THURSDAY, NOVEMBER 30, 1911.

THE SCIENTIFIC STUDY OF MAMMALS.

The Age of Mammals in Europe, Asia, and North America. By Prof. Henry Fairfield Osborn. Pp. xvii+635, with illustrations. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 18*s.* 6*d.* net.

DURING recent years no branch of study has made more important contributions to biology than that of extinct mammals. It has not only led to a more satisfactory understanding of the mammals themselves and their relationships. It has also thrown unexpected light on the general processes of organic evolution and the problems of geographical distribution. The broad features in the secular development of several groups of mammals are now better known than the growth stages in the individual life-history of many common existing species; and the underlying principles are often discoverable from a consideration of the numerous recurring phenomena which are sufficiently well known for comparison.

The literature of the subject, however, has become so voluminous and scattered that the time has arrived for an exhaustive critical summary. The aimless casual descriptions of so-called new species and varieties can only be superseded by real contributions to science when the present position of the various problems is clearly understood. Zoologists, especially palæontologists, are therefore much indebted to Prof. H. F. Osborn for the great labour he has bestowed on his new work, "The Age of Mammals," which furnishes the necessary summary by a master-hand and forms a sure basis for future research.

Prof. Osborn's volume is intended for general scientific readers as well as for specialists. It is thus prefaced by an interesting introductory section on the principles of palæontology as illustrated by extinct mammals, and on certain related geological questions. The treatment is more or less historical, with full references to the original authors, and there are several explanatory diagrams and maps. A table of strata (Fig. 13) marking the periods of successive earth-disturbances which gave rise to various mountain-systems, is especially striking. During the "Age of Mammals," or Tertiary period, the Pyrenees, Swiss Alps, and Himalayas have been formed in the Old World, while the Rocky Mountains have originated in North America.

It is well known that mammals first arose during the Secondary period, or "Age of Reptiles," but remained insignificant and restricted in their range until practically all the dominant reptiles had passed away. Prof. Osborn alludes more than once to this apparently sudden world-wide extinction of the dinosaurs, ichthyosaurs, plesiosaurs, and pterodactyls which flourished until the end of Cretaceous times; but it is only to emphasise the inexplicable nature of the phenomenon. As he remarks,

"Reptiles are so sensitive to temperature that it is natural to attribute this extinction to a general refrigeration, but the flora shows no evidence of this either in Europe or America; nor is there evidence of any great geographic cataclysm on the surface of the earth, for the plant-life transition from one age to the other in the Rocky Mountain region is altogether gradual and gentle."

Whatever may have been the cause, so soon as the great reptiles had disappeared, small primitive mammals of the kind which arose in the Secondary period suddenly began to multiply, and spread both in Europe and North America, perhaps also in South America. Their remains are found in the Basal Eocene deposits. None of these animals, however, appear to be directly ancestral to more modern groups, the direct forerunners of which arrived both in Europe and North America from some undetermined region in the period of the Lower Eocene. This second mysterious migration furnished the source of the lemurs, insectivores, true carnivores, rodents, and perissodactyl and artiodactyl ungulates. A few of the primitive mammals still survived with them through the Eocene until the beginning of Oligocene times, most of them grown unwieldy in size, such as the herbivorous Coryphodon and Uintatherium, or the carnivorous Mesonyx; but their brain remained small and simple, and they could not compete with the higher mammals in which advance in brain-power accompanied progressive elaborations in the limbs and dentition.

During the Oligocene period, sabre-toothed cats, dogs, martens, pigs, and rhinoceroses became recognisable, both in Europe and North America, while the viverrines occurred in Europe, and the hares and primitive camels were characteristic of North America. Africa was then a separate land-area, the scene of the early development of hyracoids and proboscideans. In all regions there were certain precocious and aberrant types, such as the titanotheres of North America and Arsinoitherium in Egypt, which only flourished for a short time, without leaving descendants. At the beginning of the Miocene period the most noteworthy event was the connection of Africa with Europe, which allowed the proboscideans to spread over the whole of the northern hemisphere, where they flourished and increased in size. There were now true cats and bears, tapirs, and rhinoceroses, both in the Old and New Worlds; while by the end of the Miocene the horses had nearly become one-toed, and apes, antelopes, okapis, and horned deer had appeared, at least in the Old World.

By the end of the Pliocene period mammals had become much as they are now, though most of the groups were more widely distributed, and they comprised many large species which soon disappeared after the advent of man. From the early Eocene until the early Pliocene, South America had been an isolated land-area, on which mammals had developed into several strange groups of ungulates and the true edentates (sloths, armadillos, and ant-eaters). Before the end of the Pliocene, the emergence of the isthmus of Panama permitted some of these types to wander north into the southern United States, while the camels (llamas and alpacas), cats, dogs, deer, pigs, horses, and mastodons were able for the first time to spread to the southern continent. At the end of the Pliocene period

there is evidence of extensive desiccation in western North America, southern South America, north-central Africa, and central Australia; and physical changes which are not yet understood led to a glacial epoch in the northern hemisphere in Pleistocene times. These phenomena had doubtless much to do with the extinction of the large quadrupeds and the impoverishment of the mammal fauna. Civilised man has continued the destruction.

The whole of this fascinating story is told in detail by Prof. Osborn, who not only discusses the mammals themselves, but also describes the rocks in which their remains occur, and briefly notices the successive changes in geography which they indicate. His work is illustrated by numerous text-figures of skeletons, restored sketches of extinct mammals made by the American Museum of Natural History, photographs of scenery, and diagrammatic geological sections. As might be supposed, much of it is extremely technical, and to be used for reference rather than systematic reading; but it is enlivened throughout by a succession of interesting generalisations, which are all the more valuable as having been either suggested or confirmed by the author's own researches. The peculiar feature of Prof. Osborn's book, indeed, is its stimulating freshness, and he is to be congratulated on the impulse which it is certain to give to the studies with which it deals. A. S. W.

GEOGRAPHICAL DISTRIBUTION OF FERNS.

Die Geographie der Farne. By H. Christ (Basel) Pp. 357+3 maps. (Jena: Gustav Fischer, 1910.) Price 12 marks.

DR. CHRIST has produced a volume of remarkable interest on the geographical distribution of ferns, which forms a worthy companion to Schimper's well-known "Pflanzen-Geographie auf physiologischen Grundlage." The book has been arranged in a somewhat similar manner to Schimper's "Plant Geography," and is divided into two parts. The first consists of 136 pages, devoted to considerations of the effects of soil, climate, &c., on the distribution of ferns, and in the second part the ferns of the different geographical areas are described in detail.

To the general botanist, and more particularly to the ecologist, the first portion of the book has the greater interest. Ferns, unlike the flowering plants, though very widely distributed, are not universally found over the surface of the earth, since they are definitely limited as to their environment by the need for water, and though many species are remarkable for their capability of resisting desiccation, yet they are unable to grow where the rainfall is below a certain amount. Being in the main shade plants, their maximum distribution tends to follow the wooded areas of the globe; and the dry desert areas are almost destitute of ferns.

Though mainly found growing on humus, some ferns are affected by the nature of the substratum, and this is especially the case with calcareous soils. It may often happen, however, that chalk-shunning ferns may be found on that formation owing to the depth of humus by which the calcareous soil is overlaid.

Striking examples of ferns which avoid the chalk are afforded by *Asplenium septentrionale* and by the world-wide *Pteridium aquilinum*—the bracken fern—which is found in both hemispheres, from "the equator to the poles." *Asplenium viride* and *Cystopteris montana*, on the other hand, may be cited as examples of species characteristic of the chalk. Halophytes, again, have their fern representatives, and *Acrostichum lomarioides* from the brackish swamps of tropical America, and *A. aureum*, which grows in the Rhizophora estuaries, are striking examples of this type of plant.

Then again there are the fresh-water swamp ferns, such as the widely distributed *Dryopteris thelypteris* and the well-known water fern, *Ceratopteris thalictrioides*.

The majority of ferns are perennial, but there are a few exceptions, of which Ceratopteris is one, and also the annual fern, *Anogramma leptophylla*.

Ferns afford parallels to Phanerogams in their choice of habitats and relations to climatic conditions, and also in their external forms they provide counterparts to other types of vegetation. We find them, for example, as epiphytes; tree ferns; scramblers or bramble ferns (Gleichenia, Odontosoria, &c.); twining ferns, such as *Blechnum volubile;* tendril climbers (*Lathyropteris madagascariensis*), and creeping epiphytes or rhizome climbers, which are well illustrated by the aroid-like *Oleandra neeriformis*.

The general biological features of hygrophytic ferns, hairs, secretions, storage organs, &c., are also described with a wealth of illustration.

An interesting section is devoted to the description of the xerophytic types, many of which have their home in the Andes, on the same lines as that for the hygrophytes. Two characteristic forms may be recognised: the Cheilanthes type, with short rhizome, deep roots, and small hairy pinnæ, and the Elaphoglossum type, where the rhizome is thick and creeping and the leaves tongue-like, leathery, and simple. The genera Cyclophorus, from the Old World, and Elaphoglossum, centred in the Andes, afford the most striking examples.

Ferns of high alpine or arctic regions are few, and, as compared with the phanerogamic vegetation of such situations, are not particularly characteristic. Cryptogramma and Woodsia, however, may be cited as typically northern alpine forms, while *Polystichum mohrioides* is a typical antarctic-andine species. One of the highest known species is another Polystichum, *P. Duthei*, from Kumaon, which occurs at an altitude of from 13,000 to 17,000 feet.

The bulk of the second part of the book is concerned with the fern flora of the different geographical regions, but it is preceded by some very interesting pages dealing with general questions of geographical distribution, such as the effect of the Ice age and the relics of the fern flora of past ages. The distribution of several genera is outlined, but space does not permit of a review of this section of the book in further detail. Attention may, however, be directed to the remarkable case of distribution afforded by

the genus Pleurosorus, which is found as three scarcely differing forms in Southern Spain (*P. Pozoi*), South Chile (*S. papaverifolius*), and Australia (*P. rutaefolius*). These small xerophytic rock ferns may well be cited as examples of the simultaneous appearance of a species in widely separated localities.

There is but one fault to find with this otherwise excellent book, and that is that the illustrations, most of which are very good, have been inserted without any particular reference to the text, and some difficulty is experienced in attempting to find the figures which are intended to illustrate particular descriptions.

A. W. H.

OPHTHALMIC THERAPEUTICS.

An International System of Ophthalmic Practice. Edited by Dr. Walter L. Pyle. Therapeutics. By Dr. A. Darier. Translated by S. Stephenson. Pp. xiv+444. (London: Rebman, Ltd., 1911.) Price 17*s.* 6*d.* net.

THIS is the first volume of an "International System of Ophthalmic Practice," edited by Dr. Walter L. Pyle, of Philadelphia. Other volumes announced are on "Medical Ophthalmology," by Dr. Arnold Knapp, of New York; "Ophthalmic Diagnosis," by Dr. Charles H. Beard, of Chicago; "Pathology and Bacteriology of the Eye," by Messrs. Treacher Collins and M. S. Mayou, of London; "Affections of the Orbit and Accessory Cavities," by Dr. Christian R. Holmes, of Cincinnati; "Examination and Refraction of the Eye and Eye-strain," by the editor; and "Ophthalmic Surgery," the authorship of which is not stated. It will be seen that the scheme is comprehensive, and that the aim is essentially practical. The authors are men of established reputation, and may be relied upon to carry out their work ably, so that the system will form a valuable, if not indispensable, addition to the ophthalmologist's library. If the volumes reach the standard of the sample which we have before us we may confidently prophesy the financial success of the series.

Those who have read Dr. Darier's lectures and papers on ophthalmic therapeutics in their original form in French must have approached the present work with some misgivings. Dr. Darier is an enthusiast for *novae res*. He possesses in marked degree the mental agility of the Latin race, quick to appreciate new facts, eager to traverse new paths. True, he sometimes appears to the onlookers to skip rather than to run, but then he is an artist, and a savour of art is not without its uses in dealing with the science of medicine, a science which, though yet in its infancy, is called upon to perform the feats of mature development. Dr. Darier's enthusiasm often outruns discretion, but in this book it has been curbed by the "free editorial control" which has been exercised upon the manuscript. In the end we have a sound work on the treatment of diseases of the eye, which by virtue of the large space devoted to the discussion of new methods and new drugs, forms a useful adjunct to the formal text-book.

The subject is divided into two parts, general and special therapeutics. The first commences with a chapter on methods of diagnosis, devoted to such topics as serum diagnosis and the demonstration of spirochætes. Constitutional treatment is then dealt with, stress being laid upon the technique of hypodermic and intravenous medication and subconjunctival injections. The chapter on serum- and organotherapy will prove particularly useful to the ophthalmologist, who has perforce to obtain his knowledge of these matters second-hand. It might have been expanded with advantage, and a freer citation of original papers would have enhanced its value. The ophthalmologist cannot afford to ignore serum-therapy, which now has so large a place in medical treatment, but it is a two-edged weapon, and should be used with the utmost caution. Much space is devoted to photo-electro-, hydro-, mechano-therapy, X-rays, and radium; as a rule original papers are quoted, and the reader is left to draw his own conclusions. Of more value are the chapters on drugs—anæsthetics, analgesics, vaso-dilators, vaso-constrictors, mydriatics and cycloplegics, miotics and silver compounds; their virtues and vices and the modes of their application are quite well described.

In the section on special therapeutics, the diseases of the eye are dealt with seriatim in the manner of an ordinary text-book. Too little stress is laid upon old and well-tried methods, so that the reader is liable to obtain a wrong perspective. The book, however, is clearly intended for specialists who are capable of forming an independent opinion in these matters. It would be easy to criticise many of the statements, but those most open to attack are such as only time and extended experience can ultimately settle. They are topics of constant dispute in ophthalmic journals, where they can most suitably be ventilated. In discussing cataract, glaucoma, and so on reference has to be made to operative measures. It would have been better to have relegated these matters entirely to the volume on ophthalmic surgery, where they will doubtless be treated exhaustively. The cursory remarks are of little value; on the other hand, they do not occupy much space.

We can cordially recommend the book to the consideration of advanced students of ophthalmology, and they will be well advised to look out for the other volumes of the series.

PHARMACOGNOSY IN THE UNITED STATES.

A Text-book of Botany and Pharmacognosy, intended for the Use of Students of Pharmacy, as a Reference Book for Pharmacists, and as a Handbook for Food and Drug Analysts. By Prof. H. Kraemer. Fourth revised and enlarged edition. Pp. viii+888. (Philadelphia and London: J. B. Lippincott Co., n.d.) Price 15*s.* net.

ALTHOUGH in English text-books botany is not usually combined with pharmacognosy, it is undeniable that such a combination possesses for the student of the latter science the distinct advantage that much overlapping may be avoided, and that, by selecting medicinal plants to illustrate the botanical portion, the student, while studying botany, insensibly acquires a considerable amount of information con-

cerning economically important plants. This advantage has been utilised by Prof. Kraemer to the fullest extent; indeed, it might be considered by some to have been carried rather too far, for the section on the "Classification of Angiosperms" deals with medicinal plants only. The botanical portion of the work is well written and abundantly illustrated; it is characterised by the comparatively small amount of attention given to the lower forms of vegetable life, the algæ and fungi occupying only thirty-six pages, whereas in text-books of botany these two groups are usually treated in detail that is often considered unnecessary for the pharmacognosist.

Part ii., "Pharmacognosy," is subdivided into four chapters, dealing respectively with crude drugs, powdered drugs, reagents, and micro-analysis. As the first chapter comprises only 178 pages, and deals with a large number of crude drugs, it is evident that the space allotted to each can be but small. The descriptions of the drugs are accordingly very concise, and the methods by which those that are unorganised are produced have been perhaps unduly reduced, but the constituents have received careful and sufficient treatment. Thus the accounts of the production of such important drugs as aloes, catechu, guaiacum, rubber, &c., can convey to the mind of the student but an imperfect idea of the various steps in the processes and their effect upon the drug obtained. To these details a little more space might well be given without unduly increasing the size of the work. Credit, however, must be given to the author for including a large number of drugs of comparatively rare occurrence, and thus making this section of the work more complete than is usually the case with text-books designed for the use of the student. Chapter ii., dealing with powdered drugs, has also been much elaborated. In addition to those with organised structure, it includes a number of structureless drugs (aloes, myrrh, &c.), as well as a few definite chemical compounds. The key to their identification, based primarily upon the colour, is one of the most complete that has been published. The chapter is abundantly illustrated, and contains descriptions of the microscopical characters of so many drugs that it cannot fail to be of service to the experienced microscopist as well as to the student.

Chapter iv., "Micro-analysis," deals with the identification of the crystals found in drugs and their preparations by crystallographic methods, and the time has arrived when these methods must be adopted in the study of such crystals if any real progress in that direction is to be made. It is undeniable that at present the crystals observed in drugs are often very loosely described, and that their identification frequently rests on very insufficient grounds. This part also includes the description and illustration of the crystalline forms of a number of active constituents of drugs, such as brucine sulphate, codeine sulphate, cubebin, &c., and is to be regarded as suggestive (which is certainly the case) rather than as complete.

It will thus be seen that Kraemer's text-book is a valuable contribution to the literature of pharmacognosy. It shows how medicinal plants may be utilised in the study of botany; it deals with a large number of drugs; it gives instruction in their identification in the powdered state, and it suggests lines upon which microscopical investigation may be prosecuted. The author is to be congratulated on the success of his labours. HENRY G. GREENISH.

THE CHEMISTRY OF BLEACHING.

The Principles of Bleaching and Finishing of Cotton. By S. R. Trotman and E. L. Thorp. Pp. xii+347. (London: C. Griffin and Co., Ltd., 1911.) Price 16*s.* net.

THE book before us is an attempt to blend an account of the most recent advances in the processes of bleaching and finishing of cotton goods with an equally up-to-date account of the scientific principles which form the basis of these processes. Such an attempt is comparatively rare in connection with manufacturing processes, and on that account alone the book ought to be welcomed. But when, as we find, the attempt has been highly successful, the authors must be congratulated on having produced a work of great value to all concerned in this important industry.

The book opens with an account of the structure and composition of cotton fibre, the means of testing its strength, twist, &c., followed by an account of the carbohydrates, such as starch and the sugars which are of importance to the bleacher. A full account is given of the different kinds of water, and of the means of treating it so as to make it suitable for bleaching purposes. The importance of the quality of water supplied to the works is too often overlooked by the bleacher, who ought to know that good results in bleaching largely depend on the quality of water used, and that the pure white required for some goods cannot be obtained if certain waters are used.

One of the most interesting chapters in the book is that in which the influence of bacteria in bleaching is discussed. The authors' show that cotton may be infected with bacteria at almost every stage of its manufacture, and the principal causes are the following:—

(1) Impure water for steeping.

(2) Incomplete removal of protoplasmic constituents during bleaching.

(3) Allowing goods to lie about in a damp condition, especially in warm weather.

(4) Insufficient cleanliness of plant or buildings.

(5) The use of inferior materials, *e.g.* low-grade starches and glues.

(6) The careless storing of finished goods.

The results of bacterial damage are frequently coloured spots, each spot being a colony of the organism. Sometimes the whole piece of cloth becomes infected, and has the appearance of having been dyed. A piece of lace examined by the authors left the finisher apparently perfect, but subsequently developed a pink colour.

"A microscopic examination showed the presence of numerous very fine hyphæ interlaced with the cotton fibres, and subsequent plate cultures upon a starch medium similar to the dress used for the lace proved the presence of a chromogenic mould, which was

capable of producing the observed pink colour. The point was conclusively proved by infecting sound lace with the organisms."

Further, it was found that the presence of acid was necessary to develop the colour, which only appeared after about fourteen days. This explained how the goods were passed as perfect by the finishers. Naturally much space is devoted to the treatment of the cloth before the actual bleaching and to the materials and plant used in these processes. The importance of securing purity in the materials used is insisted on, and regular testing recommended. Full details are given of the Kiers used for lye boiling and washing, and there are excellent illustrations of the most improved forms of plant.

Much attention is given to the various bleaching agents, and particularly to bleaching powder. The controversy as to its composition is carefully considered, but cannot yet be said to be finally settled. Reference is made to the very recent work of R. L. Taylor (Chemical Society's Journal, 1910, p. 2541), who has shown that the action of carbon dioxide on bleaching powder liberates chlorine only and not hypochlorous acid, as had usually been supposed. On the other hand, S. H. Higgins maintains that hypochlorous acid does enter into the bleaching action (Chemical Society's Journal, 1911, p. 858).

Limitations of space will not allow us to refer to other portions of the book. Suffice it to say that the use of other bleaching agents, such as sodium hypochlorite ozone, sodium peroxide, potassium permanganate, &c., is referred to, and there is a full account of the bleaching by electrolytic solutions, and a discussion of the economy of the process. The book will be of special use to bleachers who have a sufficient knowledge of chemistry to understand the theoretical portions.

SYSTEMATIC PSYCHOLOGY.

A First Book in Psychology. By Prof. Mary Whiton Calkins. Pp. xvi+419. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 8*s.* net.

Erkenntnistheorie. Von Prof. E. Dürr. Pp. viii+362. (Leipzig: Quelle und Meyer, 1910.) Price 8 marks.

MISS CALKINS is well known among psychologists for her treatment of psychology as the science of selves rather than as the science of mental processes. In her view, the science is best treated as "a study of conscious selves in relation to other selves and to external objects—in a word, to their environment, personal and impersonal." The aim of the present book is to give a systematic account of the various psychological topics, ordinarily treated in introductory text-books, from this point of view. As might be anticipated, Miss Calkins is least successful in her method when dealing with perception, imagination, memory, and thought, although the special point of view gives an added significance to the facts, and brings a new interest for those students who have already become familiar with the ordinary descriptions. When dealing with the more individualising and active forms of consciousness—emotion, will, belief, and the religious consciousness—the author is able to benefit by her method to the full, and gives the impression of concreteness and reality so often missing in the descriptions of these aspects of conscious life. There is no chapter specially devoted to the nature of the self, but many facts generally given under this head are very fully discussed in a section on "Abnormal Psychology" in the appendix. This appendix forms quite a third of the entire volume, and contains masses of detail the enumeration and discussion of which might obscure the general line of argument. It adds very greatly to the value of the book, and is clearly arranged, and well provided with figures and diagrams. The final section contains a large number of good "review questions."

Prof. Dürr's book, though written from the psychological point of view, does at least equal justice to the metaphysical issues involved in the problem of knowledge. It is divided into three long chapters entitled, "Die Psychologie des Erkennens," "Die Wertlehre des Erkennens," and "Die Gegendstandslehre des Erkennens" respectively, and under each of these headings numerous subdivisions occur. The book cannot be accused of lack of system, and in some respects forms a compendium of philosophy with the historical and critical methods about equally represented. Its first hundred pages on the psychology of thought, however, lift it far above the ruck of ordinary philosophical text-books, and make it of the greatest value to the psychologist. The difficulties attending the various possible theories of outer perception and inner perception (introspection) are exhaustively discussed, though in small compass, and the peculiar psychological problem involved in the case of memory and recognition is clearly stated, and a solution of it attempted. Under the sub-heading "Thought," theories of abstraction, judgment, inference, and induction are briefly considered. Several paragraphs are devoted to the question of the relation of knowledge to belief. Notes at the end of the volume give the necessary references to current literature, and in many cases continue the discussion in greater detail. The one criticism to which the book is open is that difficulties are treated in too summary and dogmatic a fashion. For conversational classes or "seminars" in philosophy and general psychology, the book should prove invaluable. There is certainly no single book in English of a similar kind at the present time.

W. B.

OUR BOOK SHELF.

(1) *Introduction to Science.* By Prof. J. Arthur Thomson. Pp. vi+256.

(2) *Astronomy.* By Arthur R. Hinks. Pp. vi+256. (Home University Library of Modern Knowledge.) (London: Williams and Norgate, 1911.) Price 1*s.* net each.

(1) PROF. THOMSON has prepared an admirable introduction to the scientific section of the series of which he is joint-editor. He has an inspiring gospel to expound, and has proved himself a worthy apostle of it. Science stands for truth and righteousness, for exact observation, for progress at all costs, for that divine discontent with existing knowledge which stimulates persistent inquiry into the unknown, and

leads the true philosopher, in Sir John Herschel's words, "to hope all things not impossible and to believe all things not unreasonable."

The scientific mood, aim, and method are described by Prof. Thomson and illustrated by apt quotation from the works of active investigators. The relations of science to philosophy, art, religion, and practical life are dealt with; and the classification of the sciences forms the subject of a particularly valuable chapter. As is appropriate in a "Home University Library," the readers are assumed to come to the university with a certain foundation of preliminary knowledge; otherwise such a reference as that to "Bode's law of the relations of the planets, or Mendeléeff's 'periodic law' of the relations of the atomic weights of the chemical elements" would be unintelligible. Given this acquaintance with the broad principles of science, we can conceive no better first survey of the significance of scientific work than that which Prof. Thomson provides.

(2) Mr. Hinks has produced a volume which is decidedly superior to most popular books on astronomy, inasmuch as it is not merely a descriptive catalogue of the characteristics of celestial bodies, but a statement of leading results and a critical analysis of conclusions. The book breathes the spirit of the practical astronomer who can form his own opinion as to the value of observations and hypotheses. It suffers by comparison with some other volumes on account of the absence of illustrations; nevertheless, it is decidedly original in substance, and the most readable and informative little book on modern astronomy we have seen for a long time.

Physikalische Chemie der Zelle und der Gewebe. By Prof. Rudolf Höber. Dritte Auflage. Pp. xv+671. (Leipzig: W. Engelmann, 1911.) Price 17.25 marks.

THIS third edition of Dr. Höber's well-known work on the physical chemistry of the cell and tissues is widely different, both in extent and quality, from the modest little volume which first appeared in 1902, and interested physiological chemists as the evangel of the new lipoid theory of cell permeability promulgated by Overton and Hans Meyer.

Since that time the chemistry of colloids and of the relationships of colloids and crystalloids has made enormous strides, and the new edition is now in reality an interesting and fairly well up-to-date textbook of this domain of knowledge. It still shows, however, on account of the way the lipoid theory keeps cropping up everywhere, manifest traces of its origin, and the author is still an earnest and wholehearted believer in an ingenious theory which has not stood the test of advance of time and growth of knowledge.

Even this sturdiest champion of the lipoid theory is driven now to admit that the experimental findings can only be explained by following Nathansohn's postulations of a mosaic cell-membrane, in which the small stones represent the lipoids and the interstitial material, a protoplasmic cement which allows a varying degree of permeability to the ions. This is accordingly a kind of dual Maxwell's demon membrane, with one kind of demon at one kind of gate letting through the lipoid-soluble bodies, and a different class of demon at a different sort of gate letting through the water-soluble bodies, and those who desire salvation for the lipoid-theory by leaving it in possession of these two demons may be congratulated on having placed it where it is well-nigh unassailable, unless, indeed, someone discovers a substance which is soluble neither in water nor lipoids and yet can contrive to get into cells.

The portions of the book which do not treat of cell permeability are well and clearly written, and give a full presentation of the subject, which may be recommended for study to those interested in the confines of physical and bio-chemistry who possess already some acquaintance with both subjects. It is not by any means a book for beginners.

BENJAMIN MOORE.

Geologische Ausflüge in der Mark Brandenburg. By K. Hucke. Pp. 155. (Leipzig: Quelle und Meyer, 1911.) Price 3.20 marks.

THIS guide for the geological student and tourist, printed in the popular black-letter type of northern Germany, should find a ready appreciation among those who travel round Berlin. The descriptions of the various excursions are clear, and there is a touch of Walther's vividness here and there, as in the account (p. 13) of the general landscape on the withdrawal of the "inland ice." Not enough is made, perhaps, of the probability that large areas of this ice stagnated in the plain, and that the withdrawal, which deposited the ground-moraine, was mainly in a vertical direction.

The index does not always guide us to the attractive generalisations which the book contains, such as the origin of the numerous lakelets and the ancient courses of the streams (p. 107). When the visitor, however, reaches a critical district he is encouraged to look beyond the immediate landscape. Formations concealed at the surface are sought in quarries underground. An interesting account is given (p. 121) of the interglacial bed of red ochre near Dahnsdorf, resulting from the oxidation of dark green iron carbonates and humates. These were deposited by water, and were subsequently preserved by boulder-clay, as a stratum 30 metres thick. The dry channels known as Rummeln (p. 136) in the elevated region of the Fläming south of Berlin are attributed to torrents from the melting ice. A new interest is thus given to these pleasant features of a land that often seems monotonous. We are told that the horizontal sheep-tracks along their sides (Fig. 55) have been regarded as river-terraces.

In the gloom of the level forest-covered regions the huge Scandinavian erratics form features of themselves (Fig. 32). The numerous photographs that illustrate this handy volume are mostly provided by the author, who has certainly shown the wide variety of deposits that may be studied in the Mark of Brandenburg.

G. A. J. C.

Playbooks of Science: Chemistry and Chemical Magic. Pp. 150. *Mechanics and Some of its Mysteries.* Pp. 120. *Flying and Some of its Mysteries.* Pp. 138. All by V. E. Johnson. (London: Henry Frowde, Hodder and Stoughton, 1912.) Price 1s. 6d. each.

BOYS who are thoroughly interested in a well-chosen hobby are the cause of much less anxiety to their parents and teachers than those who are content to idle away leisure hours. The author of these little books has for his primary aim the provision of intelligent amusement, and on the whole he has made a successful appeal to the desire young people have "to try things." "Never be content merely to read about an experiment" is the advice offered at the beginning of each book, and it is probable that many boys will be led from the performance of the tricks described to the serious study of the phenomena observed.

The two books named first are almost wholly devoted to experiments, while the third is largely a descriptive account of the various attempts to evolve the perfect flying-machine.

Der Panamakanal. By Max D. Fiegel. Pp. viii + 183. (Berlin: Dietrich Reimer—Ernst Vohsen, 1911.) Price 4 marks.

MR. FIEGEL describes clearly the course of the canal now in process of construction by the United States Government; also the engineering works and machinery, and the commercial and political aspects of the enterprise. His book will provide German readers with an informative account of the position about a year ago of what in three years' time promises to be one of the most remarkable human schemes ever brought to a successful conclusion.

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 Weather of 1911.

SIR EDWARD FRY'S letter in NATURE of November 16, and Commander Hepworth's reply in the issue of November 23, prompt me to give expression to some ideas which I have been discussing with various meteorological friends during the last few months. What I have to say will not attempt an explanation of the phenomena of the remarkable summer and autumn of this year, but it will give an indication of the direction in which, for my part, I hope to look for an explanation of those phenomena.

I agree with Sir Edward Fry that the prevalence of anticyclones in a particular direction, or the continuance of given winds, are only part of the phenomena to be explained; I think, too, that the statement may be rightly understood in a sense slightly different from that which Sir Edward intended. I mean that this summer furnished a good deal of evidence for a proposition which includes the inference that the distribution of pressure is not in itself a complete explanation of the weather. I will state my proposition now, and afterwards explain why I make it. It is that the main outlines of the distribution of pressure are imposed upon the surface layers of the atmosphere by transmission from a region 9 or 10 kilometres high—a region which is above what may be called the physical laboratory, where rain and thick clouds are made—and that the phenomena of weather are due, not to the mere existence of the air currents which correspond with the distribution of surface pressure, but to their heterogeneity. Weather as represented primarily by rainfall is dependent on the convection of moist air, while pressure distribution is governed by changes which take place above or nearly at the top of the convective region of the atmosphere. In other words, the dynamics of the atmosphere is controlled in the upper air, while the physics of the atmosphere is a matter which concerns the lower layers.

The remarkable summer has provided evidence in support of this proposition by furnishing a number of examples of pressure distributions which might well have been rainy, and were not. The Coronation festivities were somehow preserved from the copious rainfall which, according to the pressure distribution, was their due. If pressure distribution is the cause of rainfall, 100,000 children at the Crystal Palace on June 30 ought to have got wet through, but they did not. There are many other instances of the same kind which I need not quote. Let us look at the matter from the other side.

Some time during the summer Mr. W. H. Dines sent to me the results of some work which he has done upon the correlation of various data for the upper air. Among them was the correlation coefficient between the variations of pressure at the surface and at the level of 9 kilometres. For certain groups of ascents it was so large as to show a close approximation to proportionality. That is, of course, not surprising, because the variations at the surface and at 9 kilometres are certainly not independent; but what was surprising to me was that the standard deviations of pressure at the two levels in the cases under investigation were very nearly equal. Thence it follows that the pressure variations at 9 kilometres level (with two-thirds of the atmosphere below it) are not merely proportional to the variations at the surface, but the same in magnitude; and as they are certainly transmitted to the surface, it follows, further, that the variations at the surface are practically accounted for by the variations that occur at 9 kilometres. We are accustomed to urge the importance of the study of the upper air for increasing our knowledge of meteorology; but, so far as I know, we have not recognised that it was so directly responsible for steering our surface air currents.

Mr. Dines's variations were those shown between the individual balloon ascents and their average. Looking into a series of charts for the upper air recently published by Prof. Rotch, I came upon another step in the proof. In the charts Prof. Rotch gives the average wind velocity at 30,000 feet (9 kilometres) and the atmospheric density there. The product of these two is about the same as for a point near the surface, whence it follows that for Blue Hill the pressure gradient at 9 kilometres, which is proportional to the product, is the same as for the surface; in other words, not only are the chronological changes transmitted to the surface from 9 kilometres, but the average pressure distributions are similarly transmitted. In a discussion at the Meteorological Office on October 23 I was reminded that these conclusions are not new. The inverse proportionality of velocity and density of air is known as Egnell's law; and the approximate constancy of pressure gradients up to 9 kilometres was pointed out to the British Association by Gold and Harwood in 1909. But the idea of looking to the level of 9 kilometres for the outlines in full scale of our surface distribution of pressure is new; and it seems to me to be possibly the beginning of a new era in the endeavour to explain such phenomena as those of the past summer.

I cannot, at this stage, give particulars as to the details of the application of so general a proposition to special cases, such as circular revolving storms, the northern sides of which may be confined to the lower strata, nor can I say whether the application of the proposition is limited to certain parts of the world. I think it must be. It will be remembered that M. Teisserenc de Bort computed mean isobars at 4 kilometres for January and July that showed the average circulation of the upper air in each hemisphere as a great cyclonic depression, with centres at the poles. It is not likely that there is any great change of distribution between 4 kilometres and 9 kilometres. At Blue Hill the winds at 3 kilometres vary between W.S.W. and N.N.W., and these, again, should agree with the pressure distribution. We know from the study of the points where sounding balloons land that the westerly circulation is not always to be found aloft. We know, also, that at 9 kilometres the variations of temperature from day to day are as large as, or larger than, those at the surface. Hence we may conclude that the pressure distribution at 9 kilometres corresponds with a cyclonic circulation of westerly winds round the pole, periodically, but perhaps not regularly, invaded by winds from some northerly quarter, with marked changes of temperature. This will be recognised as merely a rough description of a series of V-shaped depressions, which also, on the average of the month, would give a westerly circulation. Possibly, in reality, the V-shaped depressions at 9 kilometres are made up of comparatively warm westerly winds with repeated incursions of cold air from the north or north-west, giving phenomena similar to those which have been described in recent discussions of line squalls. In the results of Mr. Cave's observations of pilot balloons there is evidence that V-shaped depressions at the surface sometimes originate with northerly winds at high levels.

If this is so, our failure to explain the outlines of the distribution of pressure by means of the surface conditions is itself explained. Mr. Dines's recent paper before the Royal Society shows how futile is the endeavour to explain them by reference to temperatures in the layers below 9 kilometres. They come from above, and their shape at any time is governed by causes in the consideration of which we must treat the globe as a whole. Our first step in explaining, for example, the recent succession of gales would be to note whether the westerly circulation in the

region of cirrus clouds had become greatly intensified. We may infer that that circulation depends, at least, in part on the differences of temperature at different latitudes, because the winds are strongest in the winter, when the difference of temperature between the tropics and the pole is greatest; but we cannot yet describe the mechanism of the process nor the variations from year to year. On the other hand, rainfall seems to have to do rather with the small variations of pressure, which elsewhere I have called the embroidery of the barogram, than with the main features of the barogram. Considerations of space prevent my pursuing here the suggestions that this proposition entails. I need hardly say that the subject is not exhausted by what I have said. W. N. SHAW.

November 27.

The Inheritance of Mental Characters.

MR. WALKER sent me, before publication, the letter which appeared in NATURE of November 23. In reply I explained that, though I have insisted elsewhere that the words *inborn*, *acquired*, and *inheritable* are often incorrectly used, yet in my paper to the Eugenics Education Society I did not define the meanings of them, partly because my space was limited and partly because I thought no misapprehension could arise in the minds of my audience. None did arise. But I learn, with surprise, that some would have arisen had my critic been present. I used the words exactly as they are commonly used in biological literature, terming such characters as heads and instincts inborn and inheritable, and such characters as scars and a knowledge of Latin acquired.

In Mr. Walker's book, "Hereditary Characters," he was good enough to reproduce many of my conclusions almost in my own words; for example, "In considering the mental characters of man we are forced to the conclusion that almost all are acquirements, and that very little besides consciousness, memory, capacities for making various acquirements, and a few instincts is inborn." This is precisely my opinion as elaborately set forth, not only "on all previous occasions," but in the very paper he criticises. The astounding thing is that he should imagine that it is, or may be, also the opinion of Prof. Karl Pearson, whose statement, he thinks, "may be loosely expressed and open to misinterpretation," but "which does not appear, on the face of it, to be at variance with his own views." I fear Prof. Pearson will pray ardently to be delivered from his friends.

I must complain that the sentence Mr. Walker quotes from my paper is, in the absence of its context, open to misinterpretation. I was not merely railing. The following is the passage from which it is taken. Prof. Pearson does not use the word "inborn"; but if the word "inheritable" or "physical" be substituted for it, my meaning is unaltered

". . . Here we have an example of a conclusion based, like many more of the conclusions of biometricians, on an ascertained correlation. It is assumed that, since offspring reproduce parental mental characters in the same degree as their physical characters, therefore, if the latter are inborn, the former must be inborn also. In other words, it is assumed that one kind of sameness necessarily involves another and a different kind of sameness."

Now, though I have collected no family histories bearing on the subject, I think that no one will deny that such characters as heads, hearts, lungs, livers, and the like are inborn and invariably present in parents and offspring—at any rate in offspring that reach school age. Here we have absolute certainty of inheritance. Again, I think no one will deny that parental birth-marks, moles, and the like, are also inborn, and that they are hardly ever, if ever, reproduced by offspring. Here the degree of inheritability is zero. Between these extremes of inheritability lie the degrees of inheritability of all the other characters. Some, like ten fingers and ten toes, are reproduced almost as certainly as heads; others, like eye-colour and hair texture, with less certainty; others with still less certainty; and so on, and so on, until we reach characters the inheritability of which is scarcely greater than that of birth-marks and moles. Plainly, then, since the inheritance of inborn characters varies between certainty and zero, Pearson's statement is without significance—void of all content. Founded with such an air of scientific accuracy on statistics and family histories which have such an appearance of scientific precision, it is so vague as to be quite nonsensical. By the use of his method any character you like may be "proved" to be inborn; for, if only you seek conscientiously, you will be sure to find another undoubtedly inborn, which is reproduced by offspring in about the same degree. Thus all English children have heads, and all speak English. If, then, you are satisfied with the method, you may conclude that English speech in English children is "bred, not created." Or, alternatively, that English children acquire their heads—for you are happy in always having these alternatives to choose from.

G. ARCHDALL REID.

Southsea, November 26.

Amedeo Avogadro.

EXACTLY a century has passed away since the eminent Italian physicist Avogadro published the law which, bearing his name, is now familiar to every elementary student of chemistry or physics. Owing to various causes, Avogadro's labours were but little appreciated, and though he occupied a foremost position among Italian men of science the scientific world in general evinced but little interest in his work. Even the indefatigable Kopp failed to realise the importance of his speculations, with the result that his first history of chemistry contained no reference at all to them. Like Carnot's, Avogadro's writings had to await an interpreter and supporter. In this respect, however, fortune proved more than kind, and in his countryman Cannizzaro, Avogadro obtained an illustrious disciple and a brilliant exponent of his doctrine. But while it is true that the name of Avogadro is now widely known, it is no less true that the record of his life seems to have escaped biographers and historians alike, a statement which will be substantiated by a search through the ordinary English works of reference.

Count Amedeo Avogadro di Quaregna came of a distinguished and noble family of Biella, a small town some way north of Turin, in Piedmont. Various members of the family had won fame in the courts or on the field, but the name is unknown to the world at large except through the work of this student of physical science. Amedeo's father, Count Filippo, married Anna Vercellone, of Biella, and on August 9, 1776, their son was born at Turin, the birthplace of Lagrange. In obedience to his father's wishes young Avogadro studied law. He received his diploma on March 16, 1796, and during the next few years occupied positions in various branches of the law offices. In April, 1801, he was appointed secretary to the Prefecture of the Eridano province. His natural inclination for mathematics and physics, however, led him to carry on his studies, and with his brother Felice he wrote, and presented to the Academy of Sciences of Turin, two papers, in 1803 and 1804, the first being on electricity and the second on the nature of metallic salts. For this work the brothers were nominated corresponding members of the academy on July 5, 1804. Amedeo now obtained permission from his father to follow the career of his own choosing, and after a short course of study he became in 1806 a demonstrator at the Royal College of the Provinces. Three years later, on November 7, 1809, he was appointed professor of positive philosophy (physics and mathematics) in the Lyceum at Vercelli, where he remained until 1821. It was during the early years of his residence at Vercelli that he produced the two memoirs which have immortalised his name. Both the memoirs were published in the *Journal de Physique* of De la Methérie. The first, which appeared in 1811, was entitled "Essai d'une manière de déterminer les masses relatives des molécules élémentaires des corps, et les proportions selon lesquelles elles entrent dans ce combinaison"; the second appeared in 1814, and was entitled "Mémoire sur les masses relatives des corps simples, ou densités présumées de leur gaz," &c. Avogadro returned to the same subject in a memoir which he published in 1821, 1826, and in 1849, and he investigated other problems bearing on the same subject. His other researches included questions in electricity, chemistry, electrochemistry, specific heat, and the expansion of bodies.

On October 6, 1821, Victor Emmanuel I. instituted the first Italian public chair of higher physics, and in November Avogadro was appointed to it. Owing to political troubles the post was suppressed two years later, and Avogadro, after a brief interval, was given a post at the Regia Camera dei Conti, where he continued with undiminished activity his cherished studies. In January, 1832, Carlo Alberto restored the chair Avogadro had occupied, but appointed to it the famous Cauchy, who, it will be remembered, had been compelled to leave the Collège de France and his seat in the National Institute of France owing to the Revolution of 1830. Cauchy had been elected, amidst a storm of indignation, to the seat in the institute vacant by the expulsion of Monge, and he was now in his turn suffering the vicissitudes of fickle fortune.

Towards the end of 1833 Cauchy left Turin to take charge of the education of the young princes at Prague, and Avogadro was again appointed to the position for which he was so well fitted. He remained professor of physics until 1850, when he resigned owing to advancing age, and was succeeded by his favourite pupil, Felice Chiò. His scientific work was continued almost to the end of his life; and he died at Turin on July 9, 1856, having nearly reached the age of eighty.

Avogadro's memoirs, numbering some forty or fifty, appeared in the *Journal de Physique*, the *Annales de Chimie et de Physique*, *Brugnatelli's Journal*, and other periodicals. Among his works was a huge compilation of 3700 pages, in four volumes, on physics, which was published at the expense of Carlo Alberto. His principal studies, as we have seen, related to the physical properties and the internal structure of bodies, and the law—that equal volumes of gas contain the same number of molecules—to which his name is attached perpetuates his memory. Ampère independently enunciated the same doctrine; but in point of priority Avogadro's claim is beyond dispute.

He was a man esteemed in private life for his kindness, affability, and sincerity. His habits were noted for their simplicity, and he was as modest as he was learned. The year following his death a marble bust in his honour was placed in the University of Turin. In the Scuola Professionale at Biella is another bust, with the inscription—

I GAS A PARI CONDIZIONI
DI PRESSIONE E DI TEMPERATURA
IN EGUALI VOLUMI CONTENGONO
UN EGUAL NUMERO DI MOLECOLE.

Last year a project was formed to celebrate the centenary of the enunciation of his law, but I do not know whether the scheme was carried through or not.[1] The above details have been obtained from the short biography of Avogadro by Alfonso Cossa, for a copy of which I am indebted to the kindness of Prof. Naccari, the present occupant of the chair of physics at Turin. EDGAR C. SMITH.

Hong Kong, October 23.

Characteristic Röntgen Radiations.

IN the September number of *The Philosophical Magazine* there appears a paper by Prof. Barkla, in which are tabulated the results of some further experiments on characteristic (fluorescent) Röntgen radiations. It appears that some of the elements of high atomic weight give "two lines in the fluorescent spectrum." Optical analogy suggests that there may be some simple relation connecting these spectral lines. Such a relation can, indeed, be readily obtained, and I should like to be allowed to direct attention to it.

In a paper on the production of characteristic Röntgen rays (Roy. Soc. Proc., 1911), I showed that for the elements from Al upwards (which gave characteristic rays in series K) the radiation they emitted could be defined, indirectly, in terms of their atomic weight. It was shown that the radiation characteristic of an element of atomic weight w is the same (when tested by penetrating power) as the most penetrating of the Röntgen rays emitted from an anti-kathode bombarded by kathode rays of velocity equal to kw, where $k=10^8$.

[1] See NATURE of October 26, p. 557.—ED.

Thus the radiation characteristic of Se would be emitted by kathode rays of velocity $7{\cdot}92\times10^9$ cm./sec. ($w=79{\cdot}2$), that characteristic of Cu by kathode rays of velocity $6{\cdot}36\times10^9$ cm./sec. ($w=63{\cdot}6$), and so on. Such kathode rays as would produce a characteristic Röntgen-radiation may be conveniently termed equivalent kathode rays. Thus we can define a radiation the λ/ρ of which is known, in terms of the velocity of the equivalent kathode rays, and so indirectly in terms of the atomic weight.

Prof. Barkla tells us that Bi gives out (in series L) a radiation of very nearly the same penetrating power as that from Se in series K (the actual values of λ/ρ are 19·0 and 18·9). From this it follows that the equivalent velocity for Bi (series L) is the same as for Se (series K), *i.e.* $7{\cdot}92\times10^9$. Thus, if we adopt series K for our standard, we can say that Bi behaves (for series L) as though it were an element of atomic weight 79.

The actual atomic weight of Bi is 208, and it behaves (for series L) as if its atomic weight were $w'=\frac{1}{2}(w-50)=79$; thus the two possible spectral lines for Bi are defined in terms of the two equivalent kathode rays of velocities $2{\cdot}08\times10^{10}$ cm./sec. and $7{\cdot}9\times10^9$ cm./sec.

The expression

$$w'=\tfrac{1}{2}(w-50)$$

holds fairly well over the greater part of the range studied by Prof. Barkla, as the following table shows.

Element	w	w'	λ/ρ (calculated)	λ/ρ (observed)
Sb	120·2	35·1	375	435
I	126·9	38·5	298	306
Ba	137·4	43·7	248	224
W	184·0	67·0	35·0	33
Pt	195·0	72·5	25·5	27·5
Au	197·2	73·6	23·8	25
Pb	207·1	78·6	20·0	20
Bi	208·0	79·0	19·1	19

The calculated values of λ/ρ have been obtained by interpolation of w' in a w, λ/ρ graph.

The observed value of λ/ρ for Sb is almost certainly too high, since in some experiments with Sb (August, 1910, Proc. Camb. Phil. Soc.) I found that the equivalent velocity was about $3{\cdot}6\times10^9$ cm./sec. (compare w' above). The agreement otherwise is as good as could be expected.

In conclusion, formulæ of the type to which attention has just been directed ($w'=A.w+B$) may possibly prove useful to experimental investigators in suggesting new "lines" and indicating where to look for them.

R. WHIDDINGTON.

St. John's College, Cambridge, November 16.

A Suggested Reform in Palæobotany.

IN a paper in the *Annals of Botany* for October (pp. 903–7, text figures) I brought forward conclusive botanical evidence that the Cretaceous fossils from the Amboy Clays of North America, hitherto known as *Ophioglossum granulatum*, Heer, are not only not Ophioglossums, but are not ferns at all, and belong to the widely distinct family of Gymnosperms, in the genus Pinus.

This result, in itself of not much importance, forms the text of a general recommendation to palæobotanists, which is as follows:—In the interests of the sciences of palæobotany, geology, and botany, I "urge that the lists published by palæobotanists should be printed in two forms, and that the names of species of leaves, stems, &c., of which there is a reasonable security of determination, should be differentiated from those in which there is no guarantee at all that the actual nature of the plant has been discovered. Any tri-nomial system is cumbrous; but those who publish on fossil plants might print their names in type of two kinds, which would indicate which species are doubtful. I should like to suggest that, instead of using italics or ordinary capitals as is usual in printing the names of species and genera, such doubtful plant-impressions should be printed in Gothic lettering. This would indicate that our knowledge about them is mediæval—of the Dark Ages—and would further save the inconvenience of tri-nomials, while it would indicate immediately the difference between the established and the doubtful determinations. As information accrued about a

specimen it could easily be transferred to the clear Latin italics.

"Thus the transference of Ophioglossum granulatum, Heer, to *Pinus granulata* (Heer) would indicate that an exceedingly doubtful determination had been replaced by one with some scientific basis. Any worker in another branch of science, seeing Ø, granulatum, in Gothic, would be warned at least to look into the grounds for the determination for himself before he—let us imagine—used the record for his stratigraphic work in correlating horizons, or in writing up the early history of the Ophioglossaceæ, when he would otherwise assume that the living genus was represented in Cretaceous times in the Ambay Clays of North America. This is merely an illustration of what is very widely spread in fossil botany; but it may serve to give point to the general proposition that the time has come when it would be of real service to the science to attempt a conscientious distinction between valuable and doubtful determinations, and that Gothic lettering might give us an easy indicator.

"The need for this is all the greater, because the results of palæobotany touch so many other fields of research, in animal palæontology, geology, and palæogeography, as well as botany itself. Workers from these other fields are seldom able to estimate the evidence that they are taking to build into their own work, even had they the time to go into the details; and thus a single error gets widely disseminated. Often it is not entirely the fault of the one who originally described the fossil, for he may say in his text that the nature of the specimen is doubtful, and that, in default of better evidence, he gives a certain name with hesitation. That name, however, once given, is quoted and put into lists without being in any way distinguished from the rest; and the results are detrimental to the advance of true knowledge in every way. It is no solution to call every leaf, as some conscientious workers do, 'Phyllites': different things, however doubtful, must have distinct names, and the use of Gothic characters for the very doubtful ones would greatly tend to 'create confidence' in the science of palæobotany."

MARIE C. STOPES.

The Unit of Momentum.

DOUBTLESS all teachers of experience are agreed that in dealing with the measurable quantities considered in mathematics and physics there is great difficulty in giving to students a clear idea of the quantities measured unless a definite name be given to the unit in terms of which measurement is made.

Until the word "radian" was introduced, circular measure was a stumbling-block to all beginners in trigonometry; the sentences "the circular measure of this angle is 1·7" and "arc over radius equals 1·7" make little impression on the untutored mind; but the sentence "this angle contains 1·7 radians—the radian being rather more than 57°" is as easy of comprehension as "the value of this is 2⅛ guineas—the guinea being 21 shillings." So in electricity, without the names ampere, volt, ohm, &c., the learner would be—as he was thirty years ago—lost in hopeless vagueness.

In mechanics we have given names to almost all the units; why not give one to the unit of momentum? I venture to suggest for general use the names which I have myself made use of for many years, and have found helpful in inducing clear thinking on the part of my students; they are analogous to the names of the units of work.

Thus the work done by a force 1 lb. acting for 1 ft. is one ft-lb.

The momentum produced by a force 1 lb. acting for 1 sec. is one sec-lb.

The work done by a force 1 poundal acting for 1 ft. is one ft-poundal.

The momentum produced by a force 1 poundal acting for 1 sec. is one sec-poundal.

The work done by a force 1 dyne acting for 1 cm. is one cm-dyne (erg).

The momentum produced by a force 1 dyne acting for 1 sec. is one sec-dyne.

Similarly we may speak of a sec-ton and a sec-tondal.

The advantage of the above names is that they emphasise the essential distinction between momentum and kinetic energy, viz. that one measures what I may call the time-effect of a force and the other its space-effect; or, to put it differently, when we know the momentum of a moving body we know *how long* a given force must act to produce the motion, and when we know its kinetic energy we know *how far* the force must act. This point of view seems to me far more desirable than the suggestion to the beginner that momentum is mv, or "mass × velocity"; such a suggestion he must either receive in deadly apathy or he must worry his brain with the impossible task of trying to conceive how mass can be *multiplied* by velocity: his teacher may try to slur over the difficulty for him by a word-juggling substitution, and say momentum is the *product* of mass and velocity; but then, what is a product? In the mathematical sense of the word it is the result of multiplication; in the non-mathematical sense it is anything resulting from or produced from certain others; and in this latter sense kinetic energy is just as much the product of mass and velocity as momentum is. So, also, the time-honoured but vague phrase "quantity of motion" could be used to express kinetic energy with quite as much aptness as to express momentum.

Using these names, we would teach—

"The momentum of m lb. moving at v f.s. is mv sec-poundals, or mv/g sec-lbs.; its K.E. is $\frac{1}{2}mv^2$ ft-poundals, or $\frac{1}{2}mv^2/g$ ft-lbs." "The momentum of m grams moving at v c.s. is mv sec-dynes; its K.E. is $\frac{1}{2}mv^2$ ergs (cm-dynes)."

F. R. BARRELL.

The University, Bristol, November 7.

I AM in the habit of saying, "the amount of momentum is 12 in C.G.S. units" or "the amount of momentum is 12 in engineers' units." The use of such a complex name as "gram-centimetre per second" would be absurd. Now Mr. Barrell has made an excellent suggestion; the names sec-dyne with all students, and sec-pound with such students as use engineers' units, are not only short and easy to remember, but they keep before the student the fundamental fact that force is time rate of change of momentum. It seems to me, however, that at the start we must define momentum as mv, and boys must from the start learn that they are no longer multiplying mere numbers. I never found that a boy had any difficulty if his master did not create one. A boy knows at once that if a distance of 100 yards is passed over in 20 seconds there is an average speed of 5 yards per second; he has no difficulty in dividing space by time, but his teacher may create great confusion in his mind if he philosophises about it.

JOHN PERRY.

Fish and Drought.

IN my letter on "Fish and Drought" published in NATURE of November 23 there is an error, due, without doubt, to a mistake in my MS., which may confuse the reader. In the tenth line from the bottom of the right-hand column of p. 108 the word "north" occurs; it should read "south."

It has been pointed out to me by friends who have read the letter that the final paragraph is rather difficult to follow. With your permission I beg to take this opportunity of rectifying its expression, as follows:—

In conclusion, I think that the observations above recorded show that the material of geological formations need not necessarily have been "laid down"; it may have been produced *in situ* like the mud in the ditch round the Park of Marchais, and that the enclosure in it of animal remains may have been in some cases due to a voluntary act of self-inhumation, undertaken, perhaps usually, with a view to self-protection. They also show that two neighbouring strata, the one carrying abundance of life and the other being destitute of it, may nevertheless be contemporaneous in date and conterminous in locality of formation.

J. Y. BUCHANAN.

November 26.

THE INTERACTION BETWEEN PASSING SHIPS.

ONE of the prominent questions of the day in naval architecture circles is that of the influence of passing ships upon each other. It has been known for many years that such an influence exists between vessels in confined waters, canals, for example, and for such canals there are usually stringent regulations as to speed and manner of passing of ships. Such conditions are, of course, extreme, but the narrowness and shallowness of the canal, merely intensify a phenomenon which is present in deeper or broader waters, but not always apparent.

tendency for it to cant in towards two; in the second position the forces are all tending to draw the two ovals together, there being throughout the body of water between them less pressure than exists on their outer sides. In the third case, oval one is subjected to forces tending to cant it towards or away from two, as the stern is in a field of pressure below normal on its nearer side, and the bow in a field of increased pressure on the inner side.

The extent and importance of these forces will depend on the lateral distance apart, on the bounding conditions of the fluid, and on the speeds, both absolute and relative, of the ovals. In order to give an indication of how greatly this influence is increased

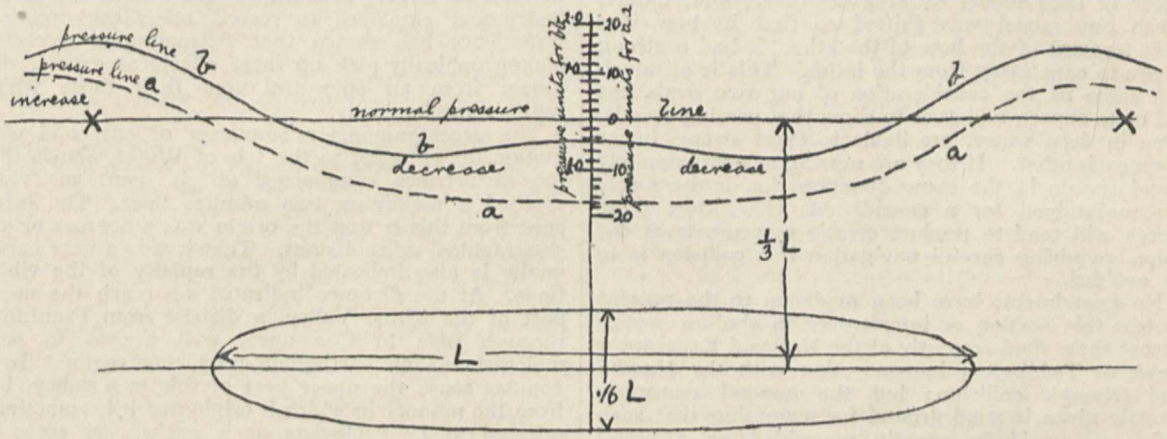


FIG. 1.—Variation of pressure around an oval along the line X X.

A ship's form unfortunately cannot be expressed by any formula, and its stream lines cannot be easily calculated, but by considering the case of two ovals formed by "sources and sinks," we can get a rational idea of the character and variation of the forces which come into play. The equation for the pressure at any point in the fluid surrounding an oval is given by:—

$$-\frac{p}{w}=\frac{v^2 f}{2g}\left[\left(\frac{\cos\phi_1}{r_1^2}-\frac{\cos\phi_2}{r_2^2}\right)+\frac{f}{4}\left(\frac{1}{r_1^4}+\frac{1}{r_2^4}-\frac{2\cos(\phi_1+\phi_2)}{r_1^2 r_2^2}\right)\right] \quad (1)$$

where r_1, ϕ_1 and r_2, ϕ_2 are distance and angle from source and sink respectively, and f varies with the distance between source and sink and length of major axis, and v^2 is the relative velocity of fluid and oval.

The line *b b* in Fig. 1 shows the variations of the pressure from the normal, along a line distant one-third the length from the centre line, and it can be seen from this that, speaking generally, there exist at each end of such an oval fields of increased pressure, and that the space between them is a region of diminished pressure.

If two such ovals are moving in the fluid, it can be readily seen that the variations of pressure due to one will modify the pressures due to the other, and that the pressure conditions on the sides of the ovals nearer to each other are different from those on the outer sides.

In Fig. 2 the ovals are shown in three positions relative to each other, and the arrows at each end of oval one show the motion which the forces due to interference tend to set up. If one is overtaking two, in the first position shown, there will be a strong

when a body moves from deep to shallow water, the curve *a a* has been drawn in Fig. 1. This shows the variation of pressure for a plane oval (*i.e.* with two-dimensional flow), having the same axes as the oval for which curve *b b* has been drawn, and it will be noticed that the scale of *a a* is one-tenth that of *b b*.

Such general reasoning, however, although showing the nature of "interference," does not give a measure of the forces involved with actual ship forms under similar conditions, and to obtain this experiments must be made with models in water of different depths.

Experiments conducted in 1898 in a German canal

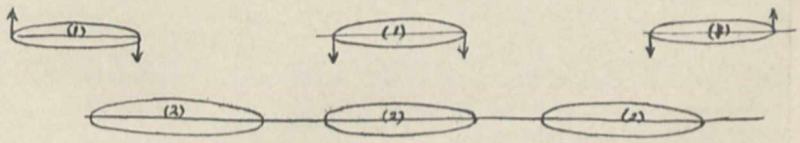


FIG. 2.—Action between passing ovals.

with barges having a sectional area approximately one-third the sectional area of the canal, showed a region of considerable excess pressure in front and at the rear of the barge, and on the bank for the whole length of the barge a remarkably strong negative current or diminution of pressure.

The experiments made by Naval Constructor D. W. Taylor in the Washington Tank, throw a considerable light on the problem. The ship-shaped models used were of the same length and were run at an average speed corresponding to 13·5 knots for 500-feet ships.

The results of the experiments show that in very deep water such ships do not begin to influence each

other appreciably until their distance apart is less than 0·8 of their length, and that this influence is becoming very noticeable when the distance apart is 0·6 of their length. It was also found that, with the models in any given position, the forces involved varied as the resistance of the models, *i.e.* for these speeds roughly with the square of the velocity as theory would lead us to expect.

The variations of the forces as one model was moved to varying fore and aft positions relative to the other (keeping the lateral distance the same) showed the very strong tendency which any model had to cant into the stern of the other model which it was overtaking, how this tendency to cant changed, as the models were brought abreast each other, to a strong sheer of each model towards the other, and, finally, when one model was shifted so that its bow was well forward of the bow of the other, it had a strong desire to cant away from the latter. This is all much the same as the consideration of our two ovals has led us to expect, and goes to show that passing vessels, even in deep water, are liable to exert strong forces upon each other. If they are moving at approximately equal speeds in the same direction, *i.e.* if the forces are maintained for a considerable time, then these forces will tend to produce erratic movements of the ships, requiring careful navigation if a collision is to be avoided.

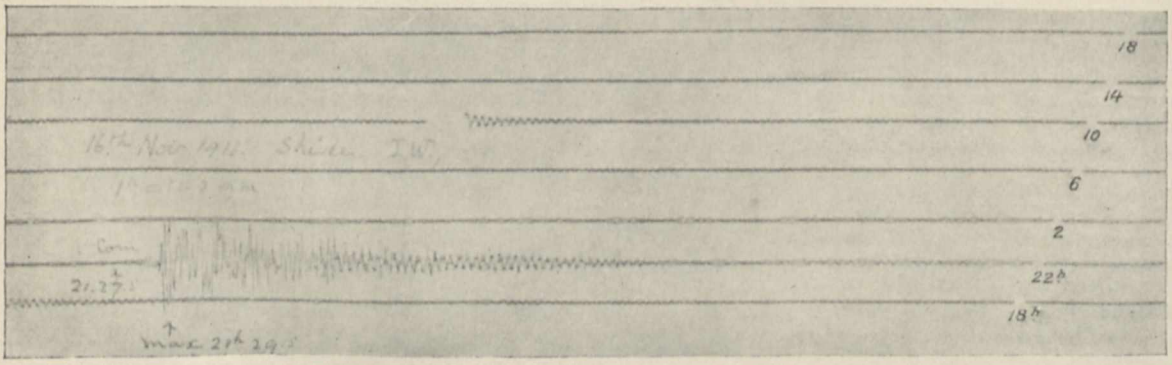
No experiments have been made up to the present to test this suction or interference in shallow water, except those made recently at the National Experiment Tank at Teddington in connection with the *Hawke* and *Olympic* collision; but the general reasoning already given is good ground for supposing that such influence would be greatly magnified as a vessel passed from deep to shallow water.

THE CENTRAL EUROPE EARTHQUAKE, NOVEMBER 16, 1911.

ON the night of November 16, at 10.25, western Germany, eastern France, and Switzerland were rudely shaken by an earthquake of exceptional intensity. At Frankfort-on-Main houses were cracked. In Freiburg, Stuttgart, Munich, Mülhausen, and in other towns, chimneys and roofs were damaged. The valley of the Upper Rhine was shaken throughout its length. At Constance two colossal statues fell from the Post Office upon the pavement. According to reports in the daily papers, walls were split, church spires were wrecked, roofs were shattered, people were "thrown out of their beds," telephone and telegraph communications were destroyed, and the path of the earthquake was marked by ruin from Magdeburg to Berlin. Everywhere terror-stricken people "rushed" from their houses, and at Ebingen 500 of its inhabitants gathered round a fire during the night and recounted their weird experiences.

It is difficult to reconcile these descriptions of widespread ruin with the fact that there does not appear to have been a single casualty. One thing about which we can be certain is that the earthquake was felt eastward to Erfurth, westwards to Nancy, and southwards to Milan. At least 17,000 square miles of Central Europe received a shaking perceptible to the greater number of its inhabitants. Outside this area it was recorded by many seismographs. Whether the disturbance was or was not recorded in very distant places largely depends upon the character of the instrument employed to record teleseismic motion. Experience has shown that seismographs recording photographically pick up these effects at greater distances from an epicentral area than those which register mechanically.

The accompanying seismogram of east and west motion, as recorded in the Isle of Wight, shows that the disturbance commenced at 9h. 27m. 30s., and reached a maximum two minutes later. The inference from this is that the origin was 5 degrees or 300 geographical miles distant. That it was a near earthquake is also indicated by the rapidity of the vibrations. At the distance indicated we reach the upper part of the Rhine Valley, a district from Frankfort, through Bâle to Constance, well known to seismologists as an earthquake-producing region. In a popular sense the upper part of this is a valley, but from the manner in which it originated it is sometimes referred to by geologists as a *graben*, or piece of territory that has fallen downwards between two faults. In this instance one of these faults borders the Vosges and the other the Black Forest. It is a tectonic displacement along which adjustments from time to time have taken place, each of which represented a relief of strain and was accompanied by a shaking. One well-known paper solemnly informs its readers that this earthquake was of Teutonic origin, and, considering the country in which it was made, the statement may be regarded as correct.



At present it cannot be said with certainty that this disturbance originated from the chief of these tectonic lines or from one of their numerous offshoots. To the right and the left of the Rhine Valley the country is cracked through and through with many minor fractures, a sudden movement on any one of which might be capable of producing all that has been observed.

J. MILNE.

DUST EXPLOSIONS.

THE explosion of a mixture of dust and air, supposed by the head of the firm of Messrs. Bibby Brothers to have been the initiating cause of the catastrophe which destroyed and set on fire part of their oil-cake and seed-crushing mills in Liverpool on the night of November 24, is the most probable explanation of that occurrence. It appears that some of the seeds which contain no oil form an exceedingly fine powder when crushed. The hypothesis is that fine powder produced in this manner became disseminated in the air of the chamber, thus forming an inflammable mixture, and was ignited by some means not ascertained, possibly by a stream of sparks due to friction between the grinding rolls, possibly by an open light. Be this as it may, a violent explosion took place, shattering that portion of the mill in which crushing is carried on, and causing the deaths of thirty-one persons, and, more or less, serious injuries to 112 others.

This event recalls the disastrous explosion which destroyed the Tradeston Flour Mills in Glasgow in 1872, and was investigated and reported upon by Profs. Rankine and Macadam. On that occasion Prof. Macadam stated: "When the whole of the conditions required theoretically for the most disastrous explosions are practically realised, the increase of pressure is equal to eight atmospheres, or 120 lbs. per square inch, which must necessarily bring about a violent explosion and wreck any ordinary building."

Another notable explosion of the same kind, which stands unrivalled in the magnitude of the havoc wrought by it, wrecked the Washburn Flour Mills at Minneapolis on May 2, 1878, and set fire to six other mills and a number of buildings in the neighbourhood. Profs. Peckham and Rye, who were commissioned by the coroner's jury to investigate the circumstances in which it took place, made a series of experiments in closed boxes to test the explosibility of a variety of powdered substances, amongst others various flour mixtures and coal dust. The powders were blown into the box with bellows and ignited by an open light. As the result of their experiments the investigators came to the conclusion "that practically all finely divided highly carbonaceous material would explode under the conditions tried."

Explosions in grinding mills are not, perhaps, so infrequent as might be imagined: a dust explosion occurred in an adjoining block in Messrs. Bibby's mill four years ago, when several workmen were injured, and many similar explosions have taken place in flour mills from time to time, causing damage and setting fire to the buildings, but not heard of beyond the immediate locality, and then probably reported merely as fires.

Most mill owners seem to be now alive to the risks they run from this cause, and take the precaution of limiting the dimensions of the spaces in which mixtures of dust and air are necessarily formed, and excluding open flames from them. Besides flour mills, sugar refineries, starch works, and factories for the preparation of madder, lycopodium powder, flour of sulphur, and so on, have all been the scenes of explosions of this kind. Lycopodium powder, which consists of the spores of *L. clavatum*, the stag-horn moss, is amongst the most inflammable of these substances. It burns with a sudden flash of yellow flame and with a hissing noise, probably due to the bursting of the individual spores, when its mixture with air is ignited.

Lastly, the inflammable, and under certain conditions explosive, nature of a mixture of air and coal dust is now becoming better understood and appreciated, and has recently constituted the subject of articles contributed by the present writer to the pages of NATURE (vol. lxxxvi., pp. 223, 595).

W. GALLOWAY.

THE TEACHING OF MATHEMATICS.[1]

THESE two reports on mathematical teaching cover very different ground, and are treated from very different points of view. The report of the London County Council refers particularly to elementary schools, though in many places it deals with general questions of mathematical teaching that apply to schools of all types. The New South Wales report refers entirely to the work of secondary schools. Again, the L.C.C. report is drawn up by a body consisting mainly of teachers in the closest touch with the child, and, throughout their report, they consider the state of development of the child's mind and the wide differences there must be between the children in the future. In marked contrast to this, the N.S.W. report does not seem to be based on an intimate knowledge of the minds of average pupils, but seems to aim only at the production of future mathematicians.

The L.C.C. report opens with a chapter devoted to general questions of mathematical teaching; then follows an excellent chapter on the first steps in arithmetic. The next chapter, "On the coordination of arithmetic with science and other subjects of the curriculum," is the most suggestive chapter in the report; there are many excellent suggestions for changing the arithmetic lesson from a dull grind to a really attractive lesson, instilling into the pupils a truly scientific spirit. The only doubt that arises in our mind is whether the second-rate teacher will keep a proper balance between the illustrations leading up to new ideas and the new ideas themselves—recent experience in geometry shows that a word of warning is necessary. The fourth chapter deals with the logical and computative sides of the subject—some of the examples considered seem to be the diabolical inventions of the examiner or the text-book writer. Finally, we have a summary of the answers to questions sent round to teachers, examiners, and inspectors—some of these are of great interest; the most interesting perhaps is taken in the first chapter; it deals with the "relative capacity of boys and girls for mathematics":—

> "Opinions expressed were in favour of a greater general capacity for mathematics, especially as tested by the solution of problems, among boys, and of greater neatness, accuracy, and conscientiousness in carrying out rules and processes, among girls. It was, however, stated that many brilliant exceptions were to be found amongst the girls. The evidence further went to show that the genius is balanced by the dullard more often among groups of boys than among groups of girls."

Altogether, the report is one of the most suggestive contributions that have been made to the literature on mathematical teaching in schools. We commend it most heartily to all teachers in secondary as well as elementary schools.

In the N.S.W. report there is a paragraph near the beginning which lays stress on the importance of coordination in teaching the various branches of mathematics, but it is not worked out in detail, and seems to break down in one or two places; *e.g.* in the second year trigonometry is included under arithmetic, whereas

[1] London County Council. Education Committee. Report of a Conference on the Teaching of Arithmetic in London Elementary Schools. December 1906–December 1908. Pp. 134. (London: P. S. King and Co., 1911.) Price 1s.

Memorandum on the Teaching of Elementary Mathematics. By Prof. H. S. Carslaw. Pp. 31. (Sydney, N.S.W.: Issued by the Department of Public Instruction, n.d.)

trigonometry, including the definitions and numerical work, is not begun until the third year. In arithmetic stress is laid on the importance of a grasp of principles, and reference is made to the harm text-books have done in the way of multiplying rules and setting up mere trivial examples as important types. We do not know the average age of entry to the secondary schools of N.S.W., but we doubt whether pupils in their first year are sufficiently mature in mind for such questions as "Retail and Banker's Discount" and "Balance Sheets." In England arithmetic has suffered seriously by the introduction of the technicalities of commerce and the money market at too early an age. The second-year course is to go deeper into such things; we should have thought it wiser to postpone most of this work to the third or fourth year, and bring in more numerical trigonometry and easy mechanics to take its place—it is intended to do something of the sort in the second year as "simple problems on the lever, wheel and axle, and inclined plane" are included, but there are no suggestions as to the practical work on which to base these problems.

The section devoted to algebra begins with a philosophical treatment of negative and fractional quantities, but it is not proposed that pupils should be taken through such a treatment "in their first steps in algebra"; but the course suggested for the first two years is what schools in England have been trying to break away from in the last decade. The whole attitude seems to be too abstract for beginners—we should have liked to see the factors of x^3+a^3, long H.C.F., and the solution of two simultaneous equations, "in which only terms of the second degree and constant terms occur," all postponed until after the second year, and indices and logarithms brought back in their place. We feel that it would have been wiser to make the early treatment much less abstract and more numerical, and to let the fourth-year course include a more scientific treatment of the elements of the subject.

Differential calculus is introduced into the fourth year's algebra, but seems to be intended only for those who matriculate in higher mathematics. We should like to see a short introduction to both differential and integral calculus introduced into secondary schools for all pupils of average ability. The treatment suggested in this report for the differential is good, including, as it does, the principles of the subject without elaborating the technique—we suspect that integral calculus is meant to be included as reference is made to the evaluation of areas, &c.

The report goes on to discuss geometry :—

"It is common knowledge that within the last few years the methods adopted in the teaching of geometry have been greatly altered. No less common is the belief that many of the changes which have been made have hardly justified themselves, that the relative importance of the various parts of the subject has been frequently forgotten, that much unsatisfactory reasoning is being accepted as logical, and that much unnecessary confusion exists. . . . A boy who has made a comparatively close acquaintance with straight lines, angles, circles, triangles, parallelograms, &c., by actual drawing and measurement, knows far more of their properties than one who has learnt by heart long lists of definitions and some of Euclid's propositions. And when, by a carefully graduated series of experiments and drawings, he has discovered for himself the fundamental theorems regarding congruent triangles, the theory of parallels, the measurement of areas, and the circle, he is ready to proceed to the study of deductive geometry, and should profit by that study in many different ways.

"This is the first, and one of the most important, of the changes which have been made in the teaching of geometry; but, with regard to it, some words of warning are still necessary. There is no doubt that the *rôle* of experiment, careful drawing, exact measurement, and calculation from the figures drawn by the pupils has been exaggerated."

With all this we agree most heartily, but with Prof. Carslaw's remedy we cannot agree; this practically amounts to taking the theorems of Euclid to the end of parallels, and setting them up as a standard order to be followed by all schools. Prof. Carslaw seems to feel that such a retrograde step is likely to meet with opposition, for he says: "Without prescribing rigid adherence to the scheme drawn up and embodied in its programme, the Department intends to base its instruction upon it." This seems to give the teacher the choice the famous Hobson gave to his customers when they came to hire horses. We can only express our deep regret that such a retrograde step should be deemed necessary in N.S.W. to remedy an evil which is doubtless the same in all its features as that we are experiencing in England.

The evil may be considered to be due to two distinct causes: (i) some teachers have not shown a proper appreciation of what constitutes a sound logical proof, and have let their pupils use slipshod arguments; (ii) pupils have a break in their careers when they pass from the elementary to the secondary schools. With regard to (i) it may be pointed out that practically all teachers, both in England and Australia, have had their training in geometry under a cast-iron system, viz. that of Euclid; some teachers under that system have acquired a splendid appreciation of what is logical, but the very existence of the evil referred to proves that other teachers have not acquired that appreciation—this does not point to finding the remedy in another cast-iron system, particularly one closely following the lines of Euclid.

Doubtless a rigid system would remedy the difficulty of transition from school to school, but that difficulty ought never to exist; for, as Prof. Carslaw points out, the only trouble due to the lack of a standard order lies in the fundamental theorems about congruence, and parallels and the angle-sum for a triangle; and that part of geometry, in our opinion, should not be treated deductively before the age of fourteen with any but pupils of very exceptional mathematical ability, and possibly not with them. It will be remembered that a couple of years ago the Board of Education published a circular recommending that these fundamental theorems be arrived at by induction, and then taken as a base on which to build up a logical system of deductive geometry. Prof. Carslaw says :—

"With this advice I find myself unable to agree. One of my reasons for disagreeing with their method is that I am sure the difficulty that these fundamental congruence theorems offer to the pupil is exaggerated, and that I believe the reasoning, by means of which they are to be proved, can be of value to him. Another ground for my dissent from the plan of that circular is that the treatment of parallels which it recommends, by its introduction of the idea of direction as fundamental, and by making the angle-sum theorem independent of the theory of parallels, includes one of those fallacies with which the long history of that theory is crowded."

We wonder whether Prof. Carslaw has seen the advice of the Board carefully followed by sympathetic teachers; it is generally found that the results of teaching on these lines are much better than those where a deductive treatment of congruence, &c., is attempted—there is greater knowledge of geometry, greater appreciation of logical geometry, and more power to tackle new work. We must differ from Prof. Carslaw when he says the difficulty of the congruence theorems is exaggerated—in a comparatively wide experience of boys, we have never found the proofs of these theorems clearly understood until the boy has

had some further acquaintance with deductive geometry in the form of riders and later propositions, though in many cases the proofs have been learnt for purposes of reproduction.

Again, Prof. Carslaw objects to the use of the idea of direction in dealing with parallels and the angle-sum theorem—we should quite agree with him that such a treatment would not be satisfactory in a deductive course, but we differ most strongly from him in thinking that a deductive treatment of parallels, &c., is necessary or wise in the first two years of geometry. The fact is, deductive geometry is not a suitable study for children before the age of twelve, and even at that age it must be a difficult study, and the deductive treatment of congruence and parallels is one of the most difficult parts of the subject, and should certainly not precede the deductive treatment of the parallelogram and the circle. We can only regret that New South Wales has been frightened by difficulties which were bound to arise in a period of transition, into going back to the old methods instead of boldly remedying the evil by helping all teachers to get the spirit of the new methods.

The report goes on to consider trigonometry and mechanics, but there is nothing that calls for serious comment. R. Y. S.

TSETSE-FLIES AND SLEEPING SICKNESS.

A DEPUTATION representing eight missionary societies at work in Nyasaland waited upon the Secretary of State for the Colonies on November 23 in order to urge that game restrictions should be removed over a whole or part of the protectorate, on the ground that the tsetse-fly was suspected of spreading sleeping sickness, and that the destruction of big game "might" eliminate the fly. In his reply, Mr. Harcourt very wisely deprecated hasty action in a matter in which "the best-informed people were the least positive as to the facts."

It is by no means certain that the destruction of the larger mammalian fauna would have any such effect as the members of the deputation seem to anticipate. In the first place, it is highly probable that the primary host of the trypanosome of sleeping sickness is man, and that if the trypanosome is now to be found in wild mammals in regions in which the disease is known to have been introduced in recent times, it is because it has been transmitted to them from human beings by the agency of the tsetse-flies. Secondly, it is very far from certain that the destruction of the larger mammalia would have the effect of eliminating tsetse-flies, which can suck the blood of any kind of vertebrate animal, and which swarm in parts of the Uganda Protectorate (for example, on small uninhabited islands in the Victoria Nyanza) where there are no larger mammalia. Thirdly, the danger must be reckoned with that to deprive the tsetses of a large portion of their natural food-supply might have the effect of forcing them to supplement the deficiency elsewhere, and might therefore render them much more aggressive towards men and domestic animals, and in this way more efficient in spreading trypanosome diseases.

Everyone with a knowledge of the complicated problems involved in the subject of the transmission of trypanosomes by tsetses will deprecate ill-considered destruction of the big game, an action which, while robbing large tracts of country of one of their most beautiful and valuable features, may very well have the effect of upsetting the balance of nature in a manner that would greatly aggravate the evils which it is desired to combat.

THE INTERNATIONAL CONFERENCE AT PARIS ON NAUTICAL ALMANACS.

ON the initiative of the Bureau des Longitudes, the directors of the various national ephemerides were invited by M. Baillaud, director of the Paris Observatory, to assemble there on Monday, October 23. The objects of the reunion were to consider what steps, if any, should be taken to extend the scope of the various ephemerides for the purposes of astronomy, and at the same time to effect economy by combined action and interchange of computations. A small number of the leading practical astronomers were also invited to represent the needs of astronomy of precision.

The first general meeting was held at the Observatory at 10 a.m., Monday, October 23. On the motion of Sir David Gill, M. Baillaud took the chair, having on his right M. Bayer, secrétaire de l'enseignement supérieure, representing M. Steeg, Ministre d'Instruction publique.

On the motion of M. Baillaud, Sir David Gill, as président d'honneur du Congrès de la Carte du Ciel, was nominated président d'honneur of the reunion, Dr. O. Backlund, imperial astronomer of Russia, vice-president, and Mr. H. Andoyer, of the Bureau of the Connaissance des Temps, together with the Comte de la Baume Pluvinel, were nominated secretaries. There were present:—Prince Roland Bonaparte (member of the Academy of Sciences); Messrs. Cowell ("Nautical Almanac," London), Fritz Cohn (Berlin), Eichelberger (Washington), Général de Azcarate (San Fernando), Boccardi (Turin), as directors of ephemerides; Messrs. Dyson (astronomer royal, Greenwich), Hough (H.M. astronomer, Cape of Good Hope), Perrine (Cordoba), André (Lyons), Picart (Bordeaux), Verschaffel (d'Abbadia), as directors of observatories; and, as representatives of the Bureau des Longitudes, MM. Bigourdan (president), Poincaré, Radau, Deslandres, Hanusse.

The meeting was opened with an admirable address by M. Baillaud, and with a cordial speech of welcome by M. Bayer on behalf of the Minister of Public Instruction. After some discussion, resolutions, recommending the adoption as soon as possible of Greenwich mean time as the argument for all predictions in nautical and astronomical ephemerides, were unanimously passed. In the afternoon of the same day the members of the congress attended by invitation the meeting of the Academy of Sciences at the institute, and in the evening were entertained at a banquet in the Observatory, at which M. Steeg, Minister of Public Instruction, was present. The toast of "The President of the French Republic" was proposed by Sir David Gill, to which an interesting and eloquent speech was made, in reply, by M. Steeg. The health of M. Baillaud was proposed by Dr. Backlund.

Further meetings of the congress were held on October 24 and 25, and at the conclusion of the meeting on October 25 a unanimous agreement on all points was reached. On Thursday, October 26, the directors of the nautical almanacs met in committee to make final cooperative arrangements and report to the general congress; their report was unanimously adopted at an afternoon meeting on the same day.

A translation of the resolutions adopted is subjoined. It is impossible to overrate the good will and cordiality which pervaded the meeting, or the kindness and hospitality of our hosts. Besides the official banquet on Monday, private dinner-parties were given by M. Andoyer on the Tuesday, by M. Baillaud on the Thursday evening, the latter followed by a reception; a luncheon and reception were also given on the Friday afternoon by Prince Roland Bonaparte, and

boxes at the theatre and Opéra were placed at the disposal of members of the congress.

The results of the congress promise to be of great interest and value, not merely by extending the scope and utility of the national ephemerides for the purposes of practical astronomy, but by the facilities which the universal adoption of Greenwich time offers for the comparison of the different lunar and planetary tables.

A probable sequence to these resolutions will be the universal adoption of Greenwich as the origin of longitudes in all future maps and hydrographic charts. The gain in simplicity and convenience will be immense.

Let us hope that England will respond to the international compliment thus paid to her by the adoption of the metric system of weights and measures.

Resolutions and Recommendations adopted by the Conference.

The conference strongly recommends that :—

(1) In all ephemerides the ecliptic coordinates of the sun should be given for Greenwich mean noon, and that the equatorial rectangular coordinates should be given for midday and midnight of Greenwich mean time.

(2) The ecliptic coordinates of the moon should be given at least for oh. and 12h. of Greenwich mean time.

(3) The ecliptic heliocentric and geocentric coordinates of the planets should be given for oh. or 12h. of Greenwich mean time.

(4) The ephemerides of the stars, that is to say, their correction from mean to apparent place, should be calculated for upper transit at the meridian of Greenwich.

The conference is of opinion that the adoption of the meridian of Greenwich for all ephemerides should be realised as soon as possible.

The conference is of opinion that in all catalogues and all collections of observations declinations instead of polar distances should be adopted.

The conference decides that those portions of the ephemerides which deal with the data necessary for the calculation of the perturbations of the small planets and comets shall be based on the masses of the planets adopted by Newcomb.

The conference decides that the names of stars shall be accompanied by a letter indicating their spectral type in terms of Pickering's notation. It is of opinion that these indications (so far as they have been determined) should in future be given in the list of 3064 stars to be published by the Bureau des Longitudes.

The conference decides that in future the stars in the fundamental and standard lists of Auwers, Boss, and Newcomb shall be designated by the letters A, B, N, and the Backlund-Hough stars by the letters BH.

For the prediction of occultations of stars the list of the Nautical Almanac shall be adopted.

The commission adopts the following resolutions :—

For the sake of uniformity in the calculation of parallaxes, eclipses, and occultations, the ephemerides shall adopt for the value of the compression of the earth the number 1/297·0, resulting from the final researches of Messrs. Tittmann, Hayford, and Helmert.

For like reasons, in the calculation of eclipses, the semi-diameter of the sun (Auwers) shall be retained, as already employed in all ephemerides.

The bureaux charged with the calculation of eclipses of the sun and moon and the occultations of stars shall choose in common agreement the tables and apparent diameters which they find most desirable, taking care to communicate in the most precise and complete fashion the data which they employ and the origin whence the adopted data have been derived.

The conference decides that the Connaissance des Temps shall continue to calculate the positions of the sun and of the planets from the Leverrier-Gaillot tables, but that bureau will in future compute the positions of the moon from the new tables of M. Radau, which are based upon Delaunay's theory. In the other ephemerides these calculations shall be based on the tables of Newcomb and of Hill for the sun and planets, and on Hansen's tables, with Newcomb's corrections, for the moon until such time as the latter tables shall be replaced by the new tables of Brown.

This second series of solar, planetary, and lunar calculations shall be undertaken by the Nautical Almanac Office, with the exception of the ephemeris of Mercury, for which the office of the " Berliner Jahrbuch " shall be responsible.

Relative to the Stars.

(1) The corrections from mean to apparent place of the stars BH shall be computed at the National Almanac Office, and be printed by the Observatory of Pulkowa ; the same will apply to the daily corrections of the principal fundamental clock-stars, which latter shall include the lunar terms of short period.

(2) The ephemerides of such of the stars A, B, N as do not occur in the list of Auwers stars, which is published annually in the " Berliner Jahrbuch," shall be calculated and printed in the observatory at Turin.

(3) The ephemerides of the Auwers stars shall be calculated and printed by the " Berliner Jahrbuch," with the exception of the 343 stars printed within brackets ; the calculation of the ephemerides of these latter shall be undertaken by L'Almanaque Nautico.

(4) The ephemerides of the pole-stars, that is to say, of all the stars situated within 10 degrees of north or south polar distance which are to be found in the provisional list of 3064 stars published by the Bureau des Longitudes, and of the other polar stars hitherto given in the ephemerides, shall be calculated from day to day by the Bureau des Longitudes, and shall contain the terms of short period, the values of which shall be separately indicated, however ; for polar stars situated between 80° and 83° declination it will be sufficient to give the ephemerides for each alternate day.

The Connaissance des Temps undertakes to print all the ephemerides of the above-mentioned stars which are not given in other similar works.

The ordinary ephemerides of the stars shall be calculated to 0·001s. in R.A. so far as 60° of declination and 0·01″ in declination, not for each tenth day, but for each tenth successive culmination at the meridian of Greenwich in order to facilitate interpolation ; they will be accompanied with the data necessary for the computation of the terms of short period.

The calculation of the constants of reduction shall be carried out by each bureau in their usual way with four or five decimals.

Relative to Eclipses and Occultations.

The calculation of eclipses of the sun and moon shall be made (in conformity with the rules established by the preceding resolutions) once by the American ephemeris and once by the Connaissance des Temps.

The computation of occultations shall be made in duplicate by the American ephemeris.

The predictions of eclipses and the elements of occultations shall be calculated with all possible precision.

Relative to Satellites.

(1) The calculation of new ephemerides of the four principal satellites of Jupiter and their phenomena shall be made by the Bureau des Longitudes, and be based on Sampson's new tables.

(2) The ephemerides relative to the ring and to the satellites of Saturn (with the exception of Phœbe) shall be calculated by the " Berliner Jahrbuch."

(3) The calculations of the ephemerides of the satellites of Mars, of the new satellites of Jupiter, of Phœbe, and of the satellites of Uranus and Neptune shall be made by the American ephemeris.

The ephemerides relative to physical observations of the sun, moon, planets, &c., shall be calculated by the American ephemeris, except the ephemeris of the crater Mösting A, which will continue to be published by the " Berliner Jahrbuch."

The computation and printing of the ephemerides of the small planets and variable stars shall be undertaken by the " Berliner Jahrbuch."

It is desirable that the calculations made by any one of the bureaux should be communicated to other bureaux, which have to use them at least three years in advance.

The above conventions will be put in force in such a way as to be complete in 1917.

It is understood that the above arrangements are provisional, subject to approval by the Governments concerned.

THE SOLAR PHYSICS OBSERVATORY.

WE take the following from Wednesday's *Times* (November 29):—

At the Congregation on Thursday, December 7, the following Graces will be offered to the Senate:—"That the recommendations contained in the report, dated November 13, 1911, of the Council of the Senate on the proposed transference of the Solar Physics Observatory to Cambridge—namely, (1) that the University accept the charge of the Solar Physics Observatory, subject to the conditions laid down in the letter from the President of the Board of Education; (2) that steps be taken to obtain the powers requisite for the suspension of the election to the Plumian professorship of astronomy and experimental philosophy when it next becomes vacant, for a time sufficient to enable the University, if necessary, to obtain changes in the statutes which define the title of the professorship and the duties of the professor—be approved."

The proposal to transfer the Solar Physics Observatory to Cambridge was discussed in the Senate last Thursday. The proposal was warmly welcomed by Prof. Newall, Prof. Sir George Darwin, Prof. Sir Robert Ball, and Dr. Glaisher. The arrangements for organising the work of the department and for the provision of the necessary site were fully explained.

Nothing seems to have been said about the financial arrangements necessary to secure permanence. In the report of the so-called Departmental Committee the following passage occurs:—

With a view to securing the permanence of any arrangement that may now be made, the committee desire to point out the importance of attaching the directorship of the Solar Observatory, if established at Cambridge, to a professorship which is not merely of a temporary character. The University may not be in a position, at present, to give any definite assurance that the professorship will be renewed at the expiration of the present tenure; but we consider it highly desirable that the Government should ascertain, before coming to a final decision, whether the University is willing at an early opportunity to consider favourably the establishment of a professorship of astrophysics on a permanent foundation.

The "permanence" contemplated by the Council of the Senate only becomes operative on the death or resignation of the present Plumian professor. It is taken for granted that the unpaid professorship of astrophysics will not be vacated for any cause in the interval. What is to happen during a vacancy is not stated. Is this the kind of "permanence" contemplated by the Government? Is the next vacation of the Plumian professorship, which everybody hopes will not occur for many years, the "early opportunity" referred to in the report of the committee?

NOTES.

FOLLOWING on the announcement last week of the appointment of an expert committee of investigation into the etiology, &c., of foot-and-mouth disease comes the interesting and, if it should be confirmed, important announcement of the discovery of the causal organism of this serious animal scourge. This claim has been put forward by a German bacteriologist, Dr. Siegel, in a paper read at the annual Congress of Prussian Veterinary Surgeons in Berlin. Dr. Siegel claims to have found the organism in the blood stream and in the local lesions in affected animals, to have cultivated it in artificial media, and that in experimenting with his organism it has satisfied the postulates of Koch. Moreover, he claims to be able to produce some degree of immunity to the disease. Details of this interesting paper are not yet to hand; and in the meantime the claim must be accepted with the reserve which must obviously be accorded to the statement of the discovery of an organism that has up to the present eluded vigorous and systematic research by other experts of almost all nationalities. In the meantime, the full details of experiments will be anxiously awaited; and if they warrant it, it will be one of the first duties of the British expert committee to investigate them carefully, and either to confirm or refute the claims of Dr. Siegel. Should the discovery be confirmed, it will indeed be an enormous boon to the whole agricultural world.

THE Bradshaw lecture is to be delivered at the Royal College of Surgeons on December 6 by Mr. R. Clement Lucas, who has chosen for his subject "Some Points in Heredity."

THE Paris correspondent of *The Times* reports that Prince Roland Bonaparte has placed at the disposal of the French Academy of Sciences a sum of 10,000*l.*, which is to serve as a fund in aid of those of its members who are engaged in research work.

THE superintendent of the Indian Museum informs us that Mr. J. Coggin Brown, curator of the museum of the Geological Survey of India, accompanies the Abor expedition as geologist. The botanical work is in the hands of Mr. I. H. Burkill, reporter on economic products to the Government of India, while Mr. Stanley Kemp, assistant superintendent in the Indian Museum, is in charge of both zoology and anthropology, with Mr. R. Hodgart as taxidermist and assistant.

THE ringing of birds in order to study their movements has been referred to frequently in these columns. About twenty thousand birds have been ringed by correspondents of *British Birds*, the rings bearing the name of the editor of that journal, Mr. Witherby. One of these birds, a sea snipe, or redshank, was shot recently at Wesport, County Mayo, and it was assumed to be a bird escaped from captivity in London. A report in *The Times* of November 29 says:—"The incident has caused much local interest, since nobody in Connaught has ever heard of a tame redshank. It has among seabirds the reputation of being remarkably shy." Local opinion in Connaught as to the difficulty of taming a redshank need not be disturbed. The bird referred to was probably ringed by one of Mr. Witherby's correspondents far away from London, and it is unlikely that it was ever in a cage.

LIEUT.-COLONEL EDGAR A. MEARNS, U.S.A., retired, associate zoologist of the United States National Museum, who accompanied the Smithsonian Expedition to Africa, under the direction of Colonel Theo. Roosevelt, will be attached as naturalist to the Childs Frick Abyssinian Expedition, which will sail from London shortly to make natural history collections in the Abyssinian region. It is proposed to make as complete a collection of the animals of the Abyssinian region as possible. The journey will be primarily through Abyssinia, but will extend into British East Africa as well, and cover a portion of that country north of the field gone over by Colonel Roosevelt in 1909–10. One of the most important regions to be visited is in the neighbourhood of Lake Rudolf, and along the shores of the lake itself. It is expected that the opera-

tions of the expedition will cover a period of approximately seven months. There is no question that, even with moderate success, the United States national collections will be enriched by valuable specimens.

THE annual Huxley memorial lecture in connection with the Royal Anthropological Institute was delivered by Prof. F. von Luschan on November 23. Prof. von Luschan in his address said that to study the old ethnic elements of Western Asia it seemed best first to eliminate the more recent immigrations of Albanians, Circassians, Bulgarians, Franks, and Levantines. It is easy also to eliminate the different nomadic tribes, of which the Kurds are of special importance, being originally xanthochroic, with light hair and light eyes, whilst in all the other groups dark complexion is far predominant. The final result of anthropometric investigations—about 5000 men were measured—is that all Western Asia was originally inhabited by a homogeneous melanochroic race with extremely short and high heads, and with a "Hittite" nose. About 4000 B.C. began a Semitic invasion from the south-east, probably from Arabia, and by people looking like modern Bedouins. Two thousand years later begins a second invasion, this time from the north-west, and by xanthochroous, long-headed tribes, like the modern Kurds, perhaps half savage, and in some way or other connected with the historic Harri, Amorites, and Tamehu. The modern Turks, Greeks, and Jews are all three equally built up upon these three elements—the Hittite, the Semitic, and the xanthochroous Nordic. Quite differently is it with the Armenians and the Persians, who, and still more the Druses, the Maronites, and the smaller sectarian groups of Syria and Asia Minor, represent the old Hittite element, and are little or not at all influenced by the somatic character of alien invaders.

AN extra meeting of the Chemical Society was held at Burlington House on Thursday last, November 23, when Prof. Harold B. Dixon, F.R.S., past-president, delivered a memorial lecture in honour of Pierre Eugène Marcelin Berthelot. Prof. Dixon dealt fully with the life and character of Berthelot, referring to his persistence, his feverish energy, and devotion to his work. Berthelot, a native of Paris, was born on October 25, 1827, in a flat overlooking the Rue du Mouton. From this flat he must often have been a spectator of many violent scenes enacted during the revolutions of 1830 and 1848. He was educated at the Lycée Henri IV, and in 1861 was promoted to the chair of organic chemistry at the Collège de France, a position he held until his death. Reference was made to the intimate and enduring friendship between Berthelot and Renan, to Berthelot's romantic marriage with Madame Breguet, and to the great happiness of their married life. Berthelot was in Paris in 1870 during the Siege of Paris, and gave considerable assistance to his country in the manufacture of explosives. Madame Berthelot, with her children, had to leave her husband, going first to Rouen and thence to London. In addition to his professorial duties, Berthelot took his share in the government of his country. In 1881 he was elected a Senator, and five years later became the Minister of Education. In 1895 he held for a short time the position of Foreign Minister in the Bourgeois Cabinet. From 1863 onwards honour upon honour was bestowed upon him. He became a foreign member of numerous scientific societies, including the Royal and the Chemical Societies; and in 1900 he was elected one of the forty of the Académie Française. A year later, on November 24, 1901, the savants from the universities and societies all over the world met at the Sorbonne, in Paris, to celebrate the seventy-fifth anniversary of his birthday, the President of the French Republic (M. Loubet) presiding. In 1907 came the dramatic end to his illustrious career, he and Madame Berthelot dying together on March 18. Prof. Dixon dwelt at some length on the varied researches for which Berthelot was famous, referring more particularly to his work on the alcohols, and to his investigations on the acetylides of silver and copper and to his researches on explosions.

IN *Man* for November Messrs. J. L. Todd and G. B. Wolbach describe a series of stone circles in the Gambia. The type is in many respects analogous to those of Europe, and their object, judging from the remains discovered in the course of the excavations, was sepulchral. The Mandingo, who now occupy the region in which they are found, know little about them, and refer them vaguely to some tribe which preceded them. Their builders must have possessed more knowledge of stone-working than the Mandingos of the present day, and had considerable aptitude in lifting heavy weights. If the recent speculations of Prof. Elliot Smith be accepted, though they involve serious difficulties, the inspiration for the construction of these monuments came from the Egyptian stone-workers. The present Mandingos so far venerate these circles that they make war sacrifices near, or on, one of the stones, and bury spear-heads there. The excavations disclosed remains of weapons very like those used by the tribe at present. The facts, so far as they go, indicate that they were the work of a branch of the Mediterranean race, to which similar constructions in western Europe have, with some degree of plausibility, been attributed.

IN the first part of the Journal of the Royal Anthropological Institute for the current year Dr. H. J. Dunkinfield Astley discusses the well-worn subject of the origin and interpretation of the cup and ring markings which appear on stone monuments. Dismissing the numerous theories of previous inquirers, he suggests that they constitute the "heraldry of primitive man," being used, like the Churinga of the Australian Arunta, to define the exogamous groups. Before this explanation can be accepted more than one difficulty must be cleared up. We must be certain, in the first place, that the social organisation of the Arunta at the present day is comparable with that of the people who engraved these symbols on the monuments. Secondly, Dr. Frazer finds no proof of totemism or totemic clans in the races of western Europe, and it is unsatisfactory to assume that totemism is established by the existence of these symbols. Dr. Astley's paper is learned and interesting, but we fear that the secret of these markings must still remain a mystery.

IN her lecture "On the Marriage of First Cousins" (Eugenics Laboratory Lecture Series, No. iv.; London: Dulau and Co., 1911, pp. 39, price 1*s.* net), Miss E. M. Elderton presents the evidence for and against this type of matrimonial alliance in a clear and interesting manner. Consanguineous marriages have been objected to, and are objected to, on the ground that they result in (1) marked decrease in fertility; (2) high infantile mortality; (3) the occurrence of deaf-mutism, insanity, albinism, hare-lip, and other deformities with greater frequency among the offspring than among the general population. The conclusions arrived at may be broadly stated as follows:—(1) there is no evidence available to indicate whether the marriages of first cousins are more often absolutely sterile than those of persons unrelated to one another, but, omitting sterile marriages, the average number of children is approximately the same in both cases; (2) the statistics collected by Mr. Arner in America, and published in the year 1908, tend to

show that among the issue of consanguineous marriages the death-rate of persons under twenty years old is considerably higher than the normal; (3) the evidence that the marriage of cousins is more likely to lead to albinism, deaf-mutism, and insanity among the offspring appears to be conclusive.

IN No. 42 of Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India, Major Rost and Captain Williams contribute the results of their own researches to the much discussed question of the cultivation of the leprosy bacillus. Although this organism has long been known and seen in the tissues of lepers, all attempts to grow it had until recently proved unsuccessful; and even now considerable scepticism is felt as to the identity of the bacteria isolated with the actual causal agent of the disease. The authors describe the organism which they obtained from cases of leprosy, and the effect produced on patients by vaccines prepared from it. In No. 41 of the same Scientific Memoirs Captain MacGilchrist considers, as the basis of original experimental work, the suitability of different preparations of quinine in medical practice. Attention is paid, in the main, to the solubility and absorbability of the different salts, and the various modes of administering them.

THE thirtieth Bulletin of the Sleeping Sickness Bureau contains an account of the intracellular phase of the rat-trypanosome, *Trypanosoma lewisi*, in its development in the rat-flea, recently discovered by Minchin and Thomson. This phase was found in fleas from twelve to thirty-six hours after they had fed on the blood of an infected rat, and appears to represent the first stage in the developmental cycle of the trypanosome in the flea. The trypanosomes penetrate into epithelial cells of the flea's stomach, grow very large, and divide into a number of trypanosomes of normal size. The daughter trypanosomes are usually eight in number. They are formed by division of the parent body within its own periplast; the flagellum of the parent is retained and moves actively until nearly the last moment, when it disappears, and the body becomes spherical and tense, and bursts suddenly, setting free the daughter trypanosomes in the cytoplasm of the host-cell, whence they find their way out singly into the lumen of the stomach.

CERTAIN small aurochs' skulls from the diluvial deposits of Belgium are described by Mr. R. v. d. Malsburg as a so-called new species, under the name of *Bos* (*urus*) *minutus*, in Bull. Internat. Ac. Cracovie, 1911, No. 5. Unless, however, the term *urus* be used in a generic sense, it would seem that a subspecies is intended. Under various forms, the author considers this *Bos minutus* to be the connecting link between the typical aurochs (which is regarded as the descendant of the Indian *B. namadicus*) and modern cattle.

WE have to acknowledge the receipt of a copy of a catalogue of the exhibits in the British section of the International Shooting and Field Sports Exhibition, held at Vienna last year. The British section, it will be remembered, was in the hands of the Government, and the catalogue is therefore issued—after the usual delay—by the official publisher. The book is well got up and well illustrated, and the section on big game—which forms the bulk—will possess a permanent value as the first attempt (unfortunately incomplete) at a list of the big-game fauna of the British Empire.

IN the Annals of the Transvaal Museum for July, 1911, Mr. J. Hewitt produces evidence to show that the maxillary bone of the viperine skull is more probably derived from the corresponding element of the proteroglyphous than of the opisthoglyphous section of colubrine snakes; in other words, that the Proteroglypha, rather than the Opisthoglypha (to which that position is assigned in the British Museum Catalogue of Snakes), have the stronger claim to be regarded as the ancestral stock of the vipers. The evidence derived from snake-venom seems to lend support to this view. In a second article (in Dutch), Dr. E. C. N. Hoepen describes a new generic and specific type of stegocephalian from the presumably Permian strata of Senekal, Orange River Colony, under the name of *Myriodon senekalensis*.

TO *Naturwissenschaftliche Wochenschrift* for November 5 Dr. Otto Wilckens contributes an article on the extinction of animal groups during geological history, in which special attention is directed to ammonites, dinosaurs, and trilobites. Whether these groups—like the ammonites at the close of the Cretaceous—became completely wiped out by some general cause (*e.g.* over-specialisation), or whether, as Dr. Steinmann believes, they developed into new forms, is a question which is argued at some length. In the case of the ammonites the author is apparently inclined to favour the view that they may have become modified into Argonauta and the other octopods, although he rejects Steinmann's theory that dinosaurs developed into great flightless birds, that were exterminated by men, or that the "enaliosaurians" gave rise to whales and dolphins and pterodactyles to bats.

TO *The American Naturalist* for November Mr. H. A. Allard contributes the second part of his account of the behaviour of bees when visiting the blossoms of cotton-plants. These bees were, of course, usually in the habit of visiting the ordinary American cottons, the flowers of these being furnished with certain nectaries which are absent in Asiatic cottons. When the insects came to fields where American and Asiatic cottons were growing side by side, they visited both indiscriminately, but when they alighted on Asiatic flowers they quickly perceived their error, and departed. "These visits of the bees to the outer basal portion of the Asiatic cotton-blossoms indicate that the visual powers alone were employed throughout the process." On the other hand, it is considered probable that bees ascertain the whereabouts of cotton fields by their sense of smell, a large area of cotton in flower giving off a distinct odour on a fine day.

THE Tertiary giraffes of India form the subject of a monograph by Mr. Guy Pilgrim, published in the *Palaeontologia Indica* (new series, vol. iv., No. 1). Years ago Mr. Lydekker, in face of the opposition of the late Prof. Rütimeyer, asserted that Sivatherium and its allies were undoubtedly giraffoids. Now that his views are definitely accepted, the list of Siwalik representatives of the group is a long one; and Mr. Pilgrim has done well in bringing the available information up to date. Following the modern fashion, he divides the Siwalik species into brachycephalic and dolichocephalic types; and he has likewise been enabled to throw considerable light on the respective geological horizons of the various forms. The most generalised Siwalik representatives of the group are described by the author under the name Progiraffa, but as one of them was, for a time, called Propalæomeryx by Mr. Lydekker, the latter designation is clearly entitled to stand. Whether it be in error or by design that some of the lower jaws are figured with the teeth pointing downwards, the effect is decidedly bad.

THE identification of the mosses collected on the Scottish Antarctic expedition having been entrusted to M. Jules Cardot, his report, received in separate form, is published

in the Transactions of the Royal Society of Edinburgh (vol. xlviii., part i.). The chief collection, from Gough Island, yielded twenty-one species, of which eleven are endemic; the solitary bog moss, *Shagnum scotiae*, is a new species, but represented also on the island of Ascension. Only two of the species are recorded from Tristan d'Acunha, and, although more common species may be expected, the author finds a closer affinity with the moss vegetation of the Magellan region. The new species from Gough Island and Ascension are described and illustrated.

THE October number of *Tropical Life* contains instructive articles on various economic products. In connection with the cultivation of the coco-nut palm, attention is directed to the fine grade of coco-nuts shipped from San San Blas, on the Panama coast, to the New York market, and to a cultivator suitable for removing strong-growing weeds from plantations. A discussion of the value of Nipa palms for the production of sugar and alcohol is based on the recommendations of Dr. H. D. Gibbs, of Manila, who affirms that an area of 100 hectares would supply sufficient raw material to keep a sugar-mill in continuous operation. Statistics relative to soya-bean cultivation in Portuguese East Africa are quoted, according to which a harvest varying from 25 to 40 bushels of seed per acre is obtainable; the yield of oil averages about 17 per cent. of the seed.

A *résumé* of recent researches into the nature of "graft-hybrids," culminating in the periclinal and sectorial chimæras obtained by Prof. H. Winkler and E. Heuer, is contributed by Dr. H. Fischer to *Naturwissenschaftliche Wochenschrift* (September 24). A description is given of the five composite types produced from grafts of the tomato and common nightshade by making an incision and so developing a new shoot from the point of union of scion and stock; and an illustration is supplied of the most complex combination, where the different branches represent the species *nigrum*, *Lycopersicum*, *Koelreuterianum*, *Gaertnerianum*, and *tubingense*. It is also explained how the solution was evolved by Dr. E. Baur from a study of the arrangement of coloured and colourless areas in the leaves of zonal pelargoniums. In both phenomena there is a mere juxtaposition of tissues derived from two original types, so that the term "graft-hybrid" proves to be a misnomer, and chimæra is accurately applied.

PROF. TITO ALIPPI has recently made a further contribution to our knowledge of the mysterious sounds known in different parts of the world as mist-poeffeurs, marinas, Barisâl guns, &c., and for which he proposes the name of *brontides* (*Boll. della Soc. Sismol. Ital.*, vol. xv., pp. 65–77). The new observations which he has collected come chiefly from the district surrounding Urbino and Rimini, in the north-east of Italy. The phenomena observed in this district follow the same laws as in other parts of Italy. They are well known in some localities and almost unknown in others not far distant. The detonations are usually described as resembling peals of thunder. They are heard most frequently in summer, with a clear sky and calm air, and generally occur in groups, and seem to come from the south-west. They do not appear to have any relation with local earthquakes, and are generally regarded by their observers as presaging bad weather, and especially snow in winter. From inquiries made elsewhere, Prof. Alippi concludes that brontides are practically absent from Sardinia and are almost quite unknown in all the western Alps.

So long as the bench-marks of the levelling system of this country are indicated by so crude a mark as the broad-arrow chiselled in masonry, or even cut upon wood, they do not respond to the needs of modern precise levelling, and small changes in such marks are not to be accurately determined. But in view of the probable relevelling of the main lines, and the employment of hemispherical-headed bolts for the principal points, the experience of the stability of bench-marks at Hamburg is of interest. There during the last twenty-five years the precise levelling has been checked from time to time, and a record of the change in level of bench-marks has been kept, the results of which are given in the *Zeitschrift für Vermessungswesen* for March 11. The bench-marks are partly on high, dry ground, and partly on moist ground which is more or less affected by the rise and fall of the tide; they are also classed as on buildings, on bridges, walls, and such masonry constructions, or on stone pillars founded on a concrete block. Of the 315 marks on the dry ground, of which 301 were on buildings, 76 have shown no settlement in twenty-five years, 118 have settled from 1 to 5 mm., 68 from 6 to 10 mm., and 53 from 1 to 4 cm. In moist ground, where 399 out of 552 marks were on buildings, 291 had settled more than 1 cm., the maximum case being 21 cm.; and of these 243 were on buildings, so that under such conditions marks on separate masonry pillars or small masonry works were less affected.

THE U.S. Weather Bureau has sent us copies of its meteorological charts of the great oceans for December. In addition to the usual data which occupy the face of the charts, the reverse sides include articles on the average air and sea temperatures for that month, illustrated by special charts. Prof. McAdie supplies some interesting details relating to the steps taken for obtaining wireless telegrams from vessels in the North Pacific, and for supplying vessels with a synopsis of weather conditions and forecasts. Cablegrams are received from Honolulu, Manila, Shanghai, and Nemuro (Japan), and, through the courtesy of the "Western Wireless Press Association," wireless messages will be sent broadcast from San Francisco daily for the benefit of vessels on the Pacific. Thus what has been accomplished on the Atlantic, as regards radio-telegraphy, seems likely to be realised shortly on the Pacific also.

AN important investigation by Dr. Hugo Karsten relating to the state of the ice in the Gulf of Finland and the northern part of the Baltic forms the sixth part of *Finnländische hydrographisch-biologische Untersuchungen*. It comprises observations made during the winters of 1897–1902, with ice-charts for each year, showing by different tints the conditions at three or four different times during the season. The state of the ice naturally differs considerably in time and space in different years, but at present there is no general and theoretical discussion of the data. This is promised with the next volume, which is to appear shortly, and will, we feel sure, be a very useful addition to our knowledge of oceanography.

IN further support of his theory of the existence in the electric discharge through vacuum tubes of "magnetic rays" made up of doublets formed by the combination of a negative electron with a positive ion, Prof. Righi describes two new experiments in the *Rendiconti* of the Academy Lincei, part iv., and in *Le Radium* for October. The first consists in bringing a bulb, in which an electrodeless discharge is being produced by an oscillating discharge through a flat coil outside it, into the magnetic field of a coil through which a direct current is flowing. The luminous ring stretches out towards the coil and becomes bell-shaped. In the second experiment canal rays are produced behind a kathode of considerable thickness placed obliquely to the axis of the tube and pierced by a small

hole at right angles to its surfaces. The canal rays are received on a plate which is connected to a galvanometer. When a magnetic field parallel to the axis of the tube is established, the "magnetic rays" produced fall on a second plate, which can also be connected to the galvanometer. This plate is found to receive no current whatever from the magnetic field, but the first plate receives a positive current, which decreases as the magnetic field increases.

In laboratories remote from large towns, the absence of a gas supply is the cause of much difficulty; and this applies to chemical, physical, bacteriological, agricultural, and metallurgical laboratory work. Carburetted water gas has been used in some cases, but has been shown to be attended with some drawbacks. We have received a pamphlet from Messrs. Mansfield and Sons, of Birkenhead, describing their oil-gas apparatus for laboratories. For the gas plant great durability and simplicity is claimed. Any kind of oil (mineral, animal, or vegetable) can be used for cracking, and no skilled labour is necessary, since putting a shovelful of coal on the fire every twenty or thirty minutes, and seeing that the oil is flowing in, is all the attendance required. The oil gas produced is permanent, has a very high calorific value, and requires no purification before use. This gas can be used in ordinary burners and appliances for laboratory use, provided that the gas jet is reduced in size to correspond with the higher carbon contents of the gas. Particulars are given in the same list of Bunsen burners, furnaces, drying and sterilising ovens, blow-pipes, and water heaters modified to burn oil gas.

The memorandum of the Manchester Steam Users' Association for the year 1910 contains some interesting investigations by their chief engineer, Mr. C. E. Stromeyer, on the trustworthiness of mild steel. Some of the results have been presented at the Iron and Steel Institute; and in the present paper Mr. Stromeyer gives subsequent data confirming the view that the presence of nitrogen gives a bad steel likely to crack in undergoing the necessary workshop processes or in subsequent working of the boiler of which it forms a part. The evidence points to the fact that steels in which the percentage of phosphorus added to five times the percentage of nitrogen exceeds 0·08 will be untrustworthy in working. The author has tried many mechanical tests with the view of discovering one which would differentiate between trustworthy and untrustworthy steels, but without success. Except as regards bad heat treatment, chemical determinations, more particularly of phosphorus and nitrogen, are the only available guides when the process of manufacture and the composition of the raw material are not known. Engineers, however, are not likely to place overmuch confidence in a test which they cannot check, and will prefer to continue to rely on the reputations of the manufacturers, combined with a few mechanical tests.

The third part of the work known as "Harmsworth Popular Science," edited by Mr. Arthur Mee, which is appearing in fortnightly sevenpenny volumes, has been received. In it the story of the evolution of the earth as the abode of plant and mineral life, the appearance of man and his gradual development, and his subsequent conquest of nature and the organisation of human society, is continued in the same popular manner as in previous issues. The work is profusely and excellently illustrated, and the account it provides of the triumphs of science will serve to encourage among ordinary readers an appreciation of the extent to which human progress is indebted to the labours of men of science.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences for December:—

Dec. 3. 19h. 39m. Saturn in conjunction with the Moon (Saturn 4° 5′ S.).
4. 15h. 55m. Mars in conjunction with the Moon (Mars 0° 50′ S.).
6. 22h. 0m. Mercury in conjunction with Lambda Sagittarii (Mercury 0° 1′ S.).
7. 7h. 0m. Mercury at greatest elongation E. of the Sun.
10. 23h. 0m. Vesta in conjunction with the Moon (Vesta 0° 28′ S.).
15. 15h. 0m. Mercury stationary.
16. 2h. 58m. Venus in conjunction with the Moon (Venus 3° 39′ N.).
22. 10h. 54m. Sun enters sign of Capricorn. Solstice.
,, 14h. 43m. Uranus in conjunction with the Moon (Uranus 4° 36′ N.).
25. 4h. 0m. Mercury in inferior conjunction with the Sun.
29. 9h. 0m. Mars stationary.
31. 3h. 59m. Saturn in conjunction with the Moon (Saturn 4° 1′ S.).
,, 20h. 10m. Mars in conjunction with the Moon (Mars 0° 1′ S.).

Observations of Mars.—Nos. 4537–8 of the *Astronomische Nachrichten* contain several important records of recent observations of Mars. Under date November 21 Prof. Lowell telegraphs: "First morning frost Mars observed since November 3, 30° from S. pole on sunrise limb."

M. Antoniadi reports an encroachment of Syrtis Major, since 1909, on the W.S.W. of Libya to the extent of about 100 km., and several other changes. The chief interest of the observations appears to be in the apparent variations wrought by changes in the Martian atmosphere. M. Antoniadi suggests that, with these eliminated, the actual changes in the majority of the small details of the planet's surface would be very few. The intrinsic colour of such "*îles*" as Argyre 1, Noachis and Hellas, it is deduced, is red, and their apparent bronze hues are produced by the passage of yellow cloud screens.

M. Comas Sola records observations made at the Fabra Observatory, Barcelona, during October 9–16. A new canal was seen on October 9 to the east of Syrtis Major; it appeared to correspond to a prolongation of Nubis, which, passing L. Mœris, extended as an arc towards Triton. The whole region of Isis and Libya was covered by an immense, oval, brilliant cloud on October 11, the new canal being completely hidden in parts; this veil afterwards moved away at about 30 km. per hour. M. Comas Sola tentatively suggests that volcanic action on Mars would account for the production of these massive veiling clouds.

Important changes are also reported by the Jarry-Desloges observatories at Massegros and Sétif. Nepenthes and Nilosyrtis are said to be enormous, and Ausonia and Hesperia greatly changed; early in November the diameter of the south polar spot was 1·2″.

Are the White Nebulæ Galaxies?—This question is attacked from several directions by Prof. F. W. Very in No. 4536 of the *Astronomische Nachrichten*, and the discussion of the various points is exceedingly interesting. Considering the relative brightness of nebulæ of different diameters, he arrives, first, at the conclusion that the light from these extra-galactic bodies does suffer absorption in interstellar space, and therefore one of the great objections to an infinitely extended universe, the apparent darkness of the sky, is explained. Then the apparent sizes and brightnesses of these bodies are compared with those of other celestial bodies of which the distances are approximately known. This leads to results as to the intrinsic brightness of the white nebulæ, hence to the question of their star-density, and, finally, it is found that these celestial objects are probably galaxies. Their diameters appear to differ to at least a fourfold extent, and the dimensions and brightness of the component stars are closely allied to those obtaining in our own stellar system. Of course many assumptions are necessary in such a discussion; but it is

interesting to note that Prof. Very deduces for the chief object of this class, the Andromeda nebula, a distance of about 1600 light-years, and suggests that the fantest and smallest of the white nebulæ may represent galaxies at a distance of one million light-years.

METEOR STUDIES.—All meteor observers would find Dr. C. P. Olivier's thesis, based on the study of more than 6200 meteors, of great interest. The determination of orbits was the primary motive, and 175 parabolic orbits have been deduced; but the other results would probably interest the average observer more. For example, the orbit of Halley's comet and that deduced for the η Aquarids are so remarkably similar that identity of origin is assured. But the size of the meteoric current is shown to be enormous, and on May 12, 1910, it was 13 million miles' radius. The evidence for stationary radiants is shown to be very weak, and the existence of such phenomena is in doubt. A special study of the so-called α-β Perseids was made, and the result indicates that they exist only in August. Duration of visibility is connected with colour, yellow meteors having the shortest, red and orange longer, and white and green meteors the longest, periods of visibility. The paper is published as an extract from the Transactions of the American Philosophical Society, N.S., vol. xxii., part i.

POPULAR OBSERVATORIES.—From time to time we have in these columns welcomed the establishment of observatories, of which the chief aim is to popularise the science of astronomy. Unfortunately, it would appear that the desire and the means to organise such institutions are greater on the Continent than here. The latest addition to the list, established at Munich, is described in No. 2007 of *La Nature*, and from the excellent illustrations it is evident that this *observatoire populaire* is well equipped. At first the organisers planned to mount the instruments on a high tower, and thus to escape some of the astronomical disabilities of an urban site; but the Commission of Architecture, which looks after the artistic amenities of Munich, decided that this project would mar the town's beauties, so the astronomers have to put up with an observatory placed at a lower altitude.

THE GREEK QUESTION AT OXFORD.

ON Tuesday, November 28, the statute providing for the exemption of candidates in the honour schools of mathematics and natural science from the necessity of offering Greek in Responsions was submitted to Convocation and rejected by a large majority, the numbers being 360 for and 595 against. The question had been thoroughly discussed by means of letters to the Press and printed fly-sheets circulated more or less widely among members of Convocation. On one side it was alleged that the modicum of Greek required in Responsions, which is practically, though not statutably, an entrance examination to the University, could be of no service to anyone who did not follow the study further, and only acted as an obstacle in the way of matters more important for the end in view. On the other side it was maintained that even a moderate acquaintance with the Greek language and literature was of value to most men; and the authority of the late Lord Kelvin was invoked in support of the opinion that this applied with especial force to those engaged in the pursuit of natural science.

An argument that was used with some force by the opponents of the statute concerned itself with the effect likely to be produced by the passing of the present proposals, followed, as they no doubt would be, by further measures of a similar nature, upon the facilities for learning Greek afforded in the smaller schools. When Greek is once made optional at the older universities, it was said, a chief inducement for the maintaining of instruction in Greek will be removed, except in the case of the great public schools, the result of which will be that many boys well capable of turning a knowledge of Greek to good account will be deprived altogether of the opportunity of learning it.

There is no doubt whatever that some of the opposition to the statute was due to the fact that many of its supporters openly avowed that they regarded it as a mere temporary compromise, to be followed in due course by more stringent limitations on compulsory Greek. This deterred many who would have voted for the statute if it had been put forward and supported as a final settlement of the question. On the other hand it is at least highly probable that many supporters of the statute disliked its provisions, but voted for it because they knew that it would not dispose of existing difficulties, and that it might be replaced in course of time by something more to their mind.

Much interest was aroused over the question as to how far a body like Convocation, which is largely non-resident, could legitimately be appealed to against the decision of what was presumably a majority of resident teachers. On one hand it was held that Congregation, the members of which are resident and to a great extent engaged in the actual teaching and examining work of the University, must be best qualified to judge of the educational requirements of different classes of undergraduates. On the other hand it was pointed out that Convocation, consisting for the most part of men who after completing their university education had passed out into the world and joined the ranks of the various professions and public services, would be well qualified to estimate the value of the education which they themselves had received, and desired by them for their own sons. A matter of broad educational policy, it was maintained, might properly come within the purview of the latter body, while questions of detail should be left in the hands of the resident teachers. In addition to this it was pointed out that the majority by which the measure passed Congregation was very far indeed from being a majority of the whole body, less than half of the members of Congregation having actually recorded their votes on that occasion.

Notwithstanding the figures of last Tuesday's division, it would be a mistake to suppose that any considerable number of people are entirely satisfied with the present system of entrance examination. There is little doubt that the question of reform will again be mooted; and it may be hoped that some plan may be devised, perhaps on the lines of a "leaving certificate" to be gained at school, which will secure a reasonable amount of support from all parties.

PAPERS ON INVERTEBRATES.

AMONG a number of papers relating to invertebrates which have recently come to hand, the following are selected for notice:—

Bulletin No. 16 of the Connecticut Geological and Natural History Survey is devoted to the first two parts of a guide to the insects of that State, prepared under the direction of Dr. W. E. Britton. Part i., comprising a general introduction, is by the editor, while in the second part Mr. B. H. Walden treats the Euplexoptera and Orthoptera. Special attention is directed to the economic aspects of the subject.

The British spiders usually included in the heterogeneous group Tmeticus and certain allied genera form the subject of an article by the Rev. J. E. Hall in the third part of vol. iii. (new series)) of the Transactions of the Natural History Society of Northumberland, Durham, and Newcastle. It is now shown that the group is divisible into sections, one represented by Centromerus, in which there are only three outer falcal teeth, and the other by several genera (some of which are named for the first time) in which there are four or five of these teeth.

In a note on the Crustacea obtained during the trawling expedition fitted out by the New Zealand Government in 1907, Dr. C. Chilton (Records Canterbury Museum, vol. i., No. 3) states that the shell of a crab of the genus Paramithrax seems to be almost invariably infested by barnacles (*Balanus decorus*), which are in some cases so numerous and so large as to exceed the crab in bulk. A hermit-crab (*Eupagurus stewarti*) was found in some cases inhabiting a massive polyzoon apparently too big for the crab to move; in other cases it sheltered in straight tubes in a Millepora, these tubes, it is suggested, perhaps having been originally formed round sea-weeds, which subsequently rotted.

To the same author we are indebted for copies of two papers on local crustaceans, published in vol. xliii. of the Transactions of the New Zealand Institute. In the former of these Mr. Chilton revises the New Zealand representatives of the group (Stomatopoda) typified by the familiar European *Squilla mantis*, while in the second he catalogues the crustaceans at present known from the Kermadec Islands. Despite the fact that the crustacean fauna of those islands has been systematically collected, for the first time no new forms are recorded.

As the result of the examination of a collection of rotifers obtained from Clare Island, west coast of Ireland, Mr. C. F. Rousselet (Proc. R. Irish Acad., vol. xxxi., p. 50) finds that these organisms do not differ materially from those of the mainland.

On the other hand, in a paper on Irish annelids of the family Maldanidæ, Mr. I. Arwidsson (*ibid.*, vol. xxix., Sect. B, p. 209) finds himself in a position to name and describe two new species, one of which is also regarded as entitled to represent a new genus.

In Bulletin No. 71 of the U.S. National Museum is published the second part of Mr. J. A. Cushman's monograph of the Foraminifera of the North Pacific, this instalment being devoted to the primitive family Textulariidæ. Several new species and a few new genera are described. The group has been found to be of considerable interest from the distributional point of view. It is stated, for instance, that "many of the species occurring in the Indo-Pacific area extend southward to the region of Torres Strait. In the North Pacific, however, these species are, as a rule, confined to the western portion from southern Japan southward. The rediscovery of some of the species described by J. Brady, from almost the exact locality where they were dredged by the *Challenger*, is very interesting, and tends to show the restricted distribution of certain forms."

Rotifers of the bdelloid group indigenous to South Africa form the subject of an article, by Mr. J. Murray, in vol. iii., No. 1, of the Annals of the Transvaal Museum. Although the Central and North African representatives of the group had received some attention, very little was known with regard to those of the South, so that the author has been able to make considerable additions to our knowledge. The paper concludes with a summary of what is known with regard to African bdelloids generally.

In vol. viii., Nos. 4–6, of the University of California Zoological Papers Mr. C. A. Kofoid continues his account of the dinoflagellate animalcules of the San Diego area, dealing in the first two papers with the genus Gonyaulax and the morphology of its skeleton, while in the third (forming the fifth of the whole series) he describes, under the name of Spiraulax, a new generic type of the peridinid group.

The nine species of earwigs now found in the British Islands (some of which are introduced) form the subject of a coloured plate in the October number of *The Entomologist's Monthly Magazine*. According to Dr. M. Burr, nearly all these earwigs, with the exception of the common species, are rare and local. R. L.

LIPOIDS AND NUTRITION.

A WORD is perhaps necessary in explanation of the term lipoids. These are substances, contained in the outer protoplasmic layer of all cells, which resemble the fats in being soluble in organic solvents. They appear to be essential constituents, and are specially abundant in that tissue which pre-eminently manifests "vital properties," namely, the nervous tissues. The majority of them, though by no means all, contain both phosphorus and nitrogen. Very little is as yet known as to their constitution and properties.

At the present moment, when so much attention is being devoted to problems of nutrition, a communication by Prof. Stepp, of Giessen (in part v. of the *Zeitschrift für Biologie*), is of very considerable interest. The idea has been gaining ground that an ordinary diet contains certain constituents, present only in minimal quantity, the presence of which, in addition to the proper proportions of protein, carbohydrate and fat, is essential for growth and the maintenance of life. Experiments made with rice in connection with "beri-beri" have pointed to such a conclusion; and the work of Prof. F. G. Hopkins, of Cambridge, of which, so far, only a preliminary account has been given, has gone very much further in the same direction.

Prof. Stepp, who selected mice for his experiments, has studied the effect of extracting the food very completely with alcohol and ether before administration. The food used consisted of a dried mixture of rice, treated so as to be particularly rich in protein, and new milk; before extraction it was found to be a very satisfactory nutrient for mice. When fed, however, with the extracted food, the mice very soon died, showing that an essential constituent had been extracted from the food. The addition of mineral salts to the extracted food did not make it of any greater value, but the addition, on the other hand, of the evaporated extract enabled the mice to remain alive and thrive. Extraction in the manner described removes, amongst other things, fats from the diet. Accordingly, experiments were made in which butter or fats such as tripalmitin, tristearin, or triolein were added to the extracted food; in no case was the addition of the faintest value in preserving life. The essential substance is considered to be a lipoid which is absent from butter, though present in the milk plasma. In proof of this it is established that an extract of dried butter-milk when added to the extracted food is sufficient to keep the mice still in good condition at the end of six weeks. It is possible to measure the quantity of this lipoid required; and the experiments show that whereas the evaporated extract of 75 c.c. of milk per 100 grams of solid extracted food was insufficient, that from 200 c.c. of milk was more than enough to maintain health.

Certain of the lipoids have been isolated in a pure state, and their effect could be tested; it was proved that the addition of either lecithin or cholesterol to the diet was of no use. The essential substance is therefore of a very subtle character. Stepp's experiments with boiled milk are of some interest; though boiled milk by itself is of value to the animals, the alcoholic and ethereal extracts of it when added to the extracted food are unable to maintain life.

If these conclusions are substantiated, an altogether new trend will be given to work on nutrition.

WATER RESOURCES OF THE UNITED STATES.

OF the three volumes recently issued by the United States Geological Survey, that (No. 256) on "The Geology and Underground Waters of Southern Minnesota," by Messrs. Hall, Meinger and Fuller, is certainly the most interesting, and claims primary notice. It is a brochure of 406 pages, with a number of sections and diagrams and four folding maps, all descriptive of matters, physiographical, geological, and chemical, connected with water supplies in the southern two-fifths of the State of Minnesota—an area of 28,265 square miles, which is roughly about the size of Scotland or Ireland. The district contains two towns of importance, Minneapolis and St. Paul; but, apart therefrom, the whole, with its 1¼ million inhabitants, is essentially agricultural in character. The surface comprises three elevated plateaus of different levels, with trough-like depressions between, all, with the exception of the extreme south-east and south-west corners, composed of glacial drift deposited during the most recent ice invasion. "Nowhere is there a more typical example of a ground moraine left in the wake of a continental ice sheet than is exhibited by the extensive, slightly undulating, monotonous expanses of southern Minnesota, dotted with countless shallow lakes and ponds, and covered with an interminable network of swamps."

Generally speaking, the drift is yellowish at the surface to a depth of some 15 feet, where it changes to a dark colour, due, no doubt, to the presence of unoxidised iron; and the water contained in it is almost universally charged with that mineral in the soluble ferrous condition. The effect of this, and of other constituents, on the utility and value of the water for various purposes is discussed at some length, and the volume then proceeds to deal with

the subject of well-sinking, after which there is a useful series of analyses and particulars of the water obtainable in different localities.

Pamphlet No. 274, on "Some Stream Waters of the Western United States" (Herman Stabler), is almost purely statistical throughout, and gives analytical tables of the constituents of water taken from the basins of the Rivers Colorado, Columbia, Mississippi, Rio Grande, and Sacramento.

Pamphlet No. 265 deals with the "Surface Water Supply in the Basins of Hudson Bay and the Upper Mississippi." The observations are by Messrs. Follansbee, Horton and Bolster, and are akin to those already described in connection with others of the dozen districts into which the States have been mapped out for the purposes of hydrological investigation.

ROMAN SURVEYING.

IN the *Zeitschrift für Vermessungswesen* (Heft 21, 1911) Prof. E. Hammer discusses the precision with which the nations of antiquity were able to mark out lines on the surface of the earth with the means at their disposal. Taking, first, that portion of the frontier of the Roman Empire which existed as a straight line about 80 kilometres long from near the River Rems in Württemburg to the district of Wallfürn in Baden, he investigates the question whether this line was laid down approximately straight by chance, or whether it was intended to be a straight line and special care was taken to arrive at this result. Points on the line were located and their positions plotted on the cadastral maps (scale 1 : 2500), from which their coordinates were determined. From these the direction-angle of portions of the line was calculated, and also the mean departure of points on the boundary line from the true straight line. For a portion amounting to 29 km. of the whole length, the mean error in position of a point on the boundary was found to be ± 2 metres, which indicates a surprising accuracy in carrying such a line over rough ground, while for portions of it an even greater precision was attained. Further observations by Prof. Leonhard, not yet published, on the remaining 50 kilometres of the boundary indicate that the accuracy is there maintained. The Romans must have fixed a few principal points in prominent positions by signals at night, and then interpolated intermediate points; the observed accuracy could never have been attained by prolonging a line.

A second case is that of the amphitheatre at Pola, laid out by a Roman architect or land surveyor, which has been recently studied by an Austrian surveyor, Herr Hofrath A. Broch. Using a plan on a scale of 1 : 250, he investigated the accuracy with which the form of the amphitheatre as constructed approached an ellipse. Taking twelve points on the curve, their mean error in position from a true ellipse was but 15 cm., in spite of the weathered surfaces of the stone contributing to this uncertainty. The axes of this ellipse were $2a = 129{\cdot}9$ m. and $2b = 102{\cdot}6$ m., or in the ratio of very nearly 9 : 7, as in the case of many Roman amphitheatres. Prof. Hammer goes on to refer to the results obtainable in a similar way from stone circles, where it is important to determine not only their dimensions, but also their accuracy of construction. The accuracy attained at Stonehenge is referred to; and in mentioning the "Standing Stones of Stenness" he suggests that in the circle of 340 feet in diameter, formed of about 60 stones $17\frac{3}{4}$ feet apart, we may have had a circle of 60 stones exactly ($60 \times 17\frac{3}{4} = 1060$) indicating a sexagesimal division of the circle.

THE NATURAL HISTORY OF TYNESIDE.[1]

AMONG the natural history societies of this country that of Tyneside stands out by reason of its illustrious traditions and successful enterprise. Without municipal assistance it has originated and maintained for many years a museum of high standing, and its members have contributed classical memoirs on the geology, flora, and fauna of Great Britain. The names of William Hutton, of the two Hancocks, of Joshua Alder, and of Hewitson, to mention only a few, are associated with some most careful and beautifully illustrated work. It is therefore fitting that an account of these men and of other single-minded devoted students of natural history who have worked on Tyneside should be commemorated in these Transactions as has been done in an article by Mr. Leonard Gill, the curator of the Hancock Museum. This article is the one of most general interest in the volume before us; but there are also other papers of more than local importance to which we may direct the attention of workers who are following similar lines of investigation.

The most important of these is the account of the Crustacea of Northumberland and Durham by Canon Norman and Dr. G. S. Brady. This is the most complete of any county list for this class, since the fresh-water and terrestrial forms are included in an exhaustive study that has occupied almost the lifetime of these distinguished carcinologists. Scattered through these records of 644 species are many interesting remarks; for example, the prevalence during the winter of Arctic Euphausiids, which are brought by a southward current so far down the east coast as Yorkshire: and the rediscovery of the Daphnid Leydigia, after a lapse of twenty years, in remarkable circumstances. In spite of the length of this list, two forms that might be expected to occur are not mentioned. Neither Cheirocephalus nor any Phyllopod is recorded, and Leptodora, so common in Cumberland, is apparently absent from Northumberland and Durham.

Perhaps the chief feature of these Transactions is the amount of attention that has been given to the study of obscure or neglected groups of invertebrates. In this respect the papers by Mr. Bagnall are especially worthy of mention. This indefatigable naturalist has not only dealt with the Collembola, but also with two much neglected groups of myriapods, the Pauropoda and Symphyla, and with the little-known Thysanoptera, or thrips. These papers constitute a valuable addition to our knowledge of the British Cryptozoic fauna. The arachnids, again, are energetically and successfully studied by members of this society; and several papers by Dr. Rendall Jackson and the Rev. T. E. Hull constitute not only additions to our knowledge of this section of the British fauna, but to that of the order as a whole. The careful description of that very rare Coal-measure arachnid *Anthracosiro woodwardi*, Pocock, by Mr. Leonard Gill, is a comparative study of the specimens found near Newcastle and elsewhere. Lastly, Miss M. C. Lebour's papers on the trematodes of the coast constitute a further instalment of good work on a very little known group; and there are other papers on topographical geology which we have not room to discuss. The society is to be congratulated on such a substantial output of valuable scientific work. As a suggestion, may we point out the desirability of printing the author's name as a headline on the left-hand page of these memoirs in order to facilitate references?

[1] Transactions of the Natural History Society of Northumberland, Durham, Newcastle upon-Tyne. New Series. Vol. iii., parts 1, 2, and 3. (London: William- and Norgate, 1908–1911.)

CANCER RESEARCH.[1]

THE Fourth Scientific Report, apart from the introduction, is restricted to three papers. The first, on spontaneous cancer in mice, by Dr. Haaland, treats of a large number of additional spontaneous tumours of the mouse since the Third Scientific Report was prepared. These tumours consist of carcinomata and sarcomata occurring in a variety of sites other than the mamma, and are considered from clinical, pathological, histological, and experimental points of view. The animals in which they were found have been submitted to a number of experimental tests in order to elucidate the relation between a tumour and the animal in which it arises. The second paper, on cancerous ancestry and cancer in mice, by Dr. heredity, which have been in progress for some six years with mice of known ancestry, and from which a large number of the tumours and mice studied in the first paper have been obtained. The third paper, on the behaviour of Murray, deals with breeding experiments bearing upon tumour-cells during propagation, is a general survey of the

[1] From the introduction to the Fourth Scientific Report on the Investigations of the Imperial Cancer Research Fund. By Dr. E. F. Bashford. Pp. xxi+223. (London: Taylor and Francis, 1911.)

observations made on all the tumours observed or propagated in the laboratory during the past eight years, and of the bearing of their relative constancy and variability upon the nature of some forms of cancer.

All three papers are intimately interdependent as regards the material upon which they are based, and they overlap in so far as each treats more especially of particular problems not excluded from consideration in the other two. Thus, as in all previous reports, the effort is made to co-ordinate the features of cancer as it occurs naturally with its behaviour under experimental conditions.

New facts are brought forward in support of the view that a malignant new growth arises from local causes in a circumscribed area, and that the relation of each malignant new growth to the affected animal is an individual one, parallel to that obtaining between the organs of the body and the organism as a whole.

Precise evidence is advanced of the existence of hereditary predisposition to the development of spontaneous cancer. It is apparently of the nature of a predisposition of certain tissues to pass into cancerous proliferation, and is not effective by determining an increased suitability of the animals primarily affected for the growth of cancer as tested by transplantation.

Tumour-cells derived from a single primary growth are shown to be liable during extended propagation to variations such as are met with, either singly or in combination, in other primary growths. It is assumed that this demonstration permits of the inference that corresponding variations occurring in the course of the prolonged proliferation of normal cells under the influence of chronic irritation may be responsible for the development of some forms of cancer.

The relations between benign and malignant new growths, and of both to normal tissue, have been studied both histologically and experimentally on an extensive material. Among the large number of tumour-strains that have been propagated by *passage* from one batch of mice to another for extended periods, there are included several reproducing very closely the features of normal tissue, either as regards its histology or its limited[2] power of growth in any one animal after homologous transplantation. Some tumour-strains, while retaining almost perfect histological differentiation, grow progressively in any one animal; while others, notwithstanding that they are quite devoid of histological differentiation, possess only a limited power of growth in any one animal. The gaps between the structure of normal tissue and the least differentiated tumours, on the one hand, and between the growth of normal tissue, when transplanted, and that of even the most rapidly proliferating tumours on the other, have been filled in by a continuous series of tumour-strains. Some of these approximate to normal tissue both in respect of structure and of power of growth on transplantation, and experiment has brought out still more clearly the pure arbitrariness of the conception of a fundamental difference between benign and malignant new growths.

The demonstration that cancer occurred in practically all races of mankind and throughout the vertebrates even when living in a state of nature, together with the demonstration of the only manner in which cancer can be transferred from one individual to another of the same species, viz. by implanting living cells, proved that it was not due to a common causal parasite. The wide zoological distribution of the disease, down to marine fishes, showed that it was not a recent acquirement such as might be referred to influences dependent on man's particular forms of civilisation. As has been frequently pointed out, the age-incidence of cancer in man and animals is, in the absence of communicability, compatible only with the recognition of the intrinsic cellular nature of cancerous proliferation.

The parallel behaviour of normal and cancer tissue, both as regards the absence of continued growth and the nature of the cytotoxic reactions induced when cancer is transferred from one animal to another of a strange species, proved that cancer had all the properties distinguishing the normal tissues of one species from those of another species.

[2] In spite of being possessed of a power of only limited growth in any one animal, tumours can be maintained in extended propagation by suitably accelerating the rapidity of *passage*. This has not yet been accomplished in the case of normal tissues.

The fact that transplantable tumours grow in normal animals as well as they do in spontaneously affected animals is evidence that the latter do not present a soil for the growth of cancer substantially different from that presented by normal animals. When this fact is contrasted with the almost invariable success of reimplanting into the animal a portion of its own spontaneous tumour, and the almost invariable failure of implantation of any spontaneous tumour into other spontaneously affected animals, the conclusion is arrived at that each tumour is peculiarly and genetically related to the individual in which it arises.

This conclusion, drawn from studying the growth of tumours under the different conditions just enumerated, is supported by the results of elaborate experiments on inducing resistance or immunity to the inoculation of cancer-cells under these different conditions. The features of resistance bearing upon the nature of cancer are briefly as follows. Resistance is induced only by the living cells, either cancerous or normal, of the same species. Under similar conditions the cancerous cells and the normal cells of strange species are both devoid of the power to induce resistance. An animal's own tumour and its own normal tissue are devoid of this power, and the means which prevent the successful inoculation of the tumour of another individual do not prevent the successful inoculation of an animal's own tumour. Tumour-tissue usually induces resistance against itself quite as well as, and, with regard to the phenomenon of spontaneous healing, much more effectively than, any other tumour. Furthermore, animals which have proved resistant to the repeated inoculation of a tumour have subsequently developed spontaneous tumours showing progressive growth. Thus experimental inquiries into the production of growth by inoculation, on the one hand, and its prevention on the other, agree in demonstrating individual relations as obtaining between a tumour and the animal in which it arises. The individuality of tumour-cells will be referred to later.

The individuality of cancer, both as regards the organism attacked and the tumour, would thus appear to have been placed at last beyond all further doubt. Such a relationship has long been maintained in various forms on the basis of deductions drawn from histological examination of the tissues at the site of the primary lesion and from the nature of dissemination; but this interpretation of the findings has been as vehemently combated. The combination of the results arrived at by microscopical investigation and experimental study appears to complete the demonstration. A long step has thus been taken in defining the direction in which the future investigation of cancer is alone likely to be profitable.

The conclusions as to the individuality of cancer are supported also by most important new statistical information given in the last report of the Registrar-General.[3] The new tabulation of the data for the years 1901–9 for England and Wales has permitted of an analysis being made of the figures recording the increase of deaths attributed to cancer, which brings out the fact that the increase during this period is referable to certain anatomical regions and not to others. For the first time it is fully demonstrated that it is erroneous to make statements of a disquieting nature about the increase of cancer in general. The analysis also shows that the incidence is very unequally distributed among the several situations, indeed, that the whole curve of incidence may be different for different organs. A progressive increase up to the highest age-periods is characteristic of the face, lip, mouth, bladder, urethra, and breast only. The other organs show a distinct diminution in the highest age-periods; but it is not yet possible to determine whether this curve indicates a liability rising to a maximum and followed by a fall, or is merely the result of ascribing deaths to other causes in the case of cancer of internal organs in aged people. Sufficient has been said to indicate how important are the problems which are solved or revealed by the improvement in the details given in the national statistics.

The study of the occurrence of cancer in mankind, and in domesticated animals in widely separated parts of the globe, has shown that the practice of peculiar customs (involving

[3] Seventy-Second Annual Report of the Registrar General of Births, Deaths, and Marriages in England and Wales (1909). (His Majesty's Stationery Office, 1911.)

the application of chronic irritants to particular parts of the body) provokes the disease in situations and organs from which it is absent when these customs do not obtain. It is reasonable to suppose that the frequency of cancer would be diminished if such practices as the use of the Kangri in Kashmir, chewing betel-nut in India, and eating very hot rice in China were discontinued. It is also reasonable to assume that the introduction into England of these exotic customs would greatly increase the frequency of cancer in this country.

So definite is the evidence of the *mediate* causation of certain forms of cancer by chronic irritants that the possibility of variations in the cancer death-rate may be admitted as regards particular organs and regions of the body. The possibility of a variation of the main incidence of cancer in conformity with changes in certain customs may also be admitted.

That irritation is really an important causative factor of cancer is an assumption which at present is justifiable only for certain forms of cancer occurring in particular parts of the body. In view of these considerations, and also because of the results of experiment as recorded in this report, it appeared desirable to have data of the incidence of cancer in persons pursuing various occupations and having different habits of life. For the purposes of comparison it will be necessary to learn not only the incidence of cancer on particular sites liable to irritation, but also its incidence on all other sites, as well as the frequency of the other causes of death in the occupations considered.

Breeding experiments with mice of known ancestry have been in progress for many years, and have been alluded to on several previous occasions, but only now have the data become sufficiently numerous to permit of conclusions being drawn. All due precautions have been taken to avoid errors in the interpretation of the figures. The data show that heredity plays a part in affecting the liability of the mouse mamma to develop cancer. At all age-periods the disease is more frequent when the mother, or either grandmother, or all three, have died from cancer of this organ than in the group in which these ancestors were free from the disease.

Apart from its bearing upon heredity, the obtaining of such mice is most important for furthering the experimental investigation of the genesis, nature, and, should it be necessary, artificial production of cancer, and for attempting to define the reasons for its apparently greater frequency in some geographical areas than in others. It will be obvious that a large field of investigation has been opened up by the segregation of mice into two groups of different liability, and it should be possible to obtain groups of animals of a still higher and a still lower liability. While it is at present impossible to explain how the liability is transmitted, it can be averred with certainty that it does not consist in the inheritance of a soil more suitable for the growth of cancer in general. It can only be inferred with some probability, that it is a local or circumscribed tissue predisposition, in virtue of which the mammary tissue is prone to pass from mere proliferative reaction into continuous or cancerous proliferation. Further, hereditary predisposition is only one of the factors concerned, for it has been found that chronic inflammatory changes are remarkably frequent in the mammæ of female mice of the laboratory; and other factors still unrecognised may exist. There is a considerable body of evidence to show that the predisposition is not a general one affecting the whole body equally, but that the tendency transmitted affects mainly one organ system, so that groups of animals may ultimately be obtained in which different organ-systems will present a definite predisposition, the other organs of the body not being unduly liable to the development of the disease.

To guard against pessimistic conclusions, it is well to point out that the influence of heredity has only been demonstrated by studying stocks in which this factor has been concentrated by careful mating, and that the influence is mainly exerted in the immediate descendants. Such a concentration as can be attained in experimental animals can only occur in the human subject, by hazard, as a coincidence of considerable rarity; and it is probable that the influence of heredity in the general population is manifested as an average predisposition of low general intensity.

In all previous reports guarded reference has been made to the well-known association of chronic irritation and certain forms of cancer, and it has been pointed out that, in common with all external conditions, they can only have *mediate* relation to the occurrence of cancer, the essential preliminaries which lie between them and its inception being regarded, not as their specific reactions, but as manifestations of properties inherent in the cells. The employment of the term "mediate" when directing attention to the relationship is due to an effort to elucidate those forms of cancer with which irritation is most constantly associated, without considering other forms in which the particular irritants concerned do not play a part, and due to the fact, already frequently emphasised, that these irritants have nothing in common beyond the capacity to excite extended proliferation of tissues (chronic inflammation), and their association with cancer.

The varied investigations of the past nine years have added a knowledge of new forms of irritation. It has become more and more evident that irritation, effective in one case, may be, and often is, quite ineffective in another species of animal, or even in other individuals of the same species. The experiments recorded in this report throw light both on the nature of predisposition to cancer, as alluded to above, and also on the long recognised, but inexplicable, relation between chronic irritation and cancer.

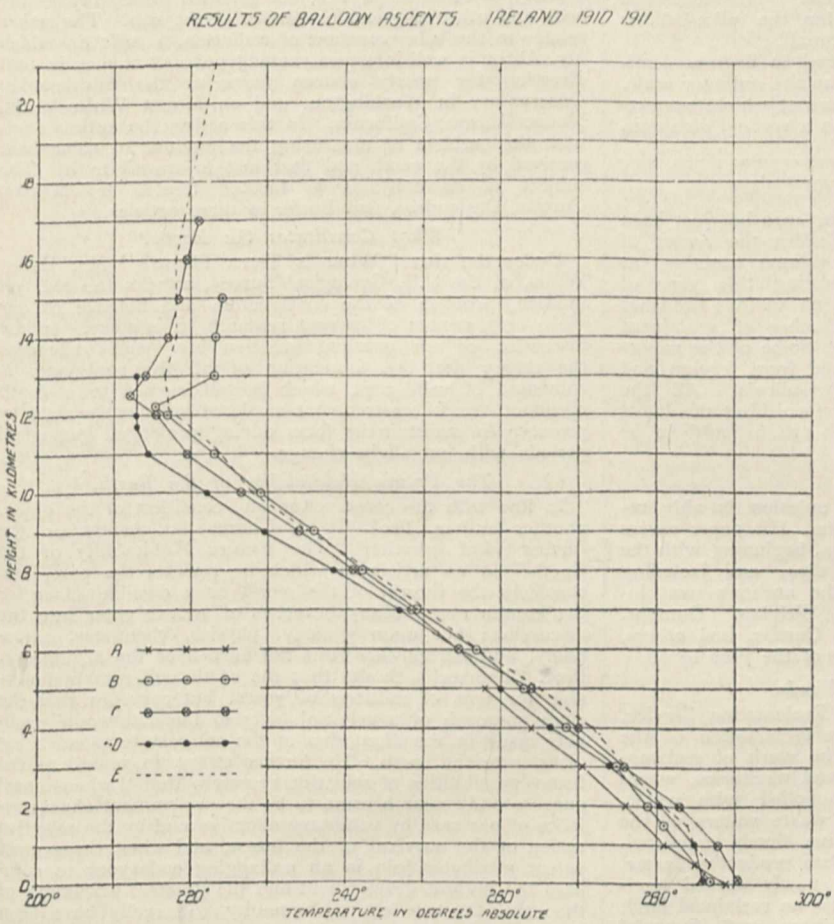
A closer definition of the nature of cancer will involve an analysis of the relation obtaining between the individual developing cancer and the tumour. This final analysis will be possible only on animals naturally afflicted with the disease, for, as pointed out consistently from the first annual report onwards, the genesis and the growth of cancer are distinct phenomena. The study of propagated cancer supplements its observation under natural conditions by investigation under varied artificial conditions, and has only an indirect bearing upon the genesis of the disease. Hence breeding experiments acquire enhanced significance, and are already being, and will continue to be, conducted on a much more extensive scale. An adequate supply of animals of differing liability to the disease must be made available for the elucidation of problems, some of which are already adumbrated; while past experience makes it likely that others, as yet unsuspected, will arise.

Because of the hope that they may ultimately have therapeutical bearings, another reference may be made to the induction of resistance to the inoculation of cancer and the means which modify the growth of transplanted tumours. Experiments along these lines bear at present upon the nature, but not upon the prevention, treatment, or cure of cancer; notwithstanding this fact the application of the results to the human subject has been urged in some quarters. In 1906–7 it was pointed out that a high degree of resistance to the transplantation of cancer did not exempt an animal from the spontaneous development of the disease. The importance of the observation was great; had immunity to the natural acquirement of cancer been also obtained, the control of the scourge would have been in sight.

In the Third Scientific Report the previous warning was re-enforced, and it was pointed out that none of the methods which had been found to influence transplanted cancer should be applied to man until they had been tested and found efficacious in the case of animals naturally affected. These warnings are borne out by further experience and inability, as yet, to modify the growth of cancer in the animal naturally affected. Instead of revealing analogies with infective diseases, and placing similar remedial and preventive measures in the hands of the physician and surgeon, the study of resistance to cancer has, until now, but brought investigators to the verge of a region filled with problems previously undreamt of. In the solution of these problems, or of more crucial ones not yet reached, lies the best hope of preventive and remedial measures; but the preliminary facts are so new to experimental biology, and as yet so imperfectly comprehended, that observers throughout the world are still engaged in discussing what may be their true significance as signposts indicating a road or roads by which the correct advance is to be made.

INVESTIGATION OF THE UPPER ATMOSPHERE.[1]

THE results of the observations at Barbados, referred to in last year's report, have been discussed by Mr. Cave in a paper read before the Royal Meteorological Society and published in its Quarterly Journal. A further supply of balloons and hydrogen has been sent to Prof. D'Albuquerque in order that he may continue the observations. Some difficulty has been experienced owing to the deterioration of rubber balloons in the climate of Barbados.



During the week August 7–13, 1910, for which international balloon ascents had been arranged over a large part of the northern hemisphere, arrangements similar to those described in last year's report were made for securing successful ascents in the British Isles, telegraphic forecasts being sent each day by the Meteorological Office to the observers. Altogether thirty-one balloons were liberated, of which nineteen were recovered and sixteen gave records of temperature to heights exceeding 10 km. Of the latter, five were sent up from Crinan, Scotland, five from Pyrton Hill, Oxfordshire, three from Manchester, two from Ditcham Park, Petersfield, and one from Oughterard, Ireland.

The British Association grant was allocated partly to ascents made by Captain Ley at Oughterard, latitude 53° 25′ N., longitude 9° 20′ W., in the west of Ireland, and partly to ascents made from Mungret College, Limerick. At Oughterard six registering balloons were sent up, and two of these were recovered. The results are shown in the diagram, A and B.

At the March meeting of the committee it was suggested that the authorities of Mungret College, Limerick, who had given evidence of keen interest in meteorological work, might be willing to liberate balloons during the international week. Such a course would avoid the recurrent expense involved in special journeys to Ireland for the ascents, and would permit of more frequent ascents being made. The college authorities expressed their willingness to fall in with the suggestion, and Mr. W. H. Dines undertook to provide instruments and balloons for preliminary ascents in connection with the short international series in June this year, and to send over someone to give necessary instructions in the preparation for the ascents.

Three balloons were liberated on this occasion, and two of them were recovered and gave records of temperature, in one case up to 17 km. The results are shown in the diagram, C, D. A balloon was also liberated from Mungret College in July, and the result is shown under E.

At the request of the joint committee, the International Commission courteously postponed the week for international ascents this year from September 4–9 to September 11–16, in order to permit of those taking part in the ascents attending the meeting of the association at Portsmouth. Arrangements have been made for further ascents from Mungret College during that week. (Since this report

Results obtained from Ascents of Registering Balloons in Ireland.

	August, 1910		June, 1911		July, 1911
	A Oughterard, August 8, 8.10 p.m.	B Oughterard, August 11, 7 a.m.	C Limerick, June 8, 7 a.m.	D Limerick, June 9, 7.10 a.m.	E Limerick, July 6, 7.10 a.m.
Max. height	5·0 km.	15·0 km.	17·0 km.	13·0 km.	21·0 km.
Minimum temperature ...	—	216° A (at 12·2 km.)	212° A (at 12·5 km.)	213° A (from 11·7 to 13 km.)	216° A (at 12·7 km.)
Place of fall	Clear Island, Co. Mayo	Moyvore, Westmeath	Kildysart	Buttevant	Cooleeney
Distance	? 50 km.	83 km.	31 km.	48 km.	56 km.
Direction *	? 0°	80°	280°	185°	68°
H_C, T_C	—	12 km., 217° A	12·5 km., 212°, 216° A	11·7 km., 213° A	12·7 km., 216° A

Notes—B. The heights above 8 km. are rather doubtful, as the original calibration marks relating to the pressure are uncertain, and the instrument was returned badly damaged. C. Wind E.N.E., light. Faint cirrus. D. Wind N.E., force 3. Cumulus, no high clouds. A rather different type of instrument was used, and the double record may be in part due to lag. E. Calm, cloudy, cirrus moving slowly from W.

* Direction 0° = N, 90° = E.

[1] From the tenth report of a committee presented at the Portsmouth meeting of the British Association, Dr. W. N. Shaw (chairman), Mr. E. Gold (secretary).

was presented the ascents have taken place. Six balloons were liberated, and five of these have been recovered.

It is desirable that observations of pilot balloons should be obtained in Ireland in addition to the records from registering balloons, and the committee recommend reappointment, with a grant of 50*l.*, to permit of this extension of the work. A special theodolite, costing about 30*l.*, is necessary for the observations. The additional outlay on balloons and hydrogen for the pilot-balloon observations would be comparatively small.

In the table temperature is expressed in degrees centigrade above the absolute zero $-273°$ on the ordinary scale. H_c is the height and T_c the temperature at which temperature begins to be practically constant in a vertical direction.

A SCIENTIFIC MISCELLANY.

THE Smithsonian report for the year 1910 has just been published by the institution. Besides the report of the regents and the secretary, the volume contains, as usual, a "general appendix," consisting this year of thirty-four papers of popular interest on various branches of science, also biographies of a number of prominent scientific men who have recently died. Some of the papers are original, while others are reprinted from foreign and domestic scientific and technical periodicals. All the articles are selected with the view of furnishing the latest accurate information on topics which are believed to be of interest to a wide circle.

Aviation.

A review of modern progress in aviation is ably recorded by the late Mr. Octave Chanute. His paper covers the principal advances made in aviation, beginning with the experiments of Hiram Maxim in 1894, and including Langley's experiments (1896–1903), the author's own investigations, the work of the Wrights, Dumont, de Lagrange, Farman, Blériot, Bell, Curtiss, and others, bringing the subject down to the close of the year 1909.

Reclamation of Arid Lands.

Mr. F. H. Newell, director of the Reclamation Service, sets forth the recent progress in the reclamation of the arid lands in the Western States. The work of reclamation includes all the Western States and territories, where nearly 10,000 families are being supplied with water. Through this great undertaking the waste waters of the West are being conserved, destructive floods prevented, apparently valueless lands converted into productive farms, and thousands of families settled in newly opened territory, where they are maintaining homes on reclaimed land. Besides engineering, with its business and financial problems, the article deals with many other subjects, such as the character of settlers, the size of farms, crops, &c., and the individual projects which together furnish water for about 1,000,000 acres, nearly one-half of which is already settled.

Electric Power from the Mississippi.

A kindred topic is the great electric power plant at Keokuk, Iowa, with its 4278-foot concrete dam across the Mississippi River between Keokuk, Iowa, and Hamilton, Ill. This subject is treated by Mr. Chester M. Clark in a well-illustrated article entitled "Electric Power from the Mississippi River." The paper shows the development of the largest single hydro-electric plant in existence through the construction of what is undoubtedly the greatest bank-to-bank dam in the world.

Papers on Physics, Chemistry, and Astrophysics.

Under the heading of physics there is an account, by Mr. T. Thorne Baker, of experiments and researches in the telegraphy of photographs, transmitted by both the wire and the wireless systems; Prof. Jean Becquerel, professor at the Museum of Natural History of Paris, has permitted the translation of his valuable paper on modern ideas on the constitution of matter, comparing the old theories of matter with the newer views recently confirmed by experiments; and Mr. R. A. Millikan has abridged his treatise on "The Isolation of an Ion," which deals with the exact measurement of an elemental electrical charge and several analogous problems.

Dr. Charles E. Munroe, professor of chemistry at George Washington University, and a well-known authority on explosives, has written an interesting paper on the modern developments in methods of testing explosives.

Mr. C. G. Abbot, director of the Astrophysical Observatory of the Smithsonian Institution, contributes an article on the recently developed subject of astrophysics, which is a study of celestial physics, but pertains principally to the heat and other physical properties of the sun. The paper relates to the solar constant of radiation, a topic on which Mr. Abbot is well informed, having pursued studies in that direction for nearly sixteen years at the Smithsonian Observatory in Washington, and on Mount Whitney and Mount Wilson, California. In this article the author deals with the problem of measuring the amount of solar heat received by the earth and that lost in transit to it. The subject of astrophysics is further treated by Messrs. Curtiss, Deslandres, and Bosler in three articles.

What Constitutes the Earth?

Under the title "What is Terra Firma?" Mr. Bailey Willis, of the U.S. Geological Survey, attacks the old, yet modern, problem of the construction and balance of our globe in a review of current research in isostasy. In the discussion of this puzzling question Mr. Willis advances the theory that the foundation of all the continents is composed of solid rock which is self-crushed to a depth of about 120 kilometres, but rendered sufficiently rigid by pressure to maintain its form during prolonged geological periods with but slight change.

The Future Habitability of the Earth.

In line with the construction and condition of the globe, another author, Prof. T. C. Chamberlin, brings up the further vital question "The Future Habitability of the Earth" in an article in which he reviews the past, and considers the future, of the world as a dwelling-place for the human race. Many branches of science enter into the discussion; but upon geology, physics, chemistry, astronomy, and astrophysics rests the burden of the arguments. Prof. Chamberlin thinks that the earth will remain habitable for tens of millions of years, but concedes that the close approach of a celestial body to the sun would probably result in the disruption of the solar system and bring disaster to the earth. He further states, in regard to the future possibilities of scientific research, that "when moral purpose and research come to be the pre-eminent characteristics of our race by voluntary adoption and by the selective action of the survival of the fittest, and when these most potent attributes join in an unflagging endeavour to compass the highest development and the greatest perpetuity of the race, the true era of humanity will really have been begun."

Botany and Forestry.

Several papers come under the head of botany, among them an interesting sketch of the sacred ear-flower of the Aztecs, a plant the identity of which has been a mystery for years, and only recently rediscovered by the author, Mr. W. E. Safford, of the Bureau of Plant Industry. This little flower, resembling the human ear, has a remarkable history, and dates back to the early explorations of Mexico. It was first described in 1569 by Padre Bernardino de Sahagun, who states that it was much used owing to its delicious fragrance and its flavour when used as a spice. Despite the formidable name (Xochinacaztli) which it bears, the author suggests its cultivation on account of its unusual fragrance and pleasant spicy flavour.

Mr. Henry S. Graves, chief of the Forest Service, contributes a well-illustrated and original article on forest preservation, in which he carefully considers all points in the great problem, making many things clear which have long been obscure.

Medicine and Medical Researches.

Those interested in medical research and allied subjects will find matter of concern in the following papers:—manifested life of tissues outside of the organism, by Mr. Alexis Carrel and Mr. Montrose T. Burrows; epidemiology of tuberculosis, by Prof. Robert Koch; the significance of the pulse-rate in vertebrate animals, by Dr. Florence Buchanan; and sanitation on farms, by Dr. Allen W. Freeman.

Ethnology and Anthropology.

A comprehensive paper on the contemporary Slav peoples from a geographical and statistical point of view, by Mr. Ludor Niederle, of the Bohemian University of Prague, which has been translated from the Slavic language into English, funished new information on the history and distribution of these peoples.

Dr. J. Walter Fewkes, of the Bureau of American Ethnology, contributes a brief review of his recent work and investigations in cave dwellings, both at home and abroad. This paper is entitled "The Cave Dwellings of the Old and New Worlds."

The report also contains biographies of Melville W. Fuller, Sir W. Huggins, and Alexander Agassiz, together with papers on other subjects.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is announced that the sum of 300,000*l*. has been raised for the endowment fund for McGill University. The Duke of Connaught, in a telegram of congratulation to Mr. Angus, chairman of the McGill Campaign Committee, directs attention to the fact that this large sum was collected in five days.

IN connection with the vacancy in the chair of mathematics at the University of Edinburgh, occasioned by the death of Prof. Chrystal, the curators of patronage of the University, in whom the patronage of this chair is vested, have decided to receive applications from intending candidates, along with testimonials, which should be lodged with their secretary, Mr. A. B. Fleming, 4 Albyn Place, Edinburgh, not later than Thursday, February 8, 1912.

WE learn from *Science* that as a result of the action of the Michigan Board of Tax Equalisation, it is estimated that the University of Michigan will in the future receive 41,600*l*. more from the State for its maintenance than hitherto. From the same source we find that at the last session of the Legislature of the State of Minnesota, among other appropriations for the University was one which will produce 1000*l*. for each of the two years before the next Legislature assembles to be voted exclusively to research, not agricultural, since that is cared for otherwise. Our contemporary also states that by the will of Miss Phoebe Caroline Swords, of New York City, 4000*l*. is bequeathed to Columbia University.

A DINNER was given at the Savoy Hotel on November 23 in aid of the fund for the erection and endowment of new buildings for Bedford College for Women. The sum of 100,000*l*. is required to complete the new buildings and provide the required endowment; and of this amount 50,000*l*., including a grant of 20,000*l*. from the London County Council, had been secured before the dinner. The London County Council has promised a further 10,000*l*. if a like sum should be obtained without delay. The primary object of the dinner was to raise the amount necessary to secure the second donation from the London County Council; and it is satisfactory to record that at the conclusion of the dinner more than 7000*l*. had been subscribed. But 30,000*l*. will still be required, even after the second contribution from the London County Council has been received.

THE most recent addition to its educational series published by the Manchester University Press is entitled "Outlines of Education Courses in Manchester University." The syllabuses of which the volume, running to 189 pages, is composed have been prepared to assist the lecture and demonstration courses given in the department of education of the university; and they are intended for the use of students. The first syllabus covers Prof. M. E. Sadler's course on the history of education in England from 1800 to 1911, and consists of exhaustive notes on each lecture, together with an invaluable bibliography directing the student to works of reference where the subjects touched upon can be studied in greater detail. Students of education everywhere will welcome this complete guide to the study of the history of education. Prof. Findlay's notes on his lectures on the principles of education are somewhat briefer, and will give the students much more to do for themselves. Here, too, frequent references to standard works on pedagogy will prove of the greatest service. The remaining discourses are more miscellaneous in character, and are dealt with in a less extended manner. The publication of the syllabuses, and the invitation extended in an introductory note to educational workers generally to criticise and advise, may be taken as a welcome indication that earnest efforts are being made in our universities gradually to build up a science of education founded upon experience and experiment.

THE annual report on the 115th session of the Glasgow and West of Scotland Technical College has now been circulated. We notice that for the academic year 1910–11 there was an increase in the numbers of both day and evening students. The success with which the governors have established cordial relations with local employers of labour is very marked. For a number of years past the requests from employers for the nomination of qualified students in chemistry to fill industrial posts have been greater than the college could satisfy, and a similar position is arising in the engineering sections of the college. Most of the appointments thus gained are in works in the district, but a considerable number are abroad. Manufacturing firms in the district are recognising in increasing measure, also, the ability of the college to assist them in many of the problems arising in their industrial operations. Requests have been made to the college for reports and advice on a variety of subjects, in addition to simple questions on the strength of metals and of building materials, the accuracy of measuring instruments, and so on. Another satisfactory feature of the strengthening relations between the college and employers is the increasing number of firms which now request reports upon the attendance and progress of their apprentices at college classes. The report shows that new courses of a technical kind are arranged as soon as a new demand arises, continual additions are made to the already extensive equipment, and the building scheme is now completed. The financial position of the college appears to be in an equally satisfactory state.

WE have received a copy of the report for the session 1910–11 of the work of the department of technology of the City and Guilds of London Institute. During the session 4495 classes in technological subjects were registered in 316 towns. These classes were attended by 52,680 students. So far as the examinations conducted by the institute during the year were concerned, the report shows 24,342 candidates were presented in technology from 465 centres in the United Kingdom, and of these 14,206 passed. By including the candidates from India and the Dominions overseas, and those for the teachers' certificates in manual training and domestic subjects, the total number of examinees was 27,205. This figure shows an increase on those of any previous year. During the session, too, ninety-one centres were visited by members of the institute's staff for the examination, inspection, or organisation of classes, several centres receiving two or three visits in order to complete the inspection. The report again directs attention to the criticisms and suggestions received from the examiners of the institute. We can here quote only two examples:—"Teachers would, for instance, be well advised to keep their knowledge thoroughly up to date by studying the transactions of the leading technical societies and institutions, and the articles in technical journals, and not confining themselves to text-books. In many subjects teachers should also, if possible, give more practice to students in expressing their ideas, in arithmetical work, and in careful sketching, *e.g.* by requiring the presentation of well-illustrated notes of lessons." The want of suitable and adequate preliminary education exhibited by students presenting themselves for entry into technical classes is again commented upon.

THE International Council of Women has done a piece of very useful work in issuing a pamphlet on "National Systems of Education" (Aberdeen: Rosemount Press, price 3*d*.). In response to a form of inquiry drawn up by Mrs. Ogilvie Gordon, representatives of the women's organisation in most European countries, in the great self-governing communities of the British Empire, and in the United States have given us brief *résumés* of the actual

position of education in their respective countries, the whole constituting (within its limits) a valuable document for a comparative study of educational systems such as the intelligent non-expert might wish to make. Thus we find that Austria is the only European country which has compulsory evening continuation schools for boys from fourteen to sixteen years of age. In Germany, practice differs in different States, but where continuation schools are compulsory they are *day* schools, something after the pattern of our half-time schools, though, of course, the pupils are older. Primary education is compulsory in most countries, though Belgium still stands for the principle of freedom. In Russia and Finland, also, it is not yet compulsory; but in Finland it is the question of the hour, and in Russia compulsion in this matter was amongst the projected reforms of the murdered Minister Stolypin. It is interesting to note, too, that compulsory school begins earlier in England than in any other European country. In Russia elementary schools only provide for children from eight to eleven years of age. We note that the pamphlet does not include France or Italy, and that the various communications are not dated. The statement that English teachers (men) in elementary schools receive 175*l*. a year, rising by annual increments of 5*l*. to 200*l*., would surely surprise the officials of the National Union; and the Board of Education Library is no longer in Cannon Row.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, November 8.—Prof. W. W. Watts, F.R.S., president, in the chair.—Prof. E. **Hull**: The interglacial gravel beds of the Isle of Wight and the south of England, and the conditions of their formation. The origin and mode of formation of the gravel terraces of the Isle of Wight and the New Forest districts are still open to discussion. The levels of the higher beds on both sides of the Solent up to about 400 feet indicate the amount of subsidence of the whole area at a time when the stratified gravels, composed mainly of rolled flints, were formed at the margin of the uprising ridges of the Chalk in the post-Glacial epoch, for this part of England. Preceding this was the great uplift by which the British Isles were joined to the Continent as land. By this uplift the English Channel was laid dry, and along its centre there ran a river from its source about the Straits of Dover to its outlet into the ocean through the continental platform. The gravel beds of this district are considered to be the representatives of the high-level gravels of the Midlands and Cromer, also of the "interglacial gravels" of Cheshire and Lancashire, and the shell-bearing beds of the Denbighshire Hills, and of Moel Tryfaen in Wales, at levels of about 1200 feet above the sea.—J. B. **Scrivenor**: The Gopeng beds of Kinta (Federated Malay States). Gopeng is a prosperous mining centre in the Kinta Valley, close to the granite of the Main Range of the Malay Peninsula. It is shown that not only are the Gopeng beds cut by veins from the granite and altered at the junction with the granite, but they are also faulted down against the limestone. The Gopeng beds, consisting of clays and boulder-clays with some stratified drift, are of glacial origin. This is proved by the inclusion of large boulders in the clay, the physical condition of the components of the clays and their distribution, and by the resemblance of the beds to Pleistocene glacial detritus. No boulders have been found showing striation due to ice action, nor has any glaciated rock-surface been found. The boulders are all decomposed owing to the power of the ground-water in removing silica; and, if the limestone ever presented the features of a glaciated surface, it has been modified by solution owing to the action of ground-water. The petrology of the Gopeng beds is described. The ice from which the detritus was derived passed over a stanniferous granite mass, and the Gopeng beds carry tin-ore throughout. The tin-ore is an original constituent of the beds, but they have been further enriched by tin-ore derived from the Mesozoic granite at their junction with the granite and in the neighbourhood of veins from the granite that have risen through the limestone. The Gopeng beds are considered to be the equivalent in time of the Talchir boulder beds of Orissa; but a petrological similarity is wanting.

Physical Society, November 10.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Prof. **Coker**: The effects of holes and semicircular notches on the distribution of stress in tension members. For the experimental determination of stresses in loaded members an optical examination of a model shaped in transparent material has advantages. Two cases of importance are examined in this way, and the results are compared with those obtained by analysis. The first example relates to the case of a hole in a tension member subjected to a uniformly applied stress p. The values of $(p_x - p_y)$, the difference between the principal stresses, are obtained optically, and they show agreement with the calculated values if the diameter of the hole is not greater than one-quarter of the width of the plate; but beyond this the agreement is not good. For practical purposes it is important to be able to estimate the maximum stress from the value obtained by assuming that the total load on a tension member is uniformly distributed over the cross-section. A formula based on the relationship found in the experiments takes the form

$$p_{\max} = \frac{6c^3}{2c^3 + 2c^2 + c + 1} p_{\text{mean}},$$

where c is the ratio of the width of the member to the diameter of the hole; if c is large compared with unity, this reduces to the simple form

$$p_{\text{mean}} = \frac{3c}{c+1}.$$

In the case of two semicircular notches, arranged symmetrically with regard to the centre line and to the cross-section, there appears to be no exact mathematical solution; but an approximation has been obtained by Leon resulting in expressions for p_x and p_y at the minimum section of the form

$$p_x = \frac{p}{2}\left(2 + \frac{a^2}{r^2} + \frac{a^4}{r^4}\right), \quad p_y = \frac{p}{2}\left(\frac{a^2}{r^2} - \frac{a^4}{r^4}\right),$$

provided that the radius of the notch is small compared with the breadth of the plate. Experimental determinations of $p_x - p_y$ show that the maximum values agree with those of the formulæ for notches having a maximum radius of about one-quarter of the breadth of the member, but the minimum values do not show good agreement if the notch has a radius greater than one-eighth of the breadth. The results appear to indicate that the radial stress for large notches is greater than that given by the formula. For determining the maximum stress from the applied mean stress a formula is proposed of the form

$$p_{\max} = \frac{12c^3}{6c^2 + 4c^2 + c + 1} p_{\text{mean}},$$

and this shows a fair agreement with the experimental values.

Royal Anthropological Institute, November 14.—Mr. R. W. **Williamson**: Mafulu mountain people of British New Guinea. The paper refers to an inland tribe of whom very little has hitherto been known, but among whom the author spent some time last year. The Mafulu are a short-statured people, sooty-brown in colour, with grizzly, brownish hair. The clothing of both men and women consists merely of a narrow band of bark cloth, passed between the legs and tied round the waist. They are cannibals, but not head-hunters. They live in scattered clusters of villages perched up in the summits of the mountain ridges, and are divided into clans, each clan having its own chief and village club-house. They bury their dead underground except as regards chiefs and important people, whose bodies are put into boxes fixed above ground, or clusters of poles in the village enclosure or in a species of fig tree. The author described some of their curious feasts and ceremonies, including the "Big Feast," at which the supports of one of these boxes are cut away so that the box and its contents fall to the ground; then the skull and bones within it, and those of all their other important dead, are smeared with the blood of slain pigs, after which the evil-disposed ghosts of their owners will no more disturb the people. The author suggested the possibility of these people having a partial pygmy or negrito ancestry.

Mineralogical Society, November 14.—Anniversary meeting.—Prof. W. J. Lewis, F.R.S., president, in the chair.—R. H. **Solly**: Dufrenoysite, associated with seligmannite, from the Binnental. In a small cavity, discovered in August, in the dolomite rock in the Lengenbach Quarry, were a few brilliant crystals of dufrenoysite, coated on their fractured surfaces with minute crystals of seligmannite. Measurements of two crystals of the former led to the discovery of twenty-six new forms.—H. G. **Smith**: A simple graphic method for determining extinction-angles in sections of biaxial crystals. A means of drawing a crystal projected on any plane and finding the extinction-directions was explained.—Dr. G. T. **Prior**: The meteoric stone which recently fell in Egypt. A meteorite fell on June 29 near the village of Abdel Malek, about 44 km. E.S.E. of Alexandria. It exhibits a brilliant, varnish-like crust, and consists mainly of a coarse-grained crystalline aggregate, without chondrules, of a green pyroxene and a brown ferriferous olivine with only a little felspar and practically no nickeliferous iron. A quantitative analysis showed that the stone includes a high percentage of lime, and that the green pyroxene, containing much lime as well as ferrous oxide and magnesia, constitutes about three-quarters of the stone by weight. A study of thin sections under the microscope showed that the pyroxene is generally twinned on 100, gives extinction angles as high as 35°, and exhibits "herring-bone" structure owing to fine twinning on 001.—T. **Crook** and S. J. **Johnstone**: Strüverite from the Federated Malay States. A mineral of doubtful identity found in the course of tin-mining on the Sebantum River, Kuala Kangsar district, Perak, was proved to be strüverite; it closely resembles the mineral recently recorded by Hess and Wells from South Dakota, U.S.A.—A. **Hutchinson**: The temperature at which gypsum becomes optically uniaxial. A small plate of gypsum, cut normal to the acute bisectrix, was placed in a glass-topped cell, through which a stream of water at a determinate temperature was passed, and the optic picture was studied under a microscope. The plate became uniaxial at 25° C.—A. **Hutchinson**: A total-reflection diagram. From this diagram the refractive index of a substance is graphically determined when given the angle of total reflection with respect to a known substance of higher refractive index. By taking the sine of the angle as coordinate, the curves are straight lines.—T. **Crook**: The occurrence of ankerite in coal. The white crystalline layers often found as infillings of the vertical joints in British coal are ankerite. Dolomite was not found, and calcite occurs sparingly as compared with ankerite in the specimens examined.

Royal Microscopical Society, November 15.—J. E. **Barnard**: A geometric slide photomicrographic apparatus. The apparatus was designed on the principle of the geometric slide throughout, as enunciated by Lord Kelvin and Tate. The base of the apparatus was formed of two castings designed on the girder principle, braced together at each end and in the middle. The portion to carry the microscope was also formed by a pair of castings braced together in the same way. Great rigidity was obtained, and the whole apparatus would move together if subjected to shock or vibration. Rods were fastened down on the top of the castings to support the apparatus, and the camera slid along these on two V-grooves on one side and on a plane surface on the other side. The camera was supported on vertical rods fixed on the geometric slides. The apparatus could be used equally well as a horizontal or vertical camera, or at an angle of 45°.—Rev. Hilderic **Friend**: Fridericia. The genus Fridericia was created by Michaelsen in 1889 to receive certain species of Enchytræids, eleven in number, possessed of dorsal pores and having setæ of unequal lengths. In 1895 Beddard reckoned twelve species, but not one was known as British. Moore, Friend, and others added to the list, which in 1900 stood at twenty-one. Bretscher, Issel, and others then took up the study, and at the present time some seventy or eighty species of Fridericia are known to science. The largest is *F. magna*, Friend, which has been found in England, Ireland, and Scotland, but so far has not been reported abroad. The author, whose researches into this genus began in 1896, here records no fewer than thirty species found up to the present time in the British Isles. Some of these are new to science; and a series of keys is appended to enable the student readily to distinguish the allied species.

Linnean Society, November 16.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. R. R. **Gates**: Certain aspects of the mutation problem in Œnothera. Work with the Œnotheras has developed in several directions, all bearing on the general question of the place to be assigned to mutation as an evolutionary factor. A concerted attack upon the behaviour of the Œnotheras in heredity and variation from several points of view gives a broader basis for the interpretation of the evolutionary significance of these phenomena than has hitherto been possible in most other genera. The cytological evidence has shown that in most of the mutants from *Œnothera Lamarckiana* the chromosome number is unchanged, but in the mutant *Œ. gigas* it is doubled. Hence mutants originate in various ways. Evidence goes to show that the chromosome doubling in *Œ. gigas* probably occurred either in the fertilised egg or in a megaspore mother-cell, which afterwards developed apogamously. On the other hand, in certain cases the mutational change probably occurred during the reduction divisions. Thus *Œ. rubricalyx* is a mutant from *Œ. rubrinervis*, which produces an extreme amount of pigment; and when crossed with the parent type the new character behaves as a Mendelian dominant, and in such a way as to show that the original mutant individual was heterozygous, and probably originated from a cross between a germ-cell in which the new dominant character appeared and one in which it was lacking. From this and much other evidence mutation in Œnothera appears to be due to a general condition of germinal instability, which in turn is probably connected with crossing in the ancestry. This, however, by no means deprives it of evolutionary significance, for all open-pollinated species of plants are hybrids in the sense that various races have participated in their immediate ancestry. Certain results were also communicated of *Œ. grandiflora* × *Œ. rubricalyx*, *Œ. Lamarckiana* × *Œ. grandiflora*, and other crosses which produce twin types.—G. Claridge **Druce**: Some floristic results of the International Phytogeographic Excursion through the British Isles.—A. W. **Hill**: Drawings of a viviparous specimen of *Juneus bufonius*. The seedlings were seen emerging from the parent capsule.—N. C. **Macnamara**: Mutations in foxglove plants. From a packet of foxglove seeds (*Digitalis purpurea*) sown in the year 1906, fifty-four plants were, in June, 1907, planted in a shrubbery of fir trees with an undergrowth of laurels. Of these plants fifty-one grew into normal foxgloves, but the three remaining plants were sports, which we may distinguish by the letters A, B, and C. A. In this plant the flowers of the lower half of the stem possessed only a bifid upper petal and seven stamens united at their bases. The flowers of the upper part of the spike were normal. B. A fine, well-grown plant 4½ feet high; throughout the whole length of the spike the flower consisted of a bifid upper petal, seven stamens, and style. The upper part of this spike was isolated; it produced abundant self-fertilised seed. C. The spike of this plant grew to be 5 feet high; from base to apex its flowers consisted of nine stamens and a style, with no vestige of petals. It seems that a certain number of the foxglove seeds sown in the year 1906 contained elements in a condition such as that described by de Vries as being "impressed by an impulsive mutability," for some of the flowers produced by these seeds were sports. Seeds from these sports produced their like in 1909; and, further, these latter plants produced some terminal flowers totally differing in character from the parent sport from which they were derived. Seeds from these terminal flowers produced their like in the year 1911; so that there are now two different strains of foxglove plants produced from the seeds sown in 1906, and these strains have been produced from self-fertilised flowers, that is, from flowers carefully protected from insects or other means of cross-fertilisation.

DUBLIN.

Royal Irish Academy, November 13.—Rev. Dr. Mahaffy, president, in the chair.—R. Lloyd **Praeger**: Phanergamia. Part ii. (Clare Island Survey.) On a former occasion the question of the origin of the island flora,

and the influence upon it of human operations, had been dealt with. In the present communication the composition of the flora of Clare Island, the plant societies, and the relation of the flora to that of the adjoining islands, were dealt with. The floras of all the islands is remarkably large in comparison with those of adjoining mainland areas, pointing to former easy migration by means of post-glacial land-connections.—The following papers were also read, in connection with the Clare Island Survey:—Claude **Morley**: Hymenoptera.—D. R. **Pack-Beresford**: Areneida and Phalangida (Spiders and Harvestmen).

PARIS.

Academy of Sciences, November 20.—M. Armand Gautier in the chair.—J. B. **Charcot**: The laboratory for scientific maritime researches of the *Pourquoi-Pas?* It is suggested that the vessel *Pourquoi-Pas?* which served for the last French Antarctic expedition, would form a very serviceable laboratory for marine biological researches. Its present equipment is described, and an appeal for the necessary funds is made.—M. **Borrelly**: Observations of the periodic Borrelly comet (1911*e*) made at the Observatory of Marseilles with the comet finder. Data are given for November 13, 14, 15, and 16. The comet is moderately bright, of the tenth magnitude, its extent being 2′.—P. **Montel**: Some analytical functions which admit of two exceptional values within one region.—G. **Kœnigs**: Surfaces which, in the course of a given movement, are continually osculating to their conjugated profile.—Raoul **Bayeux**: An apparatus of precision for the use of gaseous oxygen in physiology and therapeutics. In the instrument described and illustrated the usual indiarubber bag is replaced by a small cylinder of compressed oxygen controlled by a double metallic governor composed of two capsules similar to those used in the aneroid barometer. There is a specially designed sensitive tap for the distribution, and the amount of gas available at any instant can be read directly.—C. **Gutton**: The velocity of propagation of electromagnetic waves along a line of metallic wires.—V. **Auger**: The action of hydrogen peroxide upon the oxygen compounds of iodine. Details are given of the interaction of hydrogen peroxide with neutral and basic alkaline periodates, periodic acid, and iodic acid.—MM. **Desgrez** and **Feuillié**: The estimation of urea. The methods of Folin, Mörner, and Sjœqvist are exact, but require too much time for biological investigations, necessitating a large number of estimations. The method described is based on the use of Millon's reagent. It has been objected that Millon's reagent acts upon other nitrogenous substances besides urea, but experiments made with salts of ammonia, uric acid, creatine, creatinine, hypoxanthine, tyrosine, xanthine, leucine, guanine, and allantoin showed that the last-named substance alone interferes. The proportion of allantoin in human urine is so small that this complication cannot be considered as a real objection to the process. The necessity of suitably fixing the temperature at which the reaction is carried out is emphasised.—Marcel **Godchot** and Félix **Taboury**: Some derivatives of cyclopentanone. In a previous communication a new ketone, $C_{10}H_{16}O$, was obtained by the hydrogenation of cyclopentanone by the method of Sabatier and Senderens, and its constitution was provisionally suggested as α-cyclopentylcyclopentanone. In the present paper this formula is confirmed by additional experiments.—J. **Vallory**: Studies in the reproduction of *Chaetomium kunzeanum*, var. *chlorinum*.—P. **Desroche**: The mode of action of coloured light on the Chlamydomonas. Blue rays have a paralysing action on the zoospores, whilst the red rays have a stimulating action.—J. **Tournois**: Floral anomalies of *Humulus japonicus*.—C. L. **Gatin** and M. **Fluteaux**: The anatomical modification produced in certain plants by the dust from tarred roads. It has been shown in a previous communication that the trees in certain parts of the Bois de Boulogne have been adversely affected by the action of the dust from the treated road. In the present paper it is shown that these effects are accompanied by certain anatomical modifications in the plant.—E. **Milliau**: The detection of carbon bisulphide in oils.—E. **Vasticar**: The structure of Corti's fibres.—R. **Robinson**: New arguments in favour of the action of the suprarenal capsules on the determination of sex. A summary of the facts known on the relation between the condition of the suprarenal capsules and the sex of the embryo.—A. **Pézard**: The determination of the secondary sexual characters in the Gallinaceæ.—Anna **Drzewina**: Rapid modifications of form under the influence of deprivation of oxygen in a Medusa, *Eleutheria dichotoma*.—Albert **Frouin** and Arthur **Compton**: The loss of activity of trypsin by dialysis into distilled water, and the regeneration of the activity by the addition of salts. From the experiments described the authors conclude that the presence of salts is necessary for the trypsin to exert a proteolytic action.—Louis **Germain**: Atlantis. A review of the principal palæontological and zoological arguments in favour of the actual existence of the vanished continent, Atlantis.—Maurice **Piettre**: The melanins.—A. **Moutier**: The mechanism of general or local troubles of the arterial circulation leading to general or local arterio-sclerosis. Instruments such as sphygmomanometers are generally regarded as measuring the pressure of the blood in the interior of the artery. This the author has shown to be erroneous, the force of compression being exclusively a function of the elastic state of the arterial wall, and independent of the manometric pressure. Additional experimental evidence in favour of this view is given.—Ch. **Moureu** and A. **Lepape**: The ratios of the rare gases between themselves and with nitrogen in fire-damp. The examination of the inert residues from six samples of fire-damp shows that the crude nitrogen from the fire-damp presents a striking analogy with crude nitrogen from other natural mixtures.—Alfred **Angot**: The earthquake of November 16, 1911. The true amplitude of the horizontal movement of the ground at Paris was of the order of a millimetre.

CAPE TOWN.

Royal Society of South Africa, October 18.—Prof. H. H. W. Pearson, vice-president, in the chair.—J. **Moir**: The spectrum of ruby. Part iii. Two further very faint spectrum lines are described. The artificial ruby has been analysed, and chromium detected as the colouring matter. When a ruby is heated above 300° C. it changes, through scarlet and brown, to the colour of chromium glass, and all the characteristic spectrum lines disappear. It recovers completely on cooling. The effect of heat on the birefringence of corundum has been studied, and has been found to be insignificant. The spectrum of ruby is therefore due to chromium in a special atomic condition, which does not apparently occur elsewhere in nature.—Dr. and Mrs. J. R. **Sutton**: Some causes and effects of variation in the range of temperature. The paper contains the results of a discussion of some of the more salient meteorological aspects of a variation in the range of temperature. It deals in a general way with the changes of temperature, moisture, pressure, and sunshine, which go with a variation in the range of temperature, monthly means being used. Harmonic constants of barometric pressure and temperature are computed for months of great and small range of temperature respectively.—R. T. A. **Innes**: Algebraic development of the elliptic perturbative function used in the theories of planetary motion. The paper presents tables whereby the functions which operate on the ratio of the semi-axes can be easily calculated to any order of the eccentricities and mutual inclination, so far as regards primary and secondary terms, which alone have any importance in the planetary theories. The paper concludes with an explicit development of the secular part of the perturbative function to any order.—B. de St. J. **Van der Riet**: A supposed new mineral from Du Toit's Pan, Kimberley. The supposed new mineral from Du Toit's Pan, Kimberley, reported in NATURE of September 7 by Mr. J. R. Sutton, appears to the author to be derived from a well-known artificial material, viz. commercial calcium carbide. It is certain that acetylene generators have been in use on the mine for years, and it is quite possible that a portion of the waste from the acetylene machines has in some manner found its way to the pulsator, where the supposed mineral was discovered. It has been found possible to compare specimens of the substance referred to (kindly supplied by the general manager of De Beers' Co.) with the lumps and pellets which settle in the lime residue from generators supplying acetylene gas to the chemical laboratory of Victoria College. In

chemical as well as physical characters there is an unmistakable similarity between the two products. Thus (1) slaked lime, which, of course, accompanies carbide pellets, can be detected in some of the cavities on surfaces of the pulsator pellets. (2) Variations in hardness, form, colour, fracture, size of pellets, and peculiar markings are faithfully reproduced. (3) In either case the lumps and pellets vary in composition from iron carbide, attacked by dilute acids, to iron silico-carbide, which is attacked by hydrofluoric acid, but not by hydrochloric and sulphuric acids. (4) The pellets from either source give off an odour of acetylene when crushed. (5) The pulsator pellets, as well as ordinary carbide pellets, do not contain, so far as can be found, notable quantities of titanium. In an iron mineral derived from the ilmenite of "blue ground," by reduction at a high temperature, one should certainly expect to find titanium.—J. C. **Beattie**: Further magnetic observations in South Africa during the years 1910 and 1911. The communication contains the reduced results of observations in various parts of South Africa during 1910 and 1911 for determining the secular variation of the magnetic elements. It also contains results of additional observations in the West Transvaal and the east of Cape Province, with a discussion of the magnetic states of these regions.—W. A. Douglas **Rudge**: Action of radium salts on glass. An account of experiments carried on during the past three years in order to study the prolonged action of radium salts upon glass. Small quantities of radium were sealed up in thick-walled tubes, and the extent to which the coloration extended determined by cutting up sections of the tube, polishing the ends, and examining with a microscope. The tint developed depended upon the nature of the glass employed, and the depth of penetration depended upon the structure of the glass. Many kinds of glass show a "zonal" structure, and an abrupt change in the depth of coloration appears at the junction of successive zones. The width of the zones were measured with a micrometer, the first and darkest being 0·27 mm.; the others extended right up to the external walls of the tube, a distance of 2·48 mm. from the bore. If the coloration is due to X particles alone, the range must be much greater than would be deduced from the experiments of Rutherford and Joly. There is evidently some obstacle met with to the free passage of the rays at each zonal layer, as the coloration shows. The action of even a very impure radium salt is comparatively rapid; a few milligrams of a salt, containing about one-thousandth of its weight of radium, causes a very definite coloration at the end of twenty days, the first zone being then clearly defined. The coloration must be due to B and Y, as well as X, rays and emanation.—J. **Burtt-Davy**: A new species of Mesembryanthemum from the Transvaal, and notes on the genus Ficus.

NEW SOUTH WALES.

Linnean Society, September 27.—Mr. W. W. Froggatt president, in the chair.—Archdeacon F. E. **Haviland**: Notes on the indigenous plants of the Cobar district. The Cobar district may be said to comprise the country within a 50-mile radius of the town of Cobar, embracing an area of about 6000 square miles. It is flat, with occasional hills rising abruptly. The town of Cobar is 805 feet above sea-level, and the distance from the coast about 420 miles. The district is droughty, with prevailing high temperatures and a dry atmosphere, the average annual rainfall being about 14 inches. The flora is a typical inland, dry-country flora, the general appearance of the vegetation being that of brushwood, few trees of any kind attaining any considerable dimensions. The plants met with represent 161 genera and 284 species of Dicotyledons, 30 genera and 47 species of Monocotyledons, and 5 genera and 6 species of Acotyledons.—R. H. **Cambage**: Notes on the native flora of New South Wales. Part viii. Camden to Burragorang and Mount Werong. One of the features brought out is the marked influence of climate upon plant distribution, for, as the mountain is ascended, the vegetation is found to correspond more nearly with that of Tasmania, where a similar climate prevails. Between Camden and Burragorang, at altitudes ranging up to 1800 feet, 30 per cent. of the species are Tasmanian; but between Colong and Mount Werong, at altitudes varying from 2000 to 4000 feet above sea-level, about 48 per cent. of the plants seem to belong to species which occur in Tasmania. Reference is made to the occurrence of the narrow-leaved ironbark (*Eucalyptus crebra*) around Colong at altitudes up to 2500 feet, which is unusual in latitudes south of Sydney; its presence may generally be regarded as an indication that the rock producing the soil upon which these trees grow contains upwards of 60 per cent. silica. Although it will thrive on rather poor siliceous soils, it is absent from excellent basaltic soil a few yards away, but which contains less than 45 per cent. silica; and the question is raised whether it may not be rather the physical conditions of the soil than the chemical constituents which regulate the distribution of this tree.—R. J. **Tillyard**: The genus Diphlebia (Neuroptera: Odonata), with descriptions of new species and life-histories. The genus Diphlebia is one of three closely allied genera, grouped by de Selys to form the sixth legion (Amphipteryx) in his classification of the subfamily Calopteryginæ—Devadetta (=Tetraneura of Selys) from the Malay Peninsula, Siam, and Borneo, Amphipteryx from Colombia, and Diphlebia from Australia, represented, hitherto, by two species. Two additional species of the last of these are described as new, one from Kuranda, North Queensland (Dodd), and the other from rocky creeks in the Nandewar Ranges, New South Wales. The life-history of the latter has been worked out. In the Anisoptera, the characters of the larval gizzard determine the separation of the main groups. The same test should be applied to the unsatisfactory classification of the Zygoptera.

BOOKS RECEIVED.

Chemistry Note-book. By E. J. Sumner. Pp. 92. (Burnley: Cooper Printing Co., Ltd.) 2*s*.

Photograms of the Year, 1911–12. Typical Photographic Pictures Reproduced and Criticised. Edited by H. S. Ward. Pp. 154. (London: G. Routledge and Sons, Ltd.) 2*s*. 6*d*. net.

The Rainfall of Jamaica from about 1870 to end of 1909. By M. Hall. Pp. 27+14 maps. (Jamaica.)

Upon the Inheritance of Acquired Characters. A Hypothesis of Heredity, Development, and Assimilation. By E. Rignano. Authorised English translation by Prof. B. C. H. Harvey. With an Appendix upon the Mnemonic Origin and Nature of the Affective or Natural Tendencies. Pp. iv+413. (Chicago: Open Court Publishing Co.) 12*s*. 6*d*. net.

The Calorific Power of Gas. A Treatise on Calorific Standards and Calorimetry. By J. H. Coste. Pp. xvi+310. (London: C. Griffin and Co., Ltd.) 6*s*. net.

Junior Mathematics: being a Course of Geometry and Algebra for Beginners. By D. B. Mair. Pp. viii+200. (Oxford: Clarendon Press.) 2*s*.

Ministry of Education, Egypt. Records of the School of Medicine. Vol. iv. Part ii. By Dr. A. Looss. Pp. viii+163–613+plates xi–xix. (Cairo: National Printing Department.)

The Stars from Year to Year; with Charts for every Month. By H. P. Hawkins. Fifth edition. Pp. 23. (Bedford: Beds. Times Publishing Company, Ltd.) 1*s*. net.

The Star Almanac for 1912; with Star Charts of the Seasons, the North America Nebula, Solar Eclipse, &c. By H. P. Hawkins. (Bedford: Beds. Times Publishing Company, Ltd.) 6*d*. net.

The Star Calendar for 1912, with Revolving Chart. By H. P. Hawkins. (Bedford: Beds. Times Publishing Company, Ltd.) 1*s*. net.

The Evidence for the Supernatural. A Critical Study made with "Uncommon Sense." By Dr. I. Ll. Tuckett. Pp. vi+399. (London: Kegan Paul and Co., Ltd.) 7*s*. 6*d*. net.

Forecasting Weather. By Dr. W. N. Shaw, F.R.S. Pp. xxvii+380. (London: Constable and Co., Ltd.) 12*s*. 6*d*. net.

Boiler Draught. By H. K. Pratt. Pp. vi+138. (London: Constable and Co., Ltd.) 4*s*. net.

The Colloidal and Crystalloidal State of Matter. By Prof. P. Rohland. Translated by W. J. Britland and H. E. Potts. Pp. 54. (London: Constable and Co., Ltd.) 4*s*. net.

Applied Biology: an Elementary Text-book and Laboratory Guide. By Prof. M. A. and A. N. Bigelow. Pp. xi+583. (London: Macmillan and Co., Ltd.) 6s. net.

Revolving Vectors with Special Application to Alternating Current Phenomena. By Prof. G. W. Patterson. Pp. vi+89. (London: Macmillan and Co., Ltd.) 4s. 6d. net.

Stability in Aviation. An Introduction to Dynamical Stability as applied to the Motions of Aëroplanes. By Prof. G. H. Bryan, F.R.S. Pp. x+192. (London: Macmillan and Co., Ltd.) 5s. net.

The Making of Northern Nigeria. By Captain C. W. J. Orr. Pp. x+306. (London: Macmillan and Co., Ltd.) 8s. 6d. net.

The Land of Uz. By Abdullah Mansûr (G. Wyman Bury). Pp. xxviii+354. (London: Macmillan and Co., Ltd.) 8s. 6d. net.

Fourth Report of the Wellcome Tropical Research Laboratories at the Gordon Memorial College, Khartoum. Vol. A—Medical. Pp. 404+xxiii plates+118 figures. (London: Baillière, Tindall and Cox.) 21s. net.

The Recent and Fossil Foraminifera of the Shore-sands at Selsey Bill, Sussex. By E. Heron-Allen and A. Earland. (Printed by W. Clowes and Sons, Ltd., London.)

The Ontario High School Physics. By Dr. F. W. Merchant and Prof. C. A. Chant. Pp. viii+504. (Toronto: Copp, Clark Company, Ltd.) 90 cents.

The Ontario High School Laboratory Manual in Physics. By Dr. F. W. Merchant and Prof. C. A. Chant. Pp. viii+128. (Toronto: Copp, Clark Company, Ltd.) 35 cents.

Ministère de l'Agriculture. Direction de l'Hydraulique et des Améliorations Agricoles. Service des Grandes Forces Hydrauliques (Région des Alpes). Études Glaciologiques. Tome ii. Savoie—Programme pour l'Étude d'un Grand Glacier. Pp. vii+140.

The Indian Forest Memoirs. Forest Botany Series. Vol. i. Part i.—On some Indian Forest Grasses and their Œcology. By R. S. Hole. Pp. iv+126+xl plates. (Calcutta: Superintendent of Government Printing, India.) 8s. 6d.

The Transactions of the Linnean Society of London. Second series—Zoology. Vol. xi. Part vi.—On the Life-history of *Chermes himalayensis*, Steb., on the Spruce (*Picea Morinda*) and Silver Fir (*Abies Webbiana*). By E. P. Stebbing. Pp. 99–124+plates 20–23. (London: Linnean Society.)

DIARY OF SOCIETIES.

FRIDAY, DECEMBER 1.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Brake-lining Coefficients of Friction: J. and W. Legg.

GEOLOGISTS' ASSOCIATION, at 8.—(1) Note on a Maxilla of Triconodon from the Middle Purbeck Beds of Swanage; (2) On Prehistoric Paintings and Drawings in the Caverns of Northern Spain: Dr. A. Smith Woodward, F.R.S.

MONDAY, DECEMBER 4.

SOCIETY OF ENGINEERS, at 7.30.—The Design of Tall Chimneys: H. Adams.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Physical Properties of Clays: W. C. Hancock.—The Value of the Non-tannins in the Formation of Leather: Dr. J. Gordon Parker and R. J. Blockey.—The Estimation of Carbon Monoxide: L. A. Levy.—The Composition of Bassia Fats: Russell G. Pelly.

ARISTOTELIAN SOCIETY, at 8.—Animism and the Doctrine of Energy: Dr. T. P. Nunn.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geography and Economic Development of British Central Africa: Sir Alfred Sharpe, K.C.M.G., C.B.

ROYAL SOCIETY OF ARTS, at 8.—The Carbonisation of Coal: Prof. Vivian B. Lewes (Lecture II.).

TUESDAY, DECEMBER 5.

RÖNTGEN SOCIETY, at 8.15.—The Energy of the X-Ray: Prof. W. H. Bragg, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Electric Lighting of Railway Trains: the Brake-Vehicle Method: R. T. Smith.

WEDNESDAY, DECEMBER 6.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Estimation of Small Quantities of Essential Oil in Spices, etc. (Part II.): J. A. Brown.—The Determination of Furfural by Means of Fehling's Solution: Lewis Eynon and J. H. Lane.—The Examination of Petroleum Mixtures: J. H. Coste, E. T. Shelbourn, and E. R. Andrews.—Note on Ground Almonds: G. C. Jones and R. F. Easton.—A Method for Determining the Amount of Insoluble Particles in Raw Rubber: C. Beadle and Dr. H. P. Stevens.—Note on the Determination of Small Quantities of Methyl Alcohol: C. Simmons.—Note on Oil of Male Fern: Ernest J. Parry.—(1) The Composition of Australian (Victoria) Milk; (2) The Composition of Sweetened Condensed Milk; (3) The Aldehyde Figure of Butter: E. Holl Miller.

FARADAY SOCIETY, at 8.—A Redetermination of the Density and Coefficient of Linear Expansion of Aluminium: Dr. F. J. Brislee.—The Solution Volumes of Nitric Acid: V. H. Veley, F.R.S.—The Influence of the Physical Condition of Metals on Cathodic Over-voltage: Dr. J. N. Pring and J. R. Curzon.—Notes on Thermostats: Prof. Hugh Marshall, F.R.S.—Notes on Two Thermo Regulators: W. R. Bousfield, K.C.—Notes on Thermostats and Devices used in Connection with Thermostats: Dr. A. C. Cumming.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL SOCIETY OF ARTS, at 8.—British Guiana and its Founder, Storm van 's Gravesande: J. A. J. de Villiers.

GEOLOGICAL SOCIETY, at 8.—The Faulted Inlier of Carboniferous Limestone at Upper Vobster (Somerset): Dr. T. F. Sibly.—Geology of a Part of Costa Rica: James Romanes.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Lapworthura: a Typical Brittlestar of the Silurian Age, with Suggestions for a New Classification of the Ophiuroidea: Miss I. B. Sollas and Prof. W. J. Sollas, F.R.S.—The Physiological Influence of Ozone: Dr. Leonard Hill, F.R.S., and M. Flack.—On the Factors Concerned in Agglutination: H. R. Dean.—The Action of Dissolved Substances upon the Auto-fermentation of Yeast: Dr. A. Harden, F.R.S., and S. G. Paine.—Further Experiments upon the Blood Volume of Mammals and its Relation to the Surface Area of the Body: Prof. Georges Dreyer and W. Ray.—The Origin and Destiny of Cholesterol in the Animal Organism. Part viii. On the Cholesterol Content of the Liver of Rabbits under Various Diets and During Inanition: G. W. Ellis and J. A. Gardner.

LINNEAN SOCIETY, at 8.—The Internodes of Calamites: Prof. Percy Groom.—On Some Mosses of New Zealand: H. N. Dixon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes on National and International Standards for Electrical Machinery: Dr. R. Pohl.

CONTENTS.