australian poison plants is published in the progress reports issued as two pamphlets by the Department of Agriculture for the colony. About fifty poisonous plants are said to occur in the State, of which several belonging to the genera Gastrolobium and Oxylobium are regarded as the most general sources of stock poisoning. One species of each of these genera was examined, and from each a strongly toxic alkaloid was isolated. The authors also attempted to find an antidote; this, so far as experiments go, is furnished by a preparation of which permanganate of potash is the important constituent.

IN the course of investigations into the nature of Para rubber, Dr. D. Spence was led to examine the constituent, always present, that is insoluble in choloroform or similar solvents. Proceeding from the known occurrence of protein substances in the latex, he comes to the conclusion that the insoluble portion is a protein giving a strong xanthoproteic reaction, and comments on the peculiar fibrous structure shown markedly in sections stained with silver nitrate. This conclusion raises the practical question whether the presence of this insoluble constituent in the latex does not exercise an important physical function in the raw product. The paper is published by the Liverpool Institute of Commercial Research in the Tropics as journal reprint No. 13.

THE Journal of the Department of Agriculture of South Australia for October contains an account of the law relating to certain specified noxious weeds, with popular descriptions of them. Any landowner suffering these weeds to grow on his land, or on the adjoining roadsides, is liable to severe penalties. Should the District Council not enforce the law—and it appears this sometimes happens—the Commissioner of Crown Lands is authorised to have the weeds destroyed, and recover the cost from the council.

THE October numbers of the *Transvaal Agricultural Journal* and of the *Cape of Good Hope Agricultural Journal* have recently come to hand. The former contains an excellent article by Mr. F. B. Smith on agricultural education and research. Mr. Smith's department has been so successful in dealing with agricultural problems, and has appealed so strongly to the Boer farmer, that his plea for a sound and comprehensive system of agricultural education in the Transvaal is not likely to pass unheeded. There are also a number of articles dealing with practical farming matters, and some analyses of Transvaal fodder crops. The Cape of Good Hope has not the advantage of a large agricultural department, and its journal is consequently smaller. Some experiments are described by Prof. Duerden in which the rate of growth of ostrich feathers was found to be $1\frac{3}{4}$ inches per week.

WORCESTERSHIRE fruit growers suffer a great deal from the attacks of the apple sucker (*Psylla mali*), and arrangements were therefore made last year for Mr. Kenneth G. Furley, acting under the supervision of Mr. F. V. Theobald, to visit certain districts and carry out spraying experiments. The results are now issued as a report by the Worcestershire Education Committee. Very few eggs were found on the trees at the beginning of October, though the winged "Psylla" were flying about in great numbers; but about the middle of the month the eggs were thick on the trees, especially on the spurs. The dates of hatching varied; some came out on April 3, while others in the same orchard only appeared on April 10; the blossom and leaf buds were then attacked. Of the various washes tried, the most effective was the mixture of lime and salt recommended by Mr. Howard Chapman. The experiments were evidently well carried out, and the example of the Worcestershire Education Committee might well be followed by others. Considering the enormous losses caused to fruit and hop growers and gardeners generally by insect or fungoid pests, and the great amount of money spent on washes, it is surprising how little systematic work on the subject is done in England.

DR. C. M. LUXMOORE has sent us a copy of his final report on the analysis of one hundred soils from the county of Dorset, preliminary reports upon which, by Dr. Luxmoore himself and by Prof. Percival, have already been issued from the University College of Reading. The soils and their subsoils have been taken from typical localities situated upon all the formations, ranging from the Bagshot Sands to the Lower Lias, which are exposed in the county, and the report contains detailed analyses, both mechanical and chemical, together with certain determinations of their physical constants. In this latter connection one or two novel methods of examination have been proposed, designed to obtain some information as to the behaviour of the soils in the field. In addition to the analytical figures, the report contains a full discussion of the results, in which attempts are made to estimate the interdependence of some of the constituents and the extent to which they may be correlated with the properties of the soil. The report represents a very considerable piece of work, which has occupied Dr. Luxmoore for many years.

IN NATURE of December 27, 1906 (vol. lxxv., p. 197), attention was directed to the remarkable book by Dr. F. Oswald on the "Geology of Armenia." A second edition of this work is now promised; and the author has issued a large lithographed map of the country described, on which the geological features are coloured by hand. This map and an explanatory pamphlet are published by Messrs. Dulau and Co., London (25*s.* net), and should obviously be secured by those libraries that possess the original work of reference. The country dealt with includes, as a central feature, the great lacustrine and volcanic plain north of Lake Van, and its extent may be judged from the fact that the scale of the map is 1 inch to sixteen miles, and that the sheet measures 37½ inches by 21½ inches. In the pamphlet, which is in itself a guide to the geological structure of Armenia, the striking extent of the marine transgression in early Miocene times is emphasised, the present country being due to Middle Miocene folding, followed by fault-block movements during the Pliocene period.

THE annual report of the State geologist of New Jersey for 1906 (Trenton, 1907) is a volume of 192 pages, containing, in addition to the administrative report for the year, valuable papers on building stones, on the glass-sand industry, on the Triassic copper ores, and on trap rocks for road construction. Mr. W. E. McCourt has made some careful tests to determine the fire-resisting qualities of New Jersey building stones. The crystalline rocks at a temperature of 550° C. were not greatly affected. The gneisses cracked parallel to the banding, and, as a rule, it is safe to assume that a gneiss will be more damaged than a crystalline rock of the same texture and composition without the banding. Clay rocks suffered badly. The sandstones resisted fairly well, while the limestones seem to have suffered the least injury of all the stones tested. The paper by Messrs. H. B. Kümmel and R. B. Gage on the glass-sands of New Jersey shows that they contain more iron, and consequently obtain lower prices at the glass factories than do the Pennsylvania sands with which they compete. If the iron-bearing minerals could be removed by improved methods of washing, by magnetic separation, or by sieving, a grade of glass-sand superior to the best Pennsylvania sand would be obtained. Mr. J. Volney Lewis gives the results of his investigations of the petrography of the trap rocks and of the origin of the copper ores commonly found in proximity to them. The view put forward that the copper ores are deposits from ascending magmatic waters expelled from the great intrusive mass in the vicinity appears to be well supported by facts. Lastly, a record is given of tests of the resisting qualities of the trap as determined by a series of experiments carried out in cooperation with the Department of Agriculture. As the trap rocks are extensively used for road metal, these tests of their wearing qualities should prove of value when considered with regard to the results already shown by actual use.

A COLOURED supplement to the December number of the *Quarry* conveys an admirable impression of the appearance of the green marble now being quarried on the island of Iona. The marble occurs in gneiss of pre-Cambrian age as a well-defined vein, and its beautiful green colour is due to the presence of serpentine derived from forsterite by hydration.

AN important contribution to the study of weathering phenomena in building stones is afforded by a paper by Mr. E. Kaiser on the Stuben sandstone of Wurttemberg in the *Neues Jahrbuch für Mineralogie* (1907, ii., pp. 42–64). This stone was largely used in 1842 to 1868 on Cologne Cathedral, and now exhibits marked disintegration, the weathered material showing an external layer of scale, and below it a layer of soluble calcium and magnesium sulphates. In the quarry, on the other hand, the weathering consists in solution of the calcium and magnesium constituents of the brown spar in the rock with deposition of the iron as hydrated ferric oxide. It is evident that the disintegration in Cologne is caused by sulphur derived from smoke gases.

A DETAILED account has been published by Mr. N. W. Lord (United States Geological Survey, Bulletin No. 323) of the experimental work conducted in the chemical laboratory of the United States fuel-testing plant, St. Louis, between January 1, 1905, and July 31, 1906. Interesting results have been obtained in the determinations of specific gravities of coal, in laboratory methods of determining the adaptability of coals to improvement by washing, and in the estimation of volatile matter in coals and lignites. It is shown that the value obtained for volatile matter in coal is affected by the method of heating the sample, by the fineness of pulverisation, and by the amount of loosely held moisture present.

THE question of the concentration of ores is one to which much attention has recently been devoted, and inventors have been busy in the new field of flotation processes in which the concentrate is removed from the top and the tailings from the bottom, apparently in contravention of the law of gravity. A new process invented by Mr. A. P. Macquisten, and successfully applied in the United States, is described in the *Engineer* of December 13. It is based on the utilisation of the surface tension of liquids, it having been found that sulphide ores possess some property that prevents them from becoming wetted, whilst gangue minerals do not possess this property, and readily sink. At the Adelaide mine, Nevada, the process has been applied to copper pyrites, iron pyrites, blende, and galena with heavy gangue minerals, the presence of which rendered ordinary methods of concentration ineffective.

WE have received from Dr. Van Rijckevorsel parts iii. and iv. of his laborious investigation entitled "Constantly Recurring Secondary Maxima and Minima in the Yearly Range of Meteorological Phenomena." For details as to the methods employed we would refer our readers to the

notice of part ii., relating to temperature (NATURE, vol. lxxiii., p. 594), where it is explained that the author claims that the observations over the whole earth, collectively, and in the northern and southern hemispheres, separately, show half-yearly and other periods the epochs of which are identical. Part iii. deals with barometric pressure, for which 2755 years of observations are used, but are necessarily very unevenly distributed, 2255 years being to the north of the tropics, and only 381 years to the south. The similarity between the curves for the north and south hemispheres is not so pronounced as in the case of the temperature curves, as the years available for the south are altogether insufficient for the purpose, but the author thinks that with sufficient materials the results would probably be nearly identical. The results with regard to rainfall are much less satisfactory; the elimination of disturbances caused by heavy downpours in thunderstorms requires a much longer period of observation than is at present available. The paper is accompanied by tables and curves showing the variations exhibited by both elements.

THE foundations of geometry form the subject of the presidential address to section iii. of the Royal Society of Canada, by Prof. Alfred Baker, published in the Transactions of the society, 1906–7. The author traces the history of the axiom of parallels from an anecdote about Lagrange, and from the early writings on the subject of Gauss, Bolyai, and Lobachevski, and he gives a detailed abstract of Hilbert's assumptions. Referring to an attempt made in 1570 by Sir Henry Savile, of Oxford, to stimulate interest in Greek geometry by explaining the first eight propositions of Euclid to a class of university students, and comparing this result with the performance of modern schoolboys, Prof. Baker thinks that a time may come when schoolboys will find no difficulty with the abstractions of Hilbert's geometry, and the truth of Prof. Halsted's claim may be felt that "geometry at last made rigorous is also thereby made more simple."

THE August Bulletin of the Bureau of Standards of Washington contains a detailed comparison of the four most accurate methods of comparing the capacities of condensers, from the pen of Mr. F. W. Grover. He finds that the four are about equal in accuracy when the various sources of error inherent in each method are eliminated. He advocates the use of an auxiliary adjustable air condenser to enable comparisons to be made by the method of substitution, and shows that the power factor can readily be determined at the same time. This quantity gives valuable information as to the quality of the condenser, the absorption, and the change of capacity of the condenser with frequency.

M. CHARLES FÉRY has constructed a very simple calorimeter for determining the calorific power of gases and liquids, and gives a description of it in the November number of the *Journal de Physique*. The combustion is effected at the base of a glass chimney, the top of which supports a nickel plate pierced with a number of holes. The air necessary for combustion passes down a similar chimney, which is connected at its base with the former. The two junctions of a constantan-copper thermo-circuit are placed at the tops of the chimneys, and M. Féry finds that the electromotive force in the circuit is strictly proportional to the calorific power of the combustible and to the volume of it consumed in unit time.

MESSRS. BEMROSE AND SONS, LTD., have published the twelfth volume of the new series of the *Reliquary and Illustrated Archaeologist*, which contains the quarterly numbers of the review published during 1907. The separate issues have been referred to from time to time in these columns. It will suffice to state here that the review is now edited by the Rev. Dr. J. Charles Cox, and is devoted to the study of the early Pagan and Christian antiquities of Great Britain, the development of the arts and industries of man in past ages, to the survival of ancient usages, and kindred subjects. The price of the volume is 12*s.* net.

OUR ASTRONOMICAL COLUMN.

NOVA PERSEI, 1901.—To test the question of possible proper motion in Nova Persei (No. 2), Prof. Barnard has recently repeated his measures of the Nova's position in regard to other stars in the neighbourhood, using the 40-inch refractor of the Yerkes Observatory. Comparing the results with those obtained in 1901–2, he finds no evidence of measurable motion. The present magnitude of the Nova is about 11·6, the star having apparently increased somewhat in brightness of late (*Astronomische Nachrichten*, No. 4220, p. 323, December 12).

PROVISIONAL ELEMENTS FOR THE SPECTROSCOPIC BINARY α ANDROMEDÆ.—In No. 4220 of the *Astronomische Nachrichten* (p. 327, December 12), Dr. H. Ludendorff publishes a provisional set of elements for the orbit of α Andromedæ, which star has been announced, by several observers, as a spectroscopic binary. This following set of elements has been calculated from the measurements of thirty-eight plates:—

$U = 97{\cdot}0$ d.	$\omega = 70°$
$V = -14$ km.	$e = 0{\cdot}4$
$A = 34$ km. $B = 26$ km.	$T = 1904$ Dec. 2
$u_1 = 98°$	$a \sin i = 36{,}000{,}000$ km.

PHOTOGRAPHS OF MARS.—The second of Prof. Lowell's series of articles on Mars, which is appearing in the *Century Magazine*, is published in the December number (vol. lxxv., No. 2, p. 303). In it the author gives an account of the inauguration and the work of, and of the results obtained by, the Lowell-Todd expedition to the Andes for the observation of Mars under conditions which could not be obtained in higher latitudes and less favourable climates. One of the reproductions illustrating the article shows the Amherst telescope in position at Alianza, Chile, surrounded by the members of the expedition; five other reproductions show prints from some of the plates obtained, each plate containing from sixty to ninety images of the planets, and, alongside, drawings made at the same time by Prof. Lowell, located some 6000 miles away, show how faithfully the photographs confirm the visual observations made at the Lowell Observatory. On the best series of photographs, obtained on July 25, are to be seen delicate canaliform markings which entirely refute the suggestions that such markings, previously recorded visually, are merely subjective phenomena.

Prof. Lowell states that the results greatly exceed his most sanguine expectations, and concludes his article with the following paragraph:—"That life is there is founded on no assumption, but on massed evidence that is conclusive, and the reader should realise that opposition to the idea that we now have proof of life on Mars is not based on reason, but on emotion, however speciously cloaked. All scientific objections have been met and shown untenable as to temperature, snow, &c., but human prejudice, as with the Copernican system or the origin of species, time alone can dispel."

SATURN APPARENTLY WITHOUT RINGS.—In the December *Bulletin de la Société astronomique de France* (p. 513) M. Flammarion discusses the recent observations of Saturn, paying particular attention to the phenomenon of bright knots, observed by Prof. Campbell, and confirmed by Prof. Lowell and others. In this connection he reproduces two drawings made by Bond showing "breaks and prominences" on October 28 and November 3, 1848. These interruptions in the light of the ring were then so easily seen that the observer did not hesitate to explain the phenomenon by the light reflected from the interior edges of the rings.

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1909.

Geometry.—The Francœur prize, 1000 francs, is awarded annually for discoveries or work useful to the progress of pure and applied mathematics. For the Bordin prize, 3000 francs, the question proposed is as follows:—The absolute invariant which represents the number of distinct double integrals of the second species of an algebraic surface depends on a relative invariant ρ, which plays an important part in the theory of the integrals of total differentials of the third species and in that of algebraic curves traced on the surface. It is proposed to make a profound study of this invariant, and especially to find out how to determine its exact value, at least, for numerous kinds of surfaces.

Mechanics.—A Montyon prize, 700 francs, for inventing or improving instruments useful to the progress of agriculture, the mechanical arts, or sciences. The Poncelet prize will be awarded for a work on applied mathematics. The question for the Vaillant prize, 4000 francs, is to improve in an important point the application of the principles of the dynamics of fluids to the theory of the screw. The Boileau prize, 1300 francs, is for researches on the motion of fluids, sufficient to contribute to the progress of hydraulics.

Navigation.—The Plumey prize is for improvement of steam engines or any other invention which has most contributed to the progress of steam navigation.

Astronomy.—The Lalande prize, 540 francs, is for the most interesting observation, memoir, or work useful to the progress of astronomy, and the Valz prize, 460 francs, is awarded on similar terms. The G. de Pontécoulant prize, 700 francs, is for the encouragement of researches in celestial mechanics.

Geography.—The Tchihatchef prize, 3000 francs, for the recompense or encouragement of young naturalists distinguished in the exploration of the lesser known parts of Asia.

The Gay prize, 1500 francs, for the study of the geographical distribution of one class of cryptogams.

Physics.—The Hébert prize for the author of a treatise or discovery for the application or practical employment of electricity; the Hughes prize, 2500 francs, for a discovery or work contributing to the progress of physics; the Gaston Planté prize, 3000 francs, for the discovery of an invention or important work in the field of electricity; the L. La Caze prize, 10,000 francs, which cannot be divided, for works or memoirs contributing to the progress of physics.

Chemistry.—The Jecker prize, 10,000 francs, for works contributing to the progress of organic chemistry; the Cahours prize, 3000 francs, for the encouragement of young chemists; the Montyon prize (unhealthy trades), a prize of 2500 francs and a mention of 1500 francs, for the discovery of a means of rendering an art or trade less unhealthy; the L. La Caze prize, 10,000 francs, which may not be divided, for the best work in chemistry.

Mineralogy and Geology.—The grand prize of the physical sciences, 3000 francs. The question proposed for 1909 is the stages of evolution of the most ancient quadrupeds found in France. The Delesse prize, 1400 francs, for a work concerning geology, or, in default, mineralogy.

Botany.—The Desmazières prize, 1600 francs, for a work on cryptogams; the Montagne prize, 1500 francs, for important work bearing on the anatomy, physiology, development, or description of the lower cryptogams; the de Coincy prize, 900 francs, for a work on phanerogams; the Thore prize, 200 francs, for a memoir on the cellular cryptogams of Europe.

Anatomy and Zoology.—The Savigny prize, 1500 francs, for the assistance of young travelling zoologists, not receiving Government assistance, who occupy themselves more especially with the invertebrates of Egypt and Syria; the Da Gama Machado prize, for the best memoir on the coloured parts of the tegumentary system of animals.

Medicine and Surgery.—The Montyon prize, a prize of 2500 francs, and mentions of 1500 francs, for works or discoveries useful in the art of healing; the Barbier prize, 2000 francs, for a discovery in surgical, medical, or pharmaceutical science, or in botany with relation to medicine; the Bréant prize, 100,000 francs. The capital sum will be awarded under the terms of the legacy to anyone discovering a radical cure for Asiatic cholera, either by a specific medicine or by discovering the causes and indicating an undoubted method of destroying these causes. In default of this, the annual interest will be awarded for a memoir demonstrating in a rigorous manner the presence of materials in the atmosphere playing a part in the production or propagation of epidemic diseases. The Godard prize, 1000 francs, for the best memoir on the anatomy, physiology, or pathology of the genito-urinary organs; the Baron Larrey prize, 750 francs, for an army or navy doctor or surgeon for a work treating of military medicine, surgery, or hygiene; the Bellion prize, 1400 francs, for work forwarding the progress of medicine; the Mège prize, interest on 10,000 francs.

Physiology.—The Montyon prize, 750 francs, for work in experimental physiology; the Philipeaux prize, 900 francs, for similar work; the Lallemand prize, 1800 francs, for researches on the nervous system. The question proposed for the Pourat prize, 1000 francs, for 1909, is the origin of the anti-ferments.

Statistics.—A Montyon prize, prize 1000 francs and a mention of 500 francs, for work having a bearing on French statistics.

History of Science.—The Binoux prize, 2000 francs, for works on the history of science.

General Prizes.—The Arago, Lavoisier, and Berthelot medals. The Gegner prize, 3800 francs, for researches in the positive sciences; the Lannelongue prize, 2000 francs, for the assistance of the relatives of scientific men; the Trémont prize, 1100 francs. The Wilde prize, one of 4000 francs and two of 2000 francs, for work in astronomy, physics, chemistry, mineralogy, or experimental mechanics; the Longchamp prize, 4000 francs, for a work on the diseases of man, animals, and plants, from the special point of view of the introduction of excess of mineral substances as the cause of disease; the Saintour prize, 3000 francs; the Victor Raulin prize, 1500 francs, to facilitate the publication of works relating to geology and palæontology, mineralogy and petrography, meteorology and physics of the globe, the prize for 1909 being limited to mineralogy and petrography; the prize founded by Mme. la Marquise de Laplace; the Félix Rivot prize, 2500 francs; the Jean Jacques Berger prize, 15,000 francs, for work concerning the City of Paris; the Petit d'Ormoy prize, two prizes of 10,000 francs, one for pure and applied mathematics, and the other for natural science; the Pierson-Perrin prize, 5000 francs, for a physical discovery; the Parkin prize, 3400 francs, for researches on the curative effects of carbon in cholera, different forms of fever, and other diseases, or on the effects of volcanic action on the production of epidemic diseases; the Cuvier prize, 1500 francs, for a work on zoological palæontology, comparative anatomy, or zoology.

Of the above, the Lalande, Tchihatchef, La Caze, Delesse, Desmazières, and Wilde prizes, and the Lavoisier medal, are expressly offered without distinction of nationality; the Gaston-Planté, Montagne, and Pierson-Perrin prizes are limited to persons of French nationality.

RECENT WORK OF GEOLOGICAL SURVEYS.

THE Geological Survey of Great Britain has issued its "Summary of Progress for 1906" (1907, price 1s.), from which it is clear that a large part of the work of the staff must always be devoted to the revision of geological details in areas already mapped. This is not work that can be carried out hurriedly, or in response to every change in popular geological opinion; but the real need for re-consideration in accordance with modern discovery is at once apparent from the results recorded on pp. 2 to 5 of the present summary. Geological surveys have an important educational duty in addition to their economic functions, and one can never predict where an accurate knowledge of the earth may not lead to the foundation of an industry, or where an industrial inquiry may not suddenly illumine our relation to this globe on which we have to spend our lives.

It is pleasant to observe (p. 6) that the Geological Survey of Great Britain has been in conference with the Agri-

cultural Education Association "for the purpose of testing the relationship of the geological boundaries and the soils." On p. 110 the palæontologists report in favour of the view that the rugose corals were primarily hexamerous, a question still under discussion, as may be seen from a note in NATURE, vol. lxxvi., p. 117. The original papers in the appendix, corresponding to the well-known Bulletins of the Geological Survey of the United States, include one by Dr. Flett on the scapolite-bearing rocks of Scotland, and a valuable summary by Mr. D. A. Macalister of the quantity of tin, copper, and other minerals produced in Cornwall.

The "solid" and "drift" maps, Nos. 230 and 247, are issued simultaneously with the memoirs describing them, under the care of Dr. Aubrey Strahan, and cover parts of the great South Wales coalfield (1907, memoirs, price 2*s*. 6*d*. each; maps, 1*s*. 6*d*. each). The former memoir deals with the country round Ammanford, north of Swansea, where the Silurian strata, through the Ludlow Tilestones, pass up into the Red Marls that form the base of the Old Red Sandstone. The usual unconformity of the latter on a Caledonian land-surface is revealed, however, by the fact that it oversteps every member of the Silurian system (p. 53), until it rests directly on the Arenig rocks in the extreme north-west of the map. The details shown on these modern maps necessitate a good deal of freedom in the use of colours, and blues and greens and yellows are used for lithological divisions (which are, of course, supported by palæontology) in a way that would hardly commend itself to the soul of William Smith. Would not a variety of linings and stipplings in the same colour, which produce all the effect of separate tints, serve on such colour-printed maps for minor subdivisions of our British systems? The American and New Zealand surveys often provide us with examples.

We note (p. 37 of Memoir No. 230) that "Ordovician" now officially replaces the "Lower Silurian" of the older survey; but is it wise to restrict "Silurian," in the face of almost all the geological world, to the former "Upper Silurian" alone? Prof. De Lapparent in 1893 at any rate showed us a clear way out of the difficulty.

Memoir No. 247 includes the busy town of Swansea, and the map brings us to the southern edge of the great coalfield. Mr. E. E. L. Dixon (pp. 11–20) furnishes an interesting account of the dolomitisation of the limestone soon after its deposition in the Carboniferous sea, and the plates and descriptions ought to be useful to workers in many other districts. The growing difficulty in drawing a line between the Lower and Upper Carboniferous series in Britain is well seen by the remarks on pp. 28–29. Mr. Tiddeman (p. 121) has traced a pre-Glacial raised beach from Mumbles Head westward, the fauna of which shows that the whole Cainozoic Glacial epoch was an episode of our own times, if we take the mollusca as our guide. It is now urged (p. 127) that Rhinoceros, Elephas, Bos, and Cervus, found in the Gower Caves, lived here before the arrival of the ice, since raised beach deposits admittedly appear in the cavern-floors. The subsidence that was shown at the Barry Docks in Cardiff to be later than Neolithic times has carried peat in the Swansea area (p. 145) to a level of 44 feet below high water.

The memoir on the geology of Islay has also appeared (1907, price 2*s*. 6*d*.). The author, Mr. S. B. Wilkinson, is referred to in other memoirs as Mr. B. S. N. Wilkinson, a point of which bibliographers should take notice. The maps here described were issued some years ago, and cover a little visited and very attractive district. The ordinary pedestrian in Jura and Islay will find much romantic ground, and may still travel by introduction from one farm to another, in the good old highland style. The present writer well remembers how he was waylaid by an old peasant woman early one morning on the Jura pathway, and forced to accept a parcel of oatcake, lest he should weary before reaching the ferry at the north end of the island.

Mr. Wilkinson enables us, in his first chapter, to realise the main features of Islay, and he rightly directs attention to the extreme brilliance of the colouring on sunlit days along the coast. The rocks include much crushed and mylonitic Lewisian gneiss; sediments regarded as Torridonian; phyllites, limestones, and quartzites, correlated with the Central Highland series; and, resting on these with a slight unconformity (p. 44), a series in which dolomite is prevalent. A considerable thrust-plane separates the quartzite and conglomerate of this series in the north of the island from the rocks referred to the Torridonian. Drs. Teall and B. N. Peach have made important contributions to this memoir. It is illustrated by photographic plates of exceptional beauty. It was unnecessary, however, to supply Plate ii. in our copy in the condition of a "proof before letters."

In the *Verhandlungen der k.k. geologischen Reichsanstalt* for 1907, Herr Vacek (p. 159) continues the controversy with Herr Heritsch on the basin of Graz, and we are led to understand that the junior author, whose youth is greatly insisted on, may now be carried off the field. He is sagely advised not to quote authorities, but to become one himself. Surely we have heard something of this kind in geological exhortations nearer home.

Herr Ampferer (p. 192), in his usual systematic style, gives a reading of the structure of the Rhätikon range on the Swiss and Austrian frontier, in which he shows that he is not fascinated by what Schardt has called "Ultranappismus." Ampferer goes so far as to suggest that certain foreign blocks amid Tithonian limestone, regarded by von Seidlitz as evidence of a "Fenster," and thus connected with overfolding, have been brought into their present position by ice which overrode the chain.

The *Jahrbuch* of the same institute for 1907 contains many descriptive papers, from von Troll's study of the Pontic fauna in the basin of Vienna (p. 33) to Schubert's work on the north Dalmatian coast (p. 1). Dr. Schubert incidentally opposes the suggestion, made from a study of old maps, that extensive geographical changes have occurred in the Adriatic isles within historic times.

Dr. Hinterlechner (pp. 115–374) contributes an important memoir on the sheet of the map round Deutschbrod (Německý Brod, the German ford), in eastern Bohemia. A broad plateau of gneiss and granite here unites Bohemia and Moravia; the traveller may find it monotonous, but for the fantastic architecture of its towns. Dr. Hinterlechner shows what problems of metamorphism lie beneath its undulating fields and little woods. He urges (p. 332) that the great mass of the cordierite and biotite gneisses result from the contact-alteration of a sedimentary series, which has been left intact in one particular zone. Rocks once regarded as Archæan are shown to be intrusive in this sedimentary envelope (p. 351), the age of which remains uncertain. Here again we note the striking change of opinion forced on observers in many lands when careful field-investigation comes to be carried on. Almost all our recent researches lead us farther away from the supposed Archæan crust of purely igneous origin.

Walery Ritter von Loziński describes in the same journal (p. 375) the glacial deposits and löss of northern Galicia, and traces the ice-tongues of the epoch of maximum glaciation into the northern valleys of the central Carpathian range. He finds (p. 395) that the thin marginal ice of the great continental sheet moved to a considerable height up gentle slopes, but was unable to climb steeper hillsides. Unglaciated areas therefore appear, say 250 metres above the sea, side by side with others invaded by ice to a height of 300 metres.

Among palæontological papers may be cited a long memoir by Dr. A. Till on the jaws of fossil cephalopods (*ibid.*, pp. 535–682), an outcome of his previous studies on the examples found in the Neocomian (*ibid.*, 1906, p. 89). Four new genera are proposed, and the jaws belonging to Nautilus are marked off clearly from all others (p. 658). The latter types diminish rapidly at the close of Lower Cretaceous time, and the author (p. 680), in consequence, suggests that they were connected with the Belemnoidea. Throughout both the memoirs referred to, Dr. Till writes "Rhynchotheutis" and "Palæotheutis" consistently; but surely this is a curious error in one who is so much a specialist.

The *Bulletins de la Commission géologique de Finlande* are always of interest. In No. 23 (June, 1907) Mr. Sederholm writes, with an English summary, on "granite and gneiss, their origin, relations, and occurrence in the pre-Cambrian complex of Fenno-Scandia." The subject is one in which the author has already made a reputation. Like Hinter-

lechner, quoted above, and many others, he has been forced here to oppose the notion of a primitive crystalline crust, revealed to us in a region of Archæan rocks, and urges that the oldest rocks in this district are of sedimentary origin, penetrated by younger granites. "The strongly contorted structure" (p. 99) "characteristic of most Finnish gneisses . . . is not a secondary phenomenon in truest sense, but originated when the rock was in a melting condition." This is supported by a series of photographs of rocks intimately penetrated by granite veinlets. The author "regards the foliation of the granites, where it is not of dynamo-metamorphic origin, as formed by the incomplete melting and re-crystallisation of schistose rocks. Also the spotting of granites, he ascribes, in most cases, to the existence of incompletely resorbed fragments of older rocks." At the same time, he believes that the foliation of many Finnish granites was due to pressure after they had become solid (p. 100), and that in Finland "the basement complexes of the typical Archæan sedimentary formations are often preserved." But the base of the whole series in Fenno-Scandia has been melted up; mixed rocks, therefore, play a very important part in this area. Hutton's conception of the circulation of types of rock through denudation of the crystalline masses and their gradual renewal, appears to Sederholm to be fully justified (p. 102). The word "migmatite" is proposed for the rocks that have been called by others "composite gneiss."

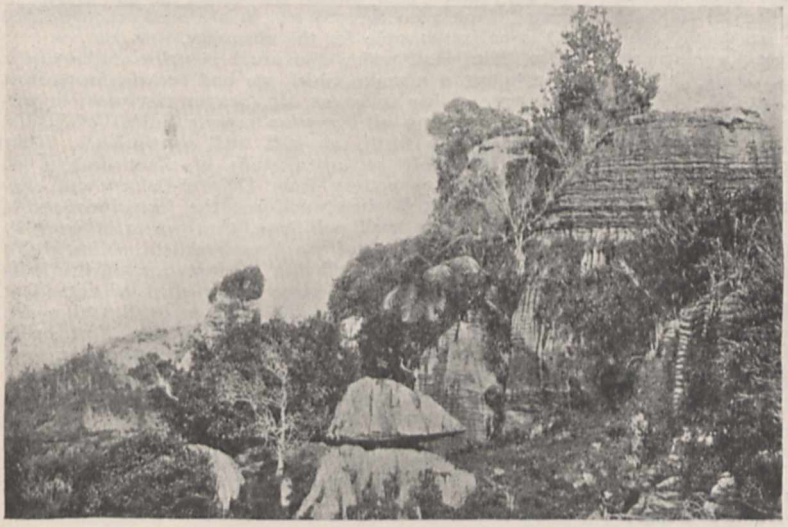

FIG. 1.—Miocene strata, near Rockville, west of Golden Bay, Nelson, New Zealand.

In Bulletin No. 21 Mr. Tanner continues his studies on the glacial phenomena of Finmark, and urges that, allowing for temporary advances of the ice during a general epoch of recession, the glaciation may here be regarded as continuous, without an interglacial break.

Turning eastward, we find Dr. W. F. Hume reporting on the geology of the eastern desert of Egypt (Ministry of Finance, Survey Department, Cairo, 1907). Gold-mining was carried on here in ancient days, and has recently been revived; the gold occurs in quartz-veins. The present account of the geology is merely preliminary, but includes the record (p. 29) of a new marine fauna in the Cretaceous sandstone.

In the "Administration Reports of Ceylon for 1906 (Mineralogical Survey)," Dr. Coomaraswámy records the discovery of thorianite *in situ* by Mr. Parsons in a vein of pegmatite, to which the mineral was traced by following up the alluvial deposits in the bed of a seasonal stream. About 6 lb. of thorianite occur in a ton of the wet decomposed pegmatite. A geological map of part of the Kandy district is added to the report.

Vol. vi. of the "Records of the Mysore Geological Department" contains several coloured maps. It is suggested that the manganiferous laterite in the Shimoga district, now being mined, may represent an old lake-deposit. The work done by the survey is of a wide character; but may we suggest that such terms as "geology student" and "topo sheets" do not fairly represent the English language?

The "Geologists' Report of Progress for September, 1903, to January, 1907, for the Federated Malay States," by Mr. J. B. Scrivenor (Kuala Lumpur, 1907, price 1 dollar), is another interesting piece of evidence as to present geological activity. A distinct foundation is laid in this pamphlet for a conception of the structure of the south end of the Malay peninsula, but the dense vegetation is here, as in Borneo, a serious obstacle to the explorer. On p. 18 there is a remarkable reference to Mr. H. N. Ridley's discovery of an alga instrumental in producing laterite. Of this we shall hope to hear much more; possibly Mr. T. H. Holland, the originator of the organic view of laterisation, has already looked into the matter.

Bulletin No. 3 of the New Zealand Geological Survey contains Mr. J. M. Bell's report on the Parapara subdivision, Karamea, at the north-west corner of the South Island. It is well furnished with landscape illustrations, as is usual with these publications, and a series of beautifully executed maps is inserted in a pocket at the end. The geological history of the district in Cainozoic times emphasises our growing convictions as to the almost world-wide occurrence of the same physical phenomena in certain geological epochs. In this corner of New Zealand, as in central Europe and Armenia, for example, we have a Miocene depression, with a marine invasion (see Fig. 1), occupying the valleys of the previous land, and then "a

FIG 2.—Bued River Valley, northern Luzon, Philippine Islands.

period of secular elevation, accompanied by faulting on an extensive scale. Gradual uprise of the land was continued practically into modern times." An epoch of extensive glaciation, with the formation of an ice-sheet in the basin of Boulder Lake, then opened in Pliocene or post-Pliocene times (p. 22). Especial attention is directed in this bulletin to the immense deposits of limonite iron-ore associated in the district with an ancient series of carbonate rocks. The ore is ascribed to the decay of iron pyrites, and to the reaction of the resulting ferrous sulphate on the carbonates. The ferrous carbonate has finally been altered to limonite, probably as a surface-phenomenon; but the resulting ores occur on a vast scale, highly encouraging for their future prospects (pp. 75–88).

The Bureau of Science of the Government of the Philippine Islands is responsible for the admirably produced *Philippine Journal of Science*, an example to our Government printers in India, or perhaps an example of the disparity of the funds officially devoted in the two countries to scientific publications. In vol. ii., No. 4 (Manila, August, 1907), Mr. A. J. Eveland describes the geology and geography of the Baguio mineral district. Here again, in the island of Luzon, we find an old crystalline basis, marine Eocene (?) and Miocene beds laid down upon it, and then an epoch of elevation and denudation. The Miocene limestone is cut through by the present Bued River valley, which reaches down to the basal diorite (Fig. 2). G. A. J. C.

ARCHÆOLOGY IN AMERICA.[1]

THE first part of the second volume of the Transactions of the University of Pennsylvania's Department of Archæology, Free Museum of Science and Art (it is a pity that this cumbrous title cannot be simplified), contains the usual instalment of articles on Cretan and Mexican archæology, with interesting contributions by Mr. G. B. Gordon on the western Eskimo of Alaska and on an engraved bone from Ohio, the decoration of which is very Mexican in character. The author of the article on Mexican archæology, Miss Adela Breton, draws interesting analogies between the Mexican conventional representations of serpents and the dragons of Chino-Japanese art. There certainly seems to be some connection, however it may be explained. The explanation, when it arrives, will, however, be a genuine one, and not on the lines of the late Mr. Donnelly's "Atlantis," with its curious comparisons of Maya signs with "Egyptian hieroglyphics," most of which had no real existence. It is a pity that the investigation of possible connections between Mexican culture and those of the rest of the world has been so seriously discredited by the "Atlantis" idea. Miss Breton's description of the Xochicalco temple is interesting reading.

Mr. Gordon describes, among other "ploys" of the Eskimo, their elaborate cat's-cradle games. From a personal trial we cannot say that his recipes for their production are as clearly put as they might be. The photographs of these Eskimo which Mr. Gordon publishes show a Mongol rather than American type; plate v., 2, might, but for the eyes being rather too deeply set, be a Japanese.

The Cretan contribution is a good article on "The Decorative Art of Crete in the Bronze Age," by Miss Edith H. Hall, who worked at Gournià with Miss Boyd (Mrs. Hawes). As a succinct description of the most striking characteristics of the succeeding "Minoan" periods of Cretan artistic development it is very useful, and supplements Dr. Evans's "Essai de Classification" and Dr. Mackenzie's articles on pottery in the "Journal of Hellenic Studies" and the "Annals of the British School at Athens." In tone Miss Hall is perhaps just a trifle too dogmatic, and dismisses the opinions of others (*e.g.* Messrs. Hogarth and Welch once or twice) too summarily. On Egyptian matters, too, she is inclined to regard as certain what those who deal with Egyptian things at first-hand know to be thoroughly uncertain. The later system of Egyptian dates is adopted (p. 12) from Prof. Breasted's history with hardly a qualm, in spite of the fact that it is not yet accepted by Petrie, Maspero, von Bissing, or Budge (to give only the most prominent names). There are growing reasons in favour of it, true; but equally there are most serious considerations to be urged against it. To talk dogmatically of the VIth Dynasty as ending "*in* 2475 B.C." (the italics are mine), or the XIIth as dating "from 2000 to 1788 B.C.," is absurd, though Miss Hall is not responsible for the absurdity.

Also, Miss Hall makes the usual mistake of the Greek archæologist, a mistake which we had occasion to correct in the case of her colleague Mr. Seager last year, in persistently regarding all Egyptian representations of plants, flowers, and so forth, as stiff and conventional. They are not invariably so, as a study of plant designs on XVIIIth Dynasty pottery from Deir el-Bahari and elsewhere shows; it is these, and not the formal dadoes of papyrus plants in wall paintings, that we must compare with the plant designs of the Cretan artists. Miss Hall's Fig. 29 is quoted as a Cretan "adaptation of the lotus clumps of Egyptian art. Here the method of arranging the flowers," she says, "is the same as in Egyptian art, yet every trace of Egyptian stiffness is gone." I could quote several examples of Egyptian representations of flowers that are far less stiff and formal than this Cretan one. The designs of Figs. 35, 48, and 49 could all be paralleled on Egyptian pottery.

Miss Hall's classificatory table of "Cretan Bronze Age Design" is very useful as a conspectus of the chief examples of the designs of the "Minoan" periods.

H. R. HALL.

[1] University of Pennsylvania: Transactions of the Department of Archæology. Free Museum of Science and Art, vol. ii., part i. Pp. 105; 29 plates. (Philadelphia: Published by the Department of Archæology, 1906.) Price 1 dollar.

THE PELYCOSAURIAN REPTILES.[1]

ALMOST exactly thirty years ago the late Prof. Cope brought to the notice of the scientific world remains of certain remarkable carnivorous reptiles from the Permian strata of Texas, for which he proposed the group-name Pelycosauria. The group was regarded as a suborder of the Rhynchocephalia, and was provisionally taken to include the theriodont reptiles of South Africa. Among the more typical representatives of the pelycosaurs are Dimetrodon and Naosaurus, extraordinary reptiles in which the dorsal spines of the trunk vertebræ are so enormously elongated (sometimes with the addition of transverse projections) that they exceed in height the depth of the body below them. Restorations of both the skeleton and the external form have now rendered these creatures familiar even to the man in the street.

As to the systematic position of these reptiles and their kindred, considerable diversity of view has obtained. By many writers they are classed with the theriodont anomodonts, but this, according to modern ideas, is altogether unjustifiable, the structure of the temporal arches in the two groups being different. Dr. Case therefore reverts to the original view that pelycosaurs form a primitive section of the rhynchocephalians.

The group is of special interest as illustrating, perhaps better than any other, the rapid evolution from a generalised type to a complex organisation that may have been the potential cause of early extinction, the life of these reptiles being coterminous with the duration of the Permian epoch. Why these specialised structures were evolved within such a comparatively short time is a subject upon which we can only conjecture. Carnivorous in habit, and easily masters of their contemporaries, these reptiles, Mr. Case suggests, may have developed their spines from mere exuberance of growth from a utilitarian beginning, but that these structures eventually became useless cannot be doubted.

That pelycosaurs existed outside of North America is proved by the occurrence of Naosaurus in the Permian of Bohemia and of Stereorhachis in that of France, while certain reptiles from central Germany may also belong to the group. On the other hand, they are unknown in South

[1] "Revision of the Pelycosauria of North America." By E. C. Case. Publication No. 55. Pp. 176+35 plates. (Carnegie Institution, Washington, D.C., 1907.)

Africa or India, and it is improbable that they are represented in the Russian Permian. If this be so, pelycosaurs are unknown in any country where anomodonts (in the wider sense of that term) occur, so that the two groups may apparently be regarded as belonging to totally distinct faunas.

Dr. Case appears to have done his work very thoroughly, and the memoir is profusely illustrated. Before, however, expressing an opinion as to whether his restorations of cranial, and especially palatal, osteology are trustworthy, it would be essential to compare the original specimens with the figures. R. L.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BY the will of Sir William G. Pearce, Bart., chairman of the Fairfield Shipbuilding and Engineering Co., Ltd., who died on November 2, Trinity College, Cambridge, will benefit to the extent of more than 400,000*l.* upon the death of Lady Pearce, should he have left no child.

THE joint matriculation board which directs and controls the matriculation examination of the universities of Leeds, Liverpool, Manchester, and Sheffield has issued its report for the year 1907. The number of candidates in July was 1,294, of whom 705 passed; and in September was 438, of whom 179 passed. The board has appointed a committee to draft a scheme for the inspection and examination of schools, and it has been assured by the universities of their general approval of the objects of the proposal.

A CONFERENCE of teachers, arranged by the London County Council, will be held at the Medical Examination Hall, Victoria Embankment, London, on January 2, 3, and 4. Two meetings will be held each day, and begin at 11 a.m. and 2 p.m. The subject for the first meeting will be nature-study, and addresses will be delivered by Dr. T. P. Nunn and Messrs. H. E. Turner and J. T. Wink-worth. At the second meeting the teaching of botany will be discussed, and the speakers will include Miss Lulham, Miss Lilian Clarke, and Miss von Wyss. At the fifth meeting, manual work in the lower standards of elementary schools will be considered, and Dr. Slaughter and Messrs. J. C. Hudson and P. B. Ballard will speak. At the last meeting Mr. W. J. Hazlitt will read a paper on open-air geography. Applications for tickets of admission should be made to Dr. Kimmins, Education Department of the London County Council, Victoria Embankment, W.C.

THE annual meeting of public school science masters will be held at Westminster School on January 14, 1908. The meeting will commence at 10 a.m., when an exhibition of scientific apparatus will be opened. During the morning the president, Prof. H. A. Miers, F.R.S., will deliver an address upon the order in which science subjects should be taught (*a*) in public schools, (*b*) at the universities. In the morning also a discussion on teaching mechanics will be opened by papers on the educational value of mechanics by Mr. C. F. Mott, of Giggleswick School, and on the teaching of practical mathematics by Mr. H. Wilkinson, of Durham School. In the afternoon a discussion on teaching physics will take place, when papers will be read by Mr. C. Cumming, of Rugby School, on a scheme of laboratory work in physics; Mr. W. E. Cross, of Whitgift Grammar School, on a suitable curriculum for the first and second years; and Mr. J. M. Wadmore, of Oldenham School, on the compulsory teaching of elementary physics to junior forms.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 5.—"On the Distribution of the Different Arteries supplying the Human Brain." By Dr. C. E. **Beevor**. Communicated by Prof. David Ferrier, F.R.S.

The area of distribution of the different arteries of the brain was ascertained, when they were injected simultaneously under the same pressure with gelatin containing soluble colours, a method not used before.

The number of brains injected was eighty-seven. The arteries injected were the posterior communicating, the anterior choroid, the anterior cerebral, the middle cerebral, and the posterior cerebral.

The *method of investigation* consisted in injecting simultaneously by means of pressure bottles, three, four, or five of these arteries with different soluble colours. The injection mass used was gelatin, coloured with soluble carmine, Nicholson's blue, naphthol green, acridine yellow, and Bismarck brown. Twelve different classes of experiments were described. The brains were hardened in formalin, and subsequently cut and examined in the sagittal, horizontal, or coronal planes.

The parts of the brain, the arterial supply of which hitherto has not been described, or which was found to be different from that described by other observers, are:—

The regio subthalamica, with the corpus subthalamicum and Forel's field; the pes pedunculi; the corpus mammillare; the anterior limb of the internal capsule; the caudate and lenticular nuclei; the different nuclei of the optic thalamus (the thalamus is not supplied by the lenticulo-optic arteries of Duret); the anterior part of the choroid membrane, which is supplied by the anterior choroid artery; the fornix and the anterior commissure. The absence of anastomoses of the three arteries supplying the posterior limb of the internal capsule and of the two arteries to the head of the caudate nucleus was also noted.

In the cortex, the anterior cerebral area extends on the outer surface along the median line posteriorly, most frequently to mid-way between the Rolandic fissure and the external parieto-occipital fissure, and inferiorly to the sulcus frontalis superior. The middle cerebral area on the outer surface reaches the middle line for the posterior half of the parietal lobe, and posteriorly the posterior pole, or half an inch in front of it, and inferiorly the middle of the third temporal gyrus. The occipital fibres of the optic radiations in the superior lip of the calcarine fissure are usually supplied by the middle cerebral artery, and in the inferior lip by the posterior cerebral, except for about the posterior inch, which is supplied entirely by the posterior cerebral.

The knowledge of the exact part of the brain which is supplied by an artery is of great importance in the diagnosis of the parts of the brain which undergo softening when this particular artery is blocked by a blood clot.

"The Influence of Increased Barometric Pressure on Man. No. 4. The Relation of Age and Body-Weight to Decompression Effects." By Leonard **Hill**, F.R.S., and M. **Greenwood**, jun.

Conclusions.—(1) Small mammals are relatively immune from decompression effects.

(2) This immunity depends on rapidity of circulation, and may be destroyed by damaging the latter with chloroform.

(3) Age is probably important *per se*, but of far less importance than body weight. We have no convincing proof that two animals of the same weight but different ages would exhibit unequal resisting powers.

(4) There is no evidence that small animals are more quickly poisoned by high pressures of oxygen than large ones.

The practical outcome of this research is that young men of small body weight and possessing a vigorous circulation should be selected for compressed air works.

Royal Meteorological Society, November 20.—Dr. H. R. Mill, president, in the chair.—Reports on the results obtained by the balloon observations made in the British Isles, July 22–27. The International Aëronautical Commission has for some years set apart the first Thursday in each month for the ascent of kites and balloons, but at last year's conference it was decided to make a special effort to obtain information on a series of consecutive days, and the last week in July was finally decided upon for the purpose. Twenty-five balloons with registering instruments were sent up in England and Scotland during the week, under the direction of Mr. W. H. Dines, at Pyrton

Hill, Oxon, and at Crinan, on the west coast of Scotland; Mr. J. E. Petavel, at Manchester University; Captain C. H. Ley, R.E., at Sellack, Herefordshire; and Mr. C. J. P. Cave, at Ditcham Park, Petersfield. Fourteen of the registering instruments have been found. Prof. W. E. Thrift also sent up a number of pilot balloons from Dublin. Nearly all the balloons drifted to the eastward, but several which reached a fair height fell within twenty miles of their starting point. The heights ranged up to more than 12½ miles, the average being about 7½ miles. The records showed that above 7½ miles the temperature remained almost unaltered with change of height.—Discussion of the meteorological observations at the British kite stations, session 1906–7: Miss M. **White**, T. V. **Pring**, and J. E. **Petavel**. The authors found that the temperature gradient varies with the direction and the velocity of the wind, and also with the amount of clouds, being greatest for a north-west wind, and on clear and fine days. It appears that the direction of the wind alters at high levels, rotating in a clockwise direction; thus a south wind tends to become more westerly.

December 18.—Dr. H. R. Mill, president, in the chair.—The possibility of a topography of the air, based on balloon observations with special theodolites: Capt. C. H. **Ley**. The author gave the results of his own observations in Herefordshire in connection with the international balloon ascents which were carried out during the past summer. His method of observing is based on the direct estimation of the range of the balloon from its apparent diameter as measured by cross threads in a telescope; the range being thus determined, an altitude and azimuth are read, and the position if the balloon fixed and plotted on a map. The author, in conclusion, states that the varying topography of the earth's surface produces disturbances in the atmosphere with effects which are transmitted throughout the lower and middle strata; and that the general effect on a current is to increase its velocity over a hill and decrease it over a valley, and this is especially the case with the vertical velocity. The origin of the phenomena is to be sought in the mechanical effect of obstruction of the lowest stratum, but there are probably various ensuing complications which may accentuate the result. The measurement of these effects can be carried out by a topography of the air made in any locality.—Indications of approaching frost: R. **Strachan**. For the purpose of making forecasts, the dry and wet bulb thermometers should be noted at or after sunset, or at 9 p.m., and the amount of cloud at the time, and during the forepart of the night if convenient. The dew point can be found by reference to hygrometrical tables. When the dew point is at or below 32° frost is in evidence, but may be evanescent, due to a rise of temperature, with change of wind, rain, or overcast sky. Even when it is above 32°, if the sky is clear it is possible that the temperature on the ground will become low enough for frost to form. Thus the evening observations should lead to a good idea of what may happen during the night.

Royal Microscopical Society, November 20.—Lord Avebury, president, in the chair.—*Exhibits.*—Conrad **Beck**: Two specimens under microscopes of photographic plates prepared by the Lumière starch-grain process for colour photography. One specimen had been exposed and the other had not. The starch grains, which were about 1/2000-inch in diameter, were stained red, violet, and green. If the object-glass of the microscope showing the unexposed plate be racked out of focus, so that the colours be blended, a very close approximation to white light is obtained. If the objective be only partially out of focus, patches and channels of colour are visible, due to the fact that the coloured grains are not sufficiently intermingled. These patches are what were seen under the microscope exhibited; to see the individual grains a much higher power than the ¼-inch used would be required.—C. L. **Curties**: Two inexpensive microscopes. The first, termed the "nature-study" microscope, was mounted on a heavy square foot. It was non-inclinable, and for observing large objects the stage and mirror could be removed and the specimen placed on the flat base. The other instrument, named the "meat examiner's" microscope, is of similar design, but the stage has grooves on its upper surface, from front to back, of a pitch equal to the field of view of a 1-inch objective; a compressor having points projecting from its under side to fit into the grooves is supplied; by sliding the compressor in one groove and then in the next, until the whole length has been traversed, the entire specimen can be examined without going over the ground two or three times.—J. T. **Pigg**: Photomicrographic lantern-slides from nature, showing the various stages in the development of the fern spore from its germination to the mature frond with its fructification.—E. **Moffat**: A new form of filter for agar and other media.—*Papers.*—The François Watkins microscope: E. M. **Nelson**.—Mercury globules as test objects for the microscope: J. W. **Gordon**.—Light filters for photomicrography: E. **Moffat**.—Demonstration of the use of colour photography in metallurgy: E. F. **Law**. A number of photomicrographic lantern-slides were exhibited showing the brilliant colours produced on the polished surfaces of alloys by the varying degrees of oxidation caused by the heat-tinting process.

Physical Society, November 22. — Prof. J. Perry, F.R.S., president, in the chair.—Specimens of singing sand from New England: S. **Skinner**. The specimens shown were from two sea-beaches in New England, one at Manchester, Mass., and the other near Small Point, Maine. The beaches are alike in character in being surrounded by hard rock walls and in not having streams which might bring silt flowing through them. The sands are consequently very clean and free from small particles, and this especially so after each tidal washing. The sand consists chiefly of angular clear quartz fragments. Mr. Skinner has been able to verify most of the facts observed by Mr. Carus Wilson (NATURE, 1891), viz.:—(1) the sounds are best obtained by plunging a hard plunger into a glazed cup containing the sand; (2) after a time the production of the sounds becomes difficult; (3) the sounding may be restored by washing, which presumably removes fine powder formed by attrition between the particles; (4) it is necessary that the displacement of the sand by the plunger should occur easily. If there is resistance due to the shape of the vessel, or due to clogging by dust, the sounding is stopped. The theory put forward in "Sound" by Profs. Poynting and Thomson seems a reasonable explanation.—A micromanometer: L. **Bairstow**. The instrument exhibited was one of two which are in regular use at the National Physical Laboratory for measurements of pressures due to air currents. When the pressures on the two sides of the gauge are balanced, the whole of the liquids employed are in their zero positions, and errors due to capillarity and viscosity are avoided. The gauge exhibited has a sensitiveness of 1/10,000th of an inch of water and a range of three-fourths of an inch of water. The gauge is slightly sensitive to temperature due to the expansion of the castor-oil used, but the changes are small and easily allowed for by taking time readings of the zero. The gauge is not suitable for rapidly varying pressures, as considerable distortion of the oil surface leads to an irregularly displaced zero.—A diabolo experiment: C. V. **Boys**. The diabolo spool exhibited has the peculiar merit that no one can spin it. It is based upon the following principle. Either the ordinary spool of commerce, which has its moment of inertia about its axis of rotational symmetry a minimum, or a spool not generally made which has the corresponding moment of inertia a maximum, has stable rotation about this axis or about a transverse axis, *i.e.* if it is temporarily rotating about an axis inclined to one or other, it will tend to shift its momentary axis of rotation and gradually settle down so as to spin about one or other. If, however, the spool is so proportioned that the moment of inertia is identical about any axis, it has no tendency to spin stably about any particular axis, and the axis of rotation wanders about so rapidly that it cannot be spun. A heavy conical sheet projecting equally on either side of the vertex, the semi-vertical angle of which is equal to $\tan^{-1}\sqrt{2}$, has this property, but such an ideal construction is impracticable. All added matter beyond the sheet in the direction of the axis makes the momental ellipsoid more prolate, while any outside the sheet makes it more oblate. Treating,

then, the ideal cone as a skeleton, and clothing it with matter within and without, a material double hollow cone may be made of the form of a diabolo spool, but with the dynamical properties of a sphere. It is preferable, however, to make the spool with an axial hole and with a slight preponderance of moment of inertia about its rotational axis. It will then spin perfectly. It may, however, be easily adjusted by the insertion of a stick, which is cut off of such a length as to make the moments of inertia equal, as tested by suspension from a torsion wire.—A gyroscope illustrating Brennan's mono-railway: Prof. H. A. **Wilson.** A gyroscope is mounted in bearings so that it can spin about a horizontal axis and precess freely. The gyroscope is further mounted at the top of a rectangular framework. The axis of spin of the wheel is first placed at right angles to the plane of the framework. Attached to the vertical axis about which the precessional motion occurs is a short crank with a spiral spring attached, so that when precession occurs in any direction the precessional couple is increased and the top returns towards its initial position. The oscillations of the gyroscope about its mean position become continually larger until the stability of the arrangement disappears.

Zoological Society, November 26.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—Some new and little-known Araneidea: Rev. O. **Pickard-Cambridge.** Eleven species were noted or described and figured:—one from Lagos, Portugal; three from Cape Colony, South Africa; one from Mashonaland; five from the Canaries; and one from Old Calabar. Seven species were described as new to science. Five of the spiders had been accidentally imported to England in packages of bananas.—New species of beetles of the cryptocephaline division of the family Chrysomelidæ from tropical South America: M. **Jacoby.**—The correlation of certain modifications of the limpet-shell (*Patella vulgata*) with definite environmental conditions: E. S. **Russell.** The method adopted by the author had been to measure the dimensions of a large number of shells from one environment and to compare them with similar measurements of shells from a second environment. The author had found the limpet a suitable animal for such investigations, as all limpets above 15 mm. "home" accurately. Limpets from high-water localities were found to be larger, broader, and higher, but narrower in proportion than those from low-water localities. Limpets from exposed localities were lower, narrower, thicker, and more irregular in outline than those from sheltered spots. On the area from which the shells were collected two types occurred, a "rough" type with strong coarse ribs and irregular margin, associated with rough stones, and a "smooth" type on polished stones.—Anatomy of the batrachian family Pelobatidæ: F. E. **Beddard.**—The Microlepidoptera of Tenerife: Lord **Walsingham.**—Dates of publication of the separate parts of Gmelin's edition (thirteenth) of the "Systema Naturæ" of Linnæus: J. **Hopkinson.** The paper stated that the first volume of this edition, containing the animal kingdom, was in seven parts, with a date, 1788, in the first part only, but that there was internal evidence of a later date of issue of subsequent parts. Investigations in the library of the British Museum had revealed the years of publication with some indication also of the period of the year in which each part appeared. The dates were:—part i., 1788; parts ii. and iii., 1789; parts iv. and v., 1790; part vi., 1791; part vii., 1792. The second volume, containing the vegetable kingdom, was in two parts, and the date of issue of part ii. had been found to be 1792. Contemporary authorities were given for the dates.—A small collection of Mammalia brought from Liberia by Mr. Leonard Leighton: R. I. **Pocock.** The paper recorded the presence in Liberia of two mammals hitherto unknown from that locality, and contained descriptions of one species of Genet and one Linsang new to science.

December 10.—Sir Edmund G. Loder, Bt., vice-president, in the chair.—The origin of the mammal-like reptiles: Dr. R. **Broom.**—A revision of the African silurid fishes of the subfamily *Clariinae*: G. A. **Boulenger.**—A new species of hæmogregarine from the blood of a Himalayan lizard, *Agama tuberculata*, from Kasauli, India: Prof. E. A. **Minchin.**

Society of Chemical Industry, December 2.—Mr. R. J. Friswell in the chair.—The estimation of naphthalene in coal gas and spent oxide of iron: C. J. **Dickenson-Gair.** The methods of estimation described are (1) the acetic acid method; (2) the re-precipitation method.—Note on the influence of formal on the properties of *Funtumia elastica*: Dr. P. **Schidrowitz** and F. **Kaye.** The authors find that the rubber obtained from the latex, treated by formal, although less elastic and resilient than that obtained by other means, was extraordinarily tough. They suggest that a rubber of this character might be particularly suitable for some purposes—*e.g.* for the covers of motor tyres—where toughness is of relatively greater importance than resiliency, and that it may in the future be found desirable to use different methods of coagulation for the same latex according to the purpose for which the rubber is intended.—Polarimetric determination of sucrose: F. **Watts** and H. A. **Tempany.** The authors have investigated (1) the effect of basic lead acetate on the optical activity of sugar solutions; (2) the effect of clarification with basic lead acetate on cane juice.—Niam fat: Dr. J. **Lewkowitsch.** Niam fat was obtained from the seeds of *Lophira alata*, Banks, a tree indigenous to Senegambia, Sierra Leone, and the Egyptian Soudan. The fat, freed from extraneous matter, forms 41 per cent. of the kernels. It is a soft, buttery mass melting at 24° C., and is used by the natives for culinary purposes and as a hair oil.

Entomological Society, December 4.—Mr. C. O. Waterhouse, president, in the chair.—*Exhibits.*—Dr. G. C. **Hodgson:** A number of examples of *Anthrocera trifolii*, collected on the same ground in Sussex, and showing a wide range of variation, including three fine melanic forms, and several showing six spots on the upper-wings.—W. J. **Kaye:** A specimen of *Papilio thoas thoas*, with the central portions of both tails removed, apparently by a narrow-billed bird. The injury appeared so symmetrical that it was thought likely that the specimen was an abnormality, but microscopical examination showed that this was not so.—The **President:** Two photographs of an African locust, which had apparently caught a mouse and was preying upon it. The specimen was found in the Congo State.—R. S. **Bagnall:** Notes on many species of Coleoptera, Thysanoptera, and Aptera from Northumberland, Durham, and Scotland, of which ten were new to Britain.—L. W. **Newman:** A long and varied series of *Ennomos autumnaria* (*alniaria*); a series of *Polia xanthomista* (*nigrocincta*), bred from ova and fed on carrot, the specimens unusually large (N. Cornwall); three pairs of hybrid *Notodonta ziczac* ♂ × *N. dromedarius* ♀, = *N. newmani*, Tutt; three very fine *Xylina conformis* bred by Evan John, S. Wales; three cocoons (*in situ*) of *Dicranura bicuspis*, collected wild in Tilgate Forest; and a fine melanic ♂ *Oporabia dilutata*, taken wild in Bexley Woods, 1907, this being the first melanic specimen of the species reported from Kent.—Dr. F. A. **Dixey:** Male and female specimens of a new Belenois allied to *B. zochalia*, Boisd., but quite distinct from the *zochalia* group. These were captured by Mr. Wiggins in the Tiriki Hills, north-east of the Victoria Nyanza.—*Papers.*—(1) The natural enemies of *Bombyx rubi* in Scotland; (2) note in further illustration of the convergence of Limenitis (Basilarchia) in America: Prof. E. B. **Poulton.**—The rest attitude of *Hyria auroraria*: J. C. **Moulton.**—The family tree of moths and butterflies, traced in their organs of sense: A. H. **Swinton.**—Notes and descriptions of Pterophoridæ and Orneodidæ: E. **Meyrick.**—Studies on the Blattidæ: R. **Shelford.**—Notes on the bionomics of British East African butterflies: Rev. K. St. A. **Rogers.**

Geological Society, December 4.—Sir Archibald Geikie, K.C.B., Sec.R.S., president, in the chair.—The faunal succession in the Carboniferous Limestone (Upper Avonian) of the Midland area (north Derbyshire and north Staffordshire): T. F. **Sibly.** The area is the periclinal mass at the south end of the Pennine anticline. The series exposed constitutes an expanded development of the Dibunophyllum zone. The most extensive section shows a thickness of 1500 feet. Three subzonal divisions are distinguished:—D_3, subzone of *Cyathaxonia rushiana*; D_2,

subzone of *Lonsdalia floriformis*; D_1, subzone of Dibunophyllum θ. An abnormal development of the Lonsdalia subzone forms a conspicuous local feature in parts of the western area. A local unconformity occurs in the eastern part of the area. A close similarity exists between the Dibunophyllum zone of the Midland area and that of North Wales. A comparison of the Dibunophyllum zone of the Midland with that of the S.W. province brings out important differences:—(*a*) the brachiopod fauna of the Lonsdalia subzone of the Midland province is richer than that of the equivalent part of the S.W. sequence; (*b*) the Cyathaxonia subzone of the Midland province is practically undeveloped in the S.W. province.—Brachiopod homœomorphy: *Spirifer glaber*: S. S. **Buckman.** The smooth, catagenetic stage of shells may have been attained by the loss of distinctive features, pointing to polygenetic origins. The series of shells figured by Davidson as *Spirifera glabra* do not all agree in being smooth. There is evidence that some forms ranged under this species are Reticulariæ (M'Coy). The use of the generic name Martinia for various smooth Spiriferids becomes unjustifiable. The author restricts the genus Spirifer, and allocates several British and foreign species among the genera Fusella, Choristites, Trigonotreta, Brachythyris, Martinia, and Reticularia.

Linnean Society, December 5.—Prof. W. A. Herdman, F.R.S., president, in the chair.—A series of specimens of *Spartina townsendi*, representing different stages of development and tall and dwarf forms, and for comparison also typical specimens of *S. alterniflora* and *S. stricta*: Dr. O. **Stapf.** The specimens of *S. townsendi* and *S. stricta* were collected by the exhibitor in the Isle of Wight; those of *S. alterniflora* near Millbrook Station in Southampton Water.—A collection of plants from Gunong Tahan, Pahang: H. N. **Ridley.**—Report on the Alcyonaria of the Sudanese Red Sea: Prof. J. A. **Thomson** and J. M. **McQueen.** The collection was made in 1906 by Mr. Cyril Crossland, from Suakim, Khor Dongola, and nine other localities, and includes three species of Stolonifera, eighteen of Alcyonacea, one being new, and four of Pseudaxonia.—Report on the Crinoidea of the Sudanese Red Sea: H. C. **Chadwick.** The collection consisted of six species, only two of which had been previously recorded from the Red Sea.—Notes on some marine algæ from the Red Sea: Prof. R. J. **Harvey-Gibson.** From material collected by Mr. Cyril Crossland in 1904 and 1905, under the direction of Prof. Herdman, F.R.S. The total number is thirty-five species; twelve belong to the Chlorophyceæ and as many to the Phæophyceæ, with eleven Rhodophyceæ. In an appendix the following phanerogams were mentioned as having been collected at the same time:—*Cymodocea nodosa*, Aschers., *Halophila stipulacea*, Aschers., *Najas major*, All., and fragments of *Salicornia fruticosa*, Linn.—Report on the Hydroida of the Sudanese Red Sea: Miss L. R. **Thornely.**

Mathematical Society, December 12.—Prof. W. Burnside, president, in the chair.—A formula in finite differences and its application to mechanical quadrature: S. T. **Shovelton.**—Weierstrass's E-function in the calculus of variations: A. E. H. **Love.**

Institution of Mining and Metallurgy, December 19.—Prof. William Gowland, president, in the chair.—The assay of telluride ores: G. T. **Holloway** and L. E. B. **Pearse.** The authors have, in view of the difficulty experienced by assayers in the determination of the precious metals in ores containing tellurium and selenium and the discrepancies observable between duplicate assays by different assayers, endeavoured to ascertain how and why, and in which portion of the assay work, the losses occur, and what means should be adopted to prevent them. The possible sources of loss appear to be as follows:—volatilisation during roasting; volatilisation and slag loss in the scorification assay; volatilisation and slag loss in the crucible assay; loss by volatilisation or in the slag in scorifying the lead button obtained in the scorification or crucible assay; or loss by volatilisation and absorption during cupellation. The paper contains details of a number of actual assays, and gives much valuable information in regard to the methods adopted and the results obtained.—A cheap form of cyanide plant: C. **Hunter.** A description of some cyanide plants of a light and portable nature actually supplied to small mining propositions in Rhodesia, with copies of the contracts and detailed specification. The cost of running such a plant is also stated.—The deep leads of Victoria, or the Cainozoic buried auriferous river deposits: H. L. **Wilkinson.** A review of the buried auriferous gravel deposits occupying the beds of ancient rivers once forming the drainage channels of Victoria at the period when large areas were covered by Pliocene seas. These include the Loddon, Avoca, Campaspe, Smythesdale-Pitfield, Stawell, and Ararat leads and their tributaries, and cover the districts of Ballarat and Bendigo. The author points out the effects of enriching belts in aggregating the rich portions of a lead and other factors determining the quantity of alluvial gold in the wash. At the end of the paper are several pages of tabular matter relating to the working costs of alluvial mines.

CAMBRIDGE.

Philosophical Society, November 11.—Dr. Hobson, president, in the chair.—A critical description of three cases of single hypogastric artery in the human fœtus: Dr. **Duckworth.**—The inheritance of white in poultry: R. C. **Punnett.**—Sexual phenomena in the free-living nematodes (preliminary note): F. A. **Potts.** The paper commenced by summarising the work of Maupas, and emphasised the interest and importance of the supplemental males found in the hermaphrodite species. These are chiefly remarkable for their withdrawal from the economy of the species, though in no sense degenerate, or unfitted for reproduction. Confirmation of Maupas's results was drawn from the study of a species of Diplogaster; some details of the culture methods used were given, and it was pointed out that this species shows that a race propagating exclusively by self-fertilisation does not of necessity show signs of degeneracy.

November 25.—Dr. Hobson, president, in the chair.—The orientation of 3:5-dichloropyridine: Dr. **Sell.**—The action of metallic magnesium on certain aliphatic acids, and the detection of formic acid: Dr. **Fenton** and H. A. **Sisson.** In a previous communication (Trans. Chem. Soc., 1907, 687) it was shown that both carbonic and formic acids may be reduced by means of metallic magnesium to formaldehyde. Experiments have now been undertaken with the object of ascertaining whether an analogous reduction can be effected in other acids, and the results so far obtained appear to indicate that this is only possible in the lower members of a series. Further, it is shown that this reduction by means of magnesium affords a characteristic and fairly delicate test for formic acid, the special reactions for formaldehyde being of a far more positive character than those for formic acid.—Some colour-reactions of organic acids with phenols: Dr. **Fenton** and G. **Barr.** Remarkably brilliant colour-reactions are often obtained when certain organic acids are treated with phenolic compounds in presence of strong sulphuric acid, and it appeared desirable to tabulate the results obtained with some of the less common acids in order to ascertain whether the reactions might be employed for the purpose of preliminary identification. By comparing the colours obtained in this way with two or more phenols, information of a positive character may often be obtained. The method has the advantage of being applicable, not only to the acids themselves, but also to their salts or esters, and is useful for provisional identification when only minute quantities of the substance are available.—Contributions to the knowledge of the oxaloimidochlorides: S. **Ruhemann.**—The absorption spectra of collidine and 9-chlorcollidine: J. E. **Purvis** and W. H. **Foster.** The curve obtained from a study of collidine showed that it was very similar to that of pyridine and lutidine previously studied by Hartley and by Baker and Baly. The differences were that there was a slight shift of the band towards the red end of the spectrum, and also that the persistence of the band was decreased a little less than that of lutidine and pyridine.—The decomposition and nitrification of

sewage (1) in alkaline solution, (2) in distilled water: J. E. **Purvis** and R. M. **Courtauld.** The results showed that after incubations extending over eight weeks there were only small quantities of nitrates produced; also that (1) there were smaller quantities of nitrates produced in the alkaline solution than in the non-alkaline; (2) a larger comparative increase of the free ammonia in the alkaline than in the non-alkaline solution; and (3) a progressive diminution in the total ammonias.—The influence of light and of copper on fermentation: J. E. **Purvis** and W. A. R. **Wilks.** The results showed that fermentation under sterilised and non-sterilised conditions in glass vessels under the influence of various spectral colours, as well as of white light, was not very seriously influenced. The most marked effects were in differences in the acidities of the fermented wort; the fermentations under the influence of red rays were more acid than those in the white light, but the differences in the numbers obtained from the optical activities were not sufficiently marked to draw definite conclusions. The influence of copper on the fermentation was very marked. Very small quantities were sufficient to cause great differences in the numbers obtained from the optical activity, the copper oxide reducing power, the attenuation, and the acidity.—Resolution of optically active ammonium salts by means of tartaric acid: H. O. **Jones.** —Studies on platinocyanides: L. A. **Levy.** The crystals of barium platinocyanide may be obtained in two forms, which exhibit a great difference in physical properties—notably in their fluorescence and colour. The present communication contains an account of the author's experiments on the nature of the two varieties and the fluorescence exhibited by them.—Orientation of substituted bromanilines: J. R. **Hill.**—The solutions of ordinary linear differential equations having doubly periodic coefficients: J. **Mercer.**

DUBLIN.

Royal Dublin Society, November 19.—Prof. Sydney Young, F.R.S., in the chair.—The synthesis of glycosides: some derivatives of xylose: H. **Ryan** and G. **Ebrill.** By the action of acetyl chloride on xylose in a sealed tube acetyl-chloro-xylose was obtained. The substance, which crystallised well, melted at 101° C. From it the xylosides of α-naphthol and carvacrol, and the tetracetyl derivative of xylose were prepared. βα-Naphthyl-xyloside was formed by addition of acetyl-chloro-xylose to a solution of potash and α-naphthol in absolute alcohol. It crystallises in long needles, which melt at 192° C. to 193° C. The substance is soluble in alcohol, acetone, and acetic ester, and almost insoluble in ether, carbon bisulphide, chloroform, and petroleum ether. It does not reduce Fehling's solution. Emulsin has no action on it. In a similar manner acetyl-chloro-xylose was converted into carvacryl-xyloside. The latter substance crystallises in needles, which are soluble in alcohol, ether, chloroform, acetic ester, and acetone, but are insoluble in carbon bisulphide. Its melting point is 105° C. Like the corresponding α-naphthyl compound, it reduces Fehling's solution only after inversion by hot dilute acids. Tetracetyl-xylose, which was obtained by the action of silver acetate on acetyl-chloro-xylose, is a crystalline solid which melts at 119° C. (uncorr.).—The radio-activity of sea-water: J. **Joly.** Examination of five samples of sea-water from various points round the Irish coast seems to show that when care is taken not to precipitate the radium in a non-emanating form when concentrating by evaporation (and for this purpose it is necessary to add a few c.c. of pure HCl when evaporating), the quantity of radium found is much greater than has been ascribed to sea-water hitherto. The larger values found may be in part due to suspended coastal materials. Experiments on mid-ocean waters are in progress.

MANCHESTER.

Literary and Philosophical Society, October 29.—Prof. H. B. Dixon, F.R.S., president, in the chair.—The atomic weight of radium: Dr. H. **Wilde.**—The production and origin of radium: Prof. E. **Rutherford.** An account was given of the historical development of our ideas in regard to radium. On the disintegration theory, radium is regarded as a substance undergoing slow spontaneous transformation with a period of about 2000 years. In order to account for the existence of radium in minerals of great age, it is necessary to suppose that radium is produced from another substance of long period of transformation. There is a genetic connection between uranium and radium, for investigation has shown that the amount of radium in minerals is in all cases proportional to their content of uranium. If this be the case, radium should gradually appear in a preparation of uranium, initially freed from radium. No such growth of radium has been observed over a period of several years, although a very minute growth of radium can be easily detected. This is not necessarily inconsistent with the disintegration theory, for if one or more products of slow transformation exist between uranium and radium, no appreciable growth of the latter is to be expected in a short interval. A search for this intermediate product has recently proved successful. Boltwood found that a preparation of actinium, initially freed from radium, grew radium at a constant and rapid rate. Boltwood at first considered that actinium was this intermediate product, and that actinium changed directly into radium. The growth of radium in actinium solutions was confirmed by the author, who had commenced experiments in that direction three years before. The experiments showed, however, that actinium did not, as Boltwood supposed, change directly into radium. By a special method, a preparation of actinium was obtained by the author which showed no appreciable growth of radium over a period of 240 days. The growth of radium, if it occurred at all, was certainly less than 1/500th of that ordinarily observed. In another case, a solution of actinium was obtained which produced radium faster than the normal. These results are completely explained by supposing that a new substance of slow transformation is present with actinium, and this substance is transformed directly into radium. This parent of radium has distinct chemical properties, which allow it to be separated from both actinium and radium. The absence of growth of radium observed in the actinium solution mentioned above is due to the fact that, by the special method, the parent of radium had been completely separated from the actinium. In recent letters to NATURE, Boltwood confirmed the results of the author, and described a satisfactory method of separating the radium parent from actinium. He has shown that this new body, which he proposes to call "ionium," gives out α and β rays, and has the chemical properties of thorium. The Royal Society recently loaned the author the actinium residues from about a ton of pitchblende. These residues contain the parent of radium, and experiments are in progress to isolate and concentrate both the actinium and ionium in these residues.

November 12.—Prof. H. B. Dixon, F.R.S., president, in the chair.—(1) The cone of *Bothrodendron mundum* (Will.); (2) on the ulodendroid scar: D. M. S. **Watson.** In the former it was pointed out that the small hermaphrodite lycopodiaceous cone described by Williamson in part x. of his series of monographs on the organisation of the fossil plants of the Coal-measures had an axis which agreed very closely with the wood of a small stem of *Bothrodendron mundum*. On the evidence of the characters of the axis and of the sporophylls, supported by constant association of the cone or its characteristic megaspores with stems of *Bothrodendron mundum*, it was concluded that the cone in question was really that of *Bothrodendron mundum*. In the paper on the ulodendroid scar, the theory that ulodendroid scars were produced by the pressure of the bases of sessile cones was shown to present difficulties, *e.g.* cones large enough to have produced scars 6 inches in diameter were unknown, and it was difficult to see how the scars would have grown appreciably without becoming wider laterally than vertically, which was never the case. It was shown that all the ordinary features of a ulodendroid scar could be explained on the theory that it represented the base of a branch attached to the whole area of the scar.

NEW SOUTH WALES.

Linnean Society, September 25.—Mr. J. H. Maiden, vice-president, in the chair.—The genus Petalura, with description of a new species (Neuroptera: Odonata): R. J. **Tillyard.** This remarkable isolated genus is probably a relic of an ancient Australian odonate fauna, which is now being steadily displaced by an Asiatic invasion. *P. gigantea*, Leach, occurs round Sydney and on the Blue Mountains, and was described nearly a hundred years ago. It is about 4½ inches across the wings. The new species, *P. ingentissima*, is found in northern Queensland. It is the largest dragon-fly known to exist at present (about 6 inches across the wings), and seems to show connection with the huge Tertiary Gomphinæ which have been found in a fossil state. It is exceedingly rare, and becoming obsolete; the only two specimens known are the types.—The dragon-flies of south-western Australia: R. J. **Tillyard.** The district worked was that lying between Perth on the north and Cape Leeuwin on the south, which has a regular and abundant rainfall. It may be divided into two portions, the Darling Ranges with their running streams, and the low coastal strip with lagoons and marshes. The Odonata of the two portions were found to be very distinct. Twenty-six species were noted, of which six are new and very interesting forms (referable to the genera Synthemis [2], Austrogomphus, Austroæschna, Argiolestes, and Pseudagrion); four or five others are very rare, and the rest are common eastern species. Many of the species are black or nearly so, and seek protection on the burnt stumps or in the foliage of the "black-boys" (Xanthorrhœa), which are abundant everywhere.—Note on a glaucophane schist from the Conandale Range, Queensland: H. I. **Jensen.**—Chemical note on recent lava from Savaii: H. I. **Jensen.**—Revision of Australian Lepidoptera, part iv.: Dr. A. J. **Turner.** This paper continues the revision of the family Geometridæ, and is mainly concerned with the subfamily Sterrhinæ. When Mr. Meyrick revised this group in 1887, he recognised thirty-two species, referred to five genera; the present revision treats of one hundred and two species, ascribed to twenty genera. Five species, referable to the subfamily Hydriomeninæ (dealt with in the preceding paper), are also described as new.

October 30.—Mr. A. H. Lucas, president, in the chair.—The Tertiary limestones and foraminiferal tuffs of Malekula, New Hebrides: F. **Chapman.** These rocks form part of the collection made by Mr. D. Mawson in 1903. The paper deals with the Miocene and the post-Miocene rocks of Malekula, south of Santo. Trillina has been found to occur in the New Hebrides; this genus has already been proved to exist in South Australia and the Philippines, which thereby connects the south coast of Australia with the islands of east Australasia and portions of the East Indian Archipelago, along which line in Oligocene times there probably existed a shallow-water area where such forms could flourish. A new species of Alveolina found in the Malekula limestone had already been figured from Javan Miocene limestones. *Lepidocyclina angularis*, found at Malekula, and already known from Miocene limestone in the Loo-Choo Islands, off Japan, shows a further extension of the Miocene shore-line as far north as Japan.—A collection of dragon-flies from Central Australia, with descriptions of new species: R. J. **Tillyard.** The collection was made by Mr. J. F. Field, and is probably typical of the odonate fauna of Central Australia. Though well within the tropics, yet the locality exhibits no definite tropical forms. The 320 specimens examined comprise ten species; eight are common over Australia, two are new. One, *Lestes aridus*, is allied to *L. leda* and *L. analis*; the other, *Austrosticta Fieldi*, is the type of a new genus.—Memoir on a few heteropterous Hemiptera from eastern Australia: G. W. **Kirkaldy.** This memoir records the Heteroptera collected by Mr. A. Koebele and Dr. R. C. L. Perkins in Queensland, and by Mr. Koebele in New South Wales. Seven genera and twenty-five species are proposed as new.—The geographical significance of floods, with especial reference to glacial action: E. C. **Andrews.** The forms of roadside gutters and of miniature cañons admit of explanation, since the time occupied in their formation falls within decades. Storm-formed cañons show, in the initial stages, spurless trenches **U**-shaped in cross-section, the trench bases possessing deep basins. At a later stage these cañons show double slopes, the upper **V**-shaped, the base **U**-shaped, in cross-section. This lower contour represents the *flood* contour. In river valleys, along shore-lines, and in glacial cañons, forms similar to these occur. Along miniature cañons generally the flood alone does the corrosive work. The application of such truths to glacial cañons explains drumlin forms and other apparent anomalies.—Solandrine, a new midriatic alkaloid: Dr. J. M. **Petrie.** The alkaloid belongs to the atropine group, and resembles hyoscine. It differs from hyoscine in its aurochloride in not reddening phenolphthalein, and it yields atropic instead of tropic acid when hydrolysed. Though the exact constitution of the alkaloid has not been worked out, the results afford evidence of the existence of a tropeine alkaloid in *Solandra laevis*, for which the name solandrine is proposed.—Description d'une nouvelle Espèce d'Oxylæmus (Coleoptera: Colydiidæ): A. **Grouvelle.**

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