THURSDAY, OCTOBER 23, 1902.

THE ENCYCLOPÆDIA BRITANNICA.

The Encyclopaedia Britannica, vols. xxviii. and xxix. Being the Fourth and Fifth of the New Volumes. Ele–Gla. Pp. xix + 742. Gla–Jut. Pp. xx + 763. (London: A. and C. Black, and the *Times*, 1902.)

THE prefatory essay to vol. xxviii. is by Sir Leslie Stephen upon the subject of "The Growth of Toleration." It is pointed out that one dominant factor in the development which has taken place has been the growth of the natural sciences; and reference is made to the influence exerted by scientific investigation upon traditional beliefs and dogmas. Mr. Benjamin Kidd contributes to vol. xxix. a prefatory essay on "The Application of the Doctrine of Evolution to Sociological Theory and Problems."

There are many scientific articles in the two volumes, several being of great importance. Among the articles to which attention must be directed are the following:—Vol. xxviii.: Electricity and electricity supply, by Prof. J. A. Fleming, Mr. W. C. D. Whetham, Prof. J. J. Thomson, Dr. L. Duncan and Mr. E. Garcke; electrochemistry, Mr. W. G. McMillan; electromagnets, Prof. J. A. Fleming; embryology, Mr. Adam Sedgwick and Dr. A. E. Driesch; energetics, Dr. J. Larmor; engines, Prof. J. A. Ewing; England and Wales (geography), Dr. H. R. Mill; Entomostraca, Rev. T. R. R. Stebbing; evolution, Dr. Chalmers Mitchell; fisheries, Mr. W. Garstang; forests and forestry, Prof. W. Schlich and Mr. G. Pinchot (United States); Fourier's series, Dr. E. W. Hobson; analytic functions, Mr. H. F. Baker; functions of real variables, Prof. A. E. H. Love; fungi, Prof. Marshall Ward; fusion, Prof. H. L. Callendar; gas and gas lighting, Prof. V. B. Lewes; gaseous fuel, Prof. G. Lunge; artificial gems, Sir William Crookes; geography, Dr. H. R. Mill; geology, Sir Archibald Geikie; geometrical continuity, Rev. Charles Taylor; line geometry, Mr. J. H. Grace, and non-Euclidean geometry, the Hon. A. A. W. Russell. Vol. xxix.: Theory of groups, Prof. W. Burnside; gunnery, and gyroscope, Prof. A. G. Greenhill; gymnosperms, Mr. A. C. Seward; halos, the late Prof. P. G. Tait; Helmholtz, Prof. J. G. McKendrick; hemichorda, and hydrozoa, Dr. G. H. Fowler; heredity, and hybridism, Dr. P. Chalmers Mitchell; Huxley, Sir W. T. Thiselton-Dyer; hygiene, Colonel J. Lane Notter; ichthyology, Dr. A. Günther; insects, Dr. D. Sharp; iron and steel, Prof. H. M. Howe; irrigation, Sir Colin Campbell Scott-Moncrieff.

It is impossible to describe the whole of these articles in a notice of limited length, but from this group of scientific contributions to the "Encyclopædia" we select a few for brief notice.

So large a part, nearly one-sixth, of vol. xxviii. is devoted to electrical subjects that we cannot, with the space at our disposal, do much more than enumerate the branches treated. Under the heading "Electricity," Prof. Fleming writes on electric conduction, current and units; Prof. J. J. Thomson on discharge through gases and electric waves; and Mr. Whetham on electrolytic conduction. These articles cover the greater part of electrical theory; the practical applications are dealt with in separate contributions. Mr. Whetham's discussion of electrolytic conduction gives a full and favourable account of the dissociation theory; the student has therefore an opportunity, from this article and from that by Prof. Armstrong on "Chemistry," of considering both sides of the question. The electrochemist is indeed particularly well catered for in the new volumes, since, in addition to the articles already mentioned, Mr. McMillan contributes two articles to the present volume on "Electrochemistry" and "Electrometallurgy." These deal with the industrial applications, the first with refining of metals, electrotyping and plating, and alkali and chlorate manufacture; and the second with furnace processes, such as the production of aluminium and calcium carbide. A contribution on "Electromagnet," written by Prof. Fleming, discusses magnetic flux, permeability and hysteresis. A long article on "Electricity Supply" deals with the principle of lighting by arc and incandescent lamps, with electric traction, and with the commercial aspects of the industrial development of electricity. The treatment of electric traction is hardly adequate if this is all that is to be given in the "Encyclopædia"; for one thing, the article is entirely without illustration, a great disadvantage to the general reader. It is also to be noticed that there is a certain amount of repetition which might have been avoided; thus, the theory of the arc is discussed at some length by both Prof. Fleming and Prof. J. J. Thomson.

"Energetics" is a name commonly associated with a philosophy which proposes to abolish Newton's laws of motion and to deduce all the equations of dynamics from the single equation of energy. Dr. Larmor's article deals with a much more useful field of study, including Carnot's principle, the general thermodynamical equations, free and available energy, and Gibbs's important work on the equilibrium of chemical systems. It forms a excellent introduction to the study of thermochemistry.

Pure mathematics is well represented in the present volumes. In an article on the "Error Law," Mr. Edgworth gives an account of the various proofs of the common law of error and of Prof. Weldon's experimental verification, corrections for cases in which the number of elements is finite, normal and abnormal correlation, and applications to various problems in statistics. In the account of Fourier's series, Dr. Hobson divides the historical development of the theory of the representation of functions by trigonometric series into three periods, the first period opening with the work of D'Alembert, Bernouilli and others in connection with vibrations of strings, the second with Fourier's memoir of 1807 on the "Theory of Heat," and the modern period being inaugurated by Riemann's memoir of 1867. The article on "Analytic Functions" contains a good general account of Weierstrass's methods; that on "Functions of Real Variables" deals largely with the *continuum* of real numbers, the domain of a variable, the doctrine of continuity, and the questions of differentiability and integrability of functions. Under "Line Geometry," we have a discussion of the properties of linear and non-linear complexes, congruences and ruled surfaces. In the article on "Non-Euclidean Geometry," Mr. Russell traces the genesis of this important branch of pure mathematics out of the attempts of mathematicians to improve the theory of parallels. A historical account is given of the development of the new geometry by Gauss, Lobatchewsky, Bolyai, Riemann and Beltrami. Considerable attention is given to the three prevailing misconceptions which have retarded the development of the subject, namely, the introduction of a fourth dimension in connection with the notion of curvature of space, the projective definitions of distance and angle, and the necessity for introducing rigid bodies in geometry.

The writer of the article on evolution has had a difficult task, with which, on the whole, he has grappled successfully. We miss, however, any clear presentment of the crucial point on which the controversies that at present divide evolutionists indisputably turn—viz. that of the transmission or otherwise of modifications due to individual plasticity. It seems inadequate to say, without explanation, that "the weakness of the neo-Lamarckian view lies in its interpretation of heredity," when, as a matter of fact, the whole neo-Lamarckian fabric must fall unless the reality of such transmission can be established. The summaries given of several modern developments of evolutionary theory are scarcely full enough to be of much value to the specialist, while the unskilled but intelligent reader in search of information, whose requirements should always be kept in view in a work like the present, will, we fear, find their language often too technical to give him what he wants. The writer tells us that

"multiradial apocentricities lie at the root of many of the phenomena that have been grouped under the designation of *Convergence*."

We should say rather that the first phrase merely repeats the idea of the second in a more cumbrous form. Moreover, we doubt whether anyone not an expert would grasp the meaning of either expression, or that of "homogeneous homoplasies," without illustration. The account given of the recent departure in biometrics is good so far as it goes, and the position of its exponents is not unfairly stated; justice, however, is hardly done to the fact that the quantitative stage is inevitable in any inquiry the material of which admits of measurement. Workers in this department are fully alive to the danger pointed out by Dr. Mitchell, and analysis of composite characters is making progress under the stimulus supplied by the rediscovery of Mendel.

The article dealing with forests and forestry is in two parts, the general part by Dr. Schlich, C.I.E., F.R.S., and that referring to the United States of America by Mr. Gifford Pinchot, Forester of the U.S. Department of Agriculture.

Dr. Schlich first deals with the general distribution of forests throughout the world, and this might with advantage be more detailed. His account of the utility of forests based on their indirect and direct advantages is admirable, the former being chiefly the prevention of the denudation of hill-sides and of the consequent flooding of low-land and the silting-up of river-beds. The direct utility of forests increases steadily with the population of civilised countries, and it is a remarkable proof of the effects of economic progress that whereas in 1880 Germany produced as much timber as she required, in 1899 she imported 4,600,000 tons, valued at 14,000,000*l.* and this in spite of the increasing yield-capacity of her State forests. The latter comprise about one-third of her forest area, but as continental communal forests are chiefly managed by the State, it is a pity that they are not separated from private forests in the table of areas, for continental private forests are frequently no better managed than our own. Eighty-seven per cent. of the timber we import yearly, worth about 22,000,000*l.*, is coniferous, and it is chiefly on Canada, with 1,250,000 square miles of forests, that the world will have to depend for the future. Curiously, the table showing movements of timber within the British Empire entirely omits Canada.

Dr. Schlich appeals to the landowners of Britain to afforest 3,000,000 of our 24,000,000 acres of lands either waste or used for light hill grazing, and for more attention to forestry by our colonies, most of which are no better than Canada in this respect. He gives an interesting account of forest management in India, the managed State forests of which, comprising, in 1900, 95,000 square miles, 10 per cent. of the area of British India, yielded (1890–95) an average net revenue, which is steadily increasing, of 73,70,000 rupees. Progress in forestry is also being made in South Africa and Ceylon.

Mr. Pinchot gives a good summary and a map of the distribution of forests in the United States, the chief causes of destruction of which are over-lumbering and fires. He gives a map of the present State reserved forests, which, although amounting in area to 72,500 square miles, look inconspicuous on the huge territory of 3,500,000 square miles. He has also drawn up a useful history of the State protection of forests, which was greatly assisted by the large reservations carried out by President Cleveland and the forest law passed in 1897, the general purport of which he explains and praises.

Forest education has progressed in America, forestry being taught at several universities and other institutions. Mr. Pinchot states, however, that European forestry is not yet applicable to America, but that the production of a net revenue and the perpetuation of the forest are the chief objects of the private forest owner, who is the principal timber producer in the States. There is an account given of the lumber trade, and the ominous note occurs that numbers of the eastern white pine lumber- and mill- men have removed to the southern States and Pacific Coast, driven away by the exhaustion of their supplies. From Dr. Schlich we learn that already the United States imports from Canada nearly as much timber as it exports.

The article "Geology" is written happily by the same authority, Sir Archibald Geikie, who contributed the elaborate essay in vol. x. of the ninth edition. He divides his subject as before into sections, and reviews in the same lucid manner the general progress made during the interval. In its cosmical aspects, the record is not, however, one wholly of progress, as Croll's astronomical theory is no longer considered to afford a solution of the problem of the Ice age. Many have dealt with the question of the earth's age, notably Sir A. Geikie, and we cannot wonder that he repeats his protest against the time-restrictions of physicists and mathematicians. No evidence of progressive diminution of activity, whether of the sea or of volcanoes, is preserved among the rocks; their record, indeed, is one of singular uniformity, despite the catastrophes of Krakatoa in Sunda Strait and of Bandai-san in Japan, to which attention is directed. Much has also been learnt about fissure-eruptions. Here we are in touch with the author's special subject, and he devotes a considerable space to the volcanic history of the British Isles. To petrography, which no doubt is dealt with in a special article, but brief reference is made.

A glance at the article on geography shows how intimately it has become linked with geology during the past quarter of a century, thanks to the labours of Suess, Penck, Lapworth and W. M. Davis. The fact that the surface of the sea preserves no uniformity, and that it may locally rise and fall to a considerable extent without change in the lithosphere, would seem to revolutionise our ideas about raised beaches and submerged forests; but the author points to certain regions where there is definite evidence of slow upheaval or depression of land. The indications of changes of level derived from a study of coral-reefs are also discussed.

Structural geology naturally occupies some space, and special reference is made to the great flexures and overthrusts that have been determined in many regions. Palæontological zones receive attention, for on this subject great progress has been made, and although we miss reference to the brilliant researches of Dr. A. W. Rowe, the importance of the subject is fully admitted. We agree with the author that there is much yet to be solved in the problem of life-zones. Special mention might have been made of observations on radiolarian chert, but in so complex and many-sided a subject as geology we feel that the author has done all that could well be done to illustrate its progress in a limited space.

Prof. Greenhill's two contributions on ballistics and the gyroscope and gyrostat are full of material of interest to students of dynamics. In a short essay Sir W. T. Thiselton-Dyer summarises the chief points of Huxley's life and work, and contrives to express the essential characters of each in a few pages. Dr. Günther has brought the article on fishes up to date. In 1870 the number of known species of living fishes was stated as 8525, but since then it has been nearly doubled. Knowledge of the distribution, organisation and development of fishes has also made substantial progress, and Dr. Günther gives a survey of the most important advances.

The article on insects is by Dr. David Sharp, whose general knowledge of the subject is probably more extensive than that of any other living entomologist. Nevertheless, it is obvious that the space at his disposal was utterly inadequate to permit of his attempting more than a mere glance at a few of the more interesting matters connected with entomology that have been discussed in recent years. Among these are the number of species of insects; antiquity; duration of life (inadequately discussed; but the fact of a water-beetle living five and a half years in captivity was new to us, though some of Lord Avebury's Queen ants have attained a much greater age); economic entomology (with special reference to Coccidæ, and to insects and malaria); luminosity (concerning which Dr. Sharp remarks, "The light given by insects has been shown to be highly economical, and if a similar illuminating agent can be produced artificially it will be a reat boon.' Granted; but then there is the immense initial difficulty of producing or imitating organic chemical substances artificially); galls; anatomy and morphology (with special reference to the structure of the segments of the head); metamorphosis; classification (twenty-two orders are now recognised, the sequence of which differs considerably from that followed in the author's "Cambridge Natural History," published in 1899) and ethology (referring to intelligence and to social insects). The article concludes with a paragraph of "authorities," including references to a few recently published books and papers on insects; but the list is necessarily so short and incomplete that we think it might almost as well have been omitted altogether.

Though limitations of space have prevented some of the writers from doing full justice to their subjects, the volumes are rich in matter of interest to the student of science, and furnish substantial evidence of progress in many branches of natural knowledge.

THE STUDY OF THE PROTISTA.

Archiv für Protistenkunde. Herausgegeben von Dr. Fritz Schaudinn. Band i. Heft 1. Pp. 192; 5 plates. (Jena: Gustav Fischer, 1902.) Price Mk. 24.

OF late years very rapid progress has been made in our knowledge of that vast assemblage of organisms for which Haeckel set up a special "kingdom" or *Reich* with the name Protista, comprising the simplest living creatures amongst which the distinction of plant and animal is of quite secondary importance. In no branch of biology do works become so quickly out of date as in that which deals with the lowest forms of life. The attention which the Protista have received has been stimulated from two sources. From a purely scientific and theoretical point of view, it is evident that many elementary problems, or fundamental phenomena, of life can be studied in their simplest form, divested of unessential complications, in these lowly organisms. This is especially true of the facts of cytology relating to the structure and activities of cells. The discoveries of the last decade of the nineteenth century have revealed a remarkable uniformity, underlying the greatest variety in form and detail, in the cell-processes of the higher animals and plants, which cannot be considered as satisfactorily understood until the steps are made clear by which they have been evolved from the usually simpler, but in any case far more diversified, types of structure or development which are found to occur in unicellular organisms. It is only necessary to refer to the problems of cell-division and fertilisation in support of this proposition. Quite apart, however, from their claims on the attention of scientific biologists, the Protista are becoming continually more important as objects of study from the practical point of view. Some, as, for instance, the organisms of fermentation, are indispensable for human arts and manufactures; others have a claim to consideration which, if more melancholy, is not less great, on account of the injuries or disease which they inflict as parasites or pathogenic agents upon man, beast, or plant. The importance of the lower organisms from the practical standpoint has already been the cause of specialisation in their study. An instance of this is seen in the rise and rapid growth of the science of bacteriology, and the special study of yeasts and fermentation has been dignified by the name of zymotechnology. By "Protistenkunde" or protistology is denoted a wider field of study, embracing all Protista as its objects, and of which bacteriology and kindred sciences are but subordinate branches.

It is not surprising, therefore, that a journal has appeared which is to be devoted entirely to protistology. The *Archiv für Protistenkunde* will be welcomed by a wide circle of naturalists, and will find a place in every biological library. Edited by Dr. Fritz Schaudinn, who has himself pursued the study of Protozoa with such remarkable success, its high standard of excellence is practically guaranteed. The contents of the first number do not disappoint our expectations, while they show at the same time that the aim of the journal is to be scientific rather than practical. With contributions headed by names so well known as Hertwig, Bütschli, Brandt and others, the new journal makes a good start.

The first article is contributed by Prof. R. Hertwig, and is a very interesting discussion on Protozoa in relation to the cell-theory. To show the scope of his dissertation, it must suffice to quote his principal conclusions. He attempts "to develop a uniform conception of the cell, applicable alike to Protozoa and Metazoa," recognising that any such attempt does not rest at present on a very firm basis, but thinking it nevertheless more useful to formulate precise conclusions, which can be criticised, than to rest content with vague indications.

"Three kinds of substances, characterised by the part they play in cell-life, must be assumed: (1) the achromatic substance; (2) the chromatin; (3) the nucleolar substance. These three substances show the following distribution in the cell of the Metazoa, and probably also in that of multicellular plants. The protoplasmic framework—leaving out of consideration the material filling the meshes or alveoli (Bütschli)—represents an intimate union of achromatic framework and chromatin, of which the latter is only separated out under special circumstances in small quantities, and then induces a heightened staining-capacity of the cell body. . . . The linin-framework of the nucleus consists only of achromatic substance, in which is deposited the chromatin, bound up with nucleolar substance and thereby organised. In this way arises the chromatic nuclear framework of authors. An excess of nucleolar substance forms the true nucleoli, which in the majority of cases are subsequently used up in the formation of chromosomes in karyokinesis, in the Metazoa just as in *Actinosphaerium*."

The first number contains five other articles besides that of Hertwig, amongst which may be noticed one by Bütschli on the structure of the Cyanophyceæ and Bacteriaceæ, a monograph of the Coccolithophoridæ by Lohmann, and a discussion by Doflein of the outlines of classification of the Protozoa. The last-named author divides the Protozoa into two main divisions: first the Plasmodroma, characterised by possessing organelles for locomotion

"which can be easily recognised as protruded portions of the body-protoplasm, and which, moreover, in many cases can be extruded and withdrawn as required";

secondly the Ciliophora, in which the organs of locomotion, when present, are cilia. The Plasmodroma comprise the three classes Rhizopoda, Mastigophora and Sporozoa; the Ciliophora comprise the Ciliata and Suctoria.

In conclusion, it is only necessary to add that the various memoirs are illustrated, where necessary, by lithographed plates of the degree of excellence to which one is accustomed in German zoological periodicals.

E. A. M.

AN ASSAYER'S HANDBOOK.

Assaying and Metallurgical Analysis for the use of Students, Chemists and Assayers. By E. L. Rhead and Prof. A. Humboldt Sexton, F.I.C., F.C.S. Pp. x + 431. (London: Longmans, Green and Co.) Price 10*s*. 6*d*. net.

THE differences between assaying and chemical analysis in the ordinary usage of the terms are perhaps not very precise. An effort was made some years back in America to apply the word "assaying" only to the estimation of some or all of the elements in a substance by means of dry reagents and heat, and the word "analysis" to all estimations by the use of reagents in aqueous solution. These definitions, however, have not met with much favour, and have little to recommend them. It would be better to limit "assaying" to the estimation of the valuable constituent or constituents of an ore or other substance, and to use "analysis" for the estimation of the other constituents and for all qualitative determinations. According to this view, a gold ore would be assayed for gold and silver, and the sulphur, copper, iron, &c., would be determined by analysis, while a copper ore would be assayed for copper, the sulphur in iron pyrites would be determined by assay, and so on. Messrs. Rhead and Sexton have in general followed this method, but there are difficulties in its adoption, and in any case an authoritative definition is required.

There are already many books on the subject, and although some of them are out of date, the need of a new one which does not follow any strikingly original and advantageous plan does not seem pressing. It may be presumed that the authors of the book under review have found difficulties in teaching their students with the aid of the older books, and after supplying their own wants have decided to offer their system to other teachers. The result is by no means displeasing. The plan of the book is excellent. The student or assayer can find what he wants without delay, and the description of the required process is always terse, usually accurate and in many instances sufficiently complete. The accuracy, however, is unfortunately by no means without exception, but the chief fault of the book is that in the effort to reduce its size terseness has been pushed to an extreme, and the working directions are often insufficient to enable the process in course of description to be properly carried out even by an assayer of some experience unless he has been previously taught what to do.

An example of the lack of accuracy occurs in the description of the iodide method of estimating copper, in the course of which on p. 79 the student is informed that

"Cupric salts liberate iodine from potassium iodide. The liberated iodine may be estimated by means of a solution of potassium thiosulphate of known strength, sodium iodide and sodium tetrathionate being produced."

If he is puzzled by the production of sodium salts from potassium thiosulphate, and turns to the fuller account on p. 85 for elucidation, he is confronted by the equation

$$2CuSO_4 + 4K = Cu_2I_2 + 2K_2SO_4 + 2I.$$

In the subsequent directions, moreover, no attempt is made to shorten calculation by the use of a normal standard solution or of one that will enable the percentage of copper to be read off from the burette. The student is told to "Dissolve [0·5 grm. copper] in 5 c.c. nitric acid and boil till all nitrous fumes are expelled," a dangerous piece of advice, and one that contains no hint of the practice now often preferred of getting rid of the nitric acid by means of sulphuric acid and so removing all chance of the disconcerting return of the blue colour. The dangers of terseness are also shown in the account of the estimation of lead as lead sulphate, on p. 64, where the directions are as follows:—

"The solution is evaporated with sulphuric acid till the fumes of the acid are given off. The solution is diluted with water, allowed to settle, filtered, washed by decantation with water acidulated with sulphuric acid, and finally on the filter with dilute alcohol or water," and so forth.

These directions are inadequate, and it may be doubted whether either Prof. Rhead's or Prof. Sexton's students have ever been set to work without a fuller and more careful account of the precautions to be observed.

Among other blemishes, the omission of all reference to Mulder's neutral point in the Gay-Lussac method of estimating silver may be mentioned, and the importance of check assays in this method is not sufficiently insisted on.

However, all these faults do not prevent the book from being useful both as a supplement to oral laboratory teaching and as a book of reference to experienced assayers. It is divided into three parts, part i. being devoted to a brief description of laboratory appliances and general processes, part ii. to the assay of the more important metals as well as chlorine and sulphur, and part iii. to a short account of certain analyses which have to be made in practice in metallurgical works. Of these, part iii. is perhaps less satisfactory than the others, but, although it is far from complete, there is much useful information in it, and speaking generally, analytical chemists and assayers will not regret the addition of the volume to their bookshelves. T. K. R.

OUR BOOK SHELF.

The Climates and Baths of Great Britain. Vol. ii. Pp. xvi + 628. (London: Macmillan and Co., Ltd., 1902.) Price 12*s.* 6*d.* net.

THIS volume completes the work undertaken by the committee of the Royal Medical and Chirurgical Society of London in 1889. The general arrangement of the subject-matter is on the same plan as in vol. i., and in order to maintain this uniformity the meteorology of the same series of years (namely, 1880–1890) has been investigated.

The volume deals with London and Middlesex, the east coast, the midland counties, Lancashire, the lake district, Northumberland, North and South Wales, Ireland—including its mineral springs; and the whole of the work has been placed in the hands of contributors whose names are well known in the medical world. It should be added that seven excellent maps, showing areas, elevations, rainfalls and isothermals, are also incorporated.

The local information contained in this and in the former volume was mainly collected by means of circular letters sent to medical men practising at the various health resorts and bath-places, in which they were asked their opinion as to the prevalence of certain diseases; the influence of the climate upon patients sent there for the treatment of different diseases; the common causes of death and frequency of old age among residents; the system of drainage; the water supply; and the local climatological data. Where medicinal baths exist, inquiry was made as to what morbid conditions are treated with advantage by these baths, the ways in which the waters are employed, the diseased conditions contraindicating their use, and the time of the year advised for their application.

The chapter dealing with London and Middlesex is certainly one of the best. The writer, Dr. William Ewart, remarks that in London "everything is artificial," from the "made ground" upon which it is built to its water courses, some of which are turned away from their natural beds, and to the composition of its air, so much altered by smoke, London fogs and mists, that the meteorology of London is one *sui generis*. Dr. Ewart asks, why should life in London be, on the test of mortality, so much safer than in many other districts? This he considers to be partly explained by the relative dryness and warmth prevailing in the streets; and he concludes that, with all its faults, its climate is a protective one, with less exposure, greater warmth and less humidity than is the case in many other districts.

The work is undoubtedly a valuable one, and well repays the large amount of time and labour which must have been devoted to its compilation. It will be found alike serviceable for reference to medical practitioners and their patients, and also to medical officers of health and local sanitary authorities, who are so largely interested in the health of the communities under their charge. The only respect in which this useful work leaves something to be desired is that the information should be of a more definite character than that furnished with reference to the prevalence of disease in some of the localities dealt with.

Electric Wiring: a Primer for the Use of Wiremen and Students. By W. C. Clinton, B.Sc. Pp. viii + 179. (London: John Murray, 1902.) Price 1*s.* 6*d.*

ELECTRIC wiring is not a very suitable subject on which to write a primer. From the wireman's point of view it is a subject to be studied only by practical apprenticeship; from the engineer's it is a special branch of electrical work to be taken up at a time when primers are things of the past. Nor do we quite see the right of such a book to a place in Mr. Murray's "Home and School Library," which is intended (as an advertisement sets forth) for the general reader as well as for school use. The general reader does not want to know how to make joints, and the schoolboy would be far better employed learning the first principles of electricity instead of the elementary details of one of its practical applications. Apart from considerations such as these, it must be admitted that Mr. Clinton has done his work well and written an interesting little book. He deals with wiring for both electric light and electric bells, and as these between them involve the principles of electricity, magnetism and electrochemistry, he has said a few words about the theory of all three subjects, and has strengthened these by the addition of some worked examples of an elementary character. The theoretical parts are necessarily brief, the bulk of the book being devoted to descriptions of the practical work which are clearly written and well illustrated. A little more space might have been given to the construction of bell indicators and to the maintenance and peculiarities of batteries, both of more importance to the wireman than the details of the manufacture of electric incandescent lamps. Also the distribution of lamps to give the best illumination, the use of globes and shades, and the ageing of incandescent lamps are all subjects on which wiremen would be wise to be informed, which are dealt with either inadequately or not at all. There is a question we should like to ask: Is Mr. Clinton correct in saying that the B.C. holder is known as the "bottom contact"? We had always thought that the letters stood for "bayonet cap," and certainly "bayonet holder" is much the more general phrase.

Finally, we may add that the book should be useful to the wireman entering for the City and Guilds examination in this subject; he will find it a valuable travelling companion as he proceeds to the examination room.

M. S.

The Common Spiders of the United States. By James H. Emerton. Pp. xviii + 225. (Boston, U.S.A., and London: Ginn and Company, 1902.) Price 6*s*. 6*d*. net.

THE study of spiders is probably less neglected in the United States than in Britain, for writers on general entomology like Packard and Comstock have included them in their works, and there are several valuable books on the subject. Still, spiders are less popular than butterflies or beetles, and Mr. Emerton has brought out the work before us, illustrated with no less than 501 illustrations in the text, in which he has given a very useful account of the commoner American spiders, classed under ten families. Mr. Emerton informs us that there are at least 300 or 400 species of spiders to be found in the neighbourhood of any city in the United States. The introductory matter is very good, dealing with structure, habits, collecting, &c., and the diagrams on p. ix, showing the undersurface of a spider and the front of the head, are particularly clear. So many families, genera, and occasionally even species of spiders are common to the United States and Europe that a student beginning to collect British spiders could not do better than use this book in conjunction with Miss Staveley's "British Spiders," before passing on to the more elaborate works of Blackwall and Pickard Cambridge.

Trees in Prose and Poetry. Compiled by Gertrude L. Stone and M. Grace Fickett, Instructors in State Normal School, Gorham, Maine. Pp. xi + 184; illustrated. (Boston, U.S.A., and London: Ginn and Company, 1902.) Price 2*s*.

THERE are many methods of nature-study in America, and in some more attention is given to the æsthetic and emotional sides of education than to the scientific. This little book is a collection of extracts from good writers showing that trees have often been the source of literary inspiration. It is good that children should become familiar with the best literature their country provides, and when at the same time they have their attention directed to the study of nature, the lesson becomes of increased value.

Chart of the Metric System. Constructed by Prof. C. Bopp. With a pamphlet of "Notes." Pp. 15. (London: Williams and Norgate.)

THIS diagram of the metric units of length, area and volume is printed on a sheet of paper about 3 feet 6 inches by 2 feet 6 inches. The various measures are shown full size. To be of the greatest use in class teaching, the chart should be used in conjunction with models, and fortunately these are to be obtained. With the aid of the "Notes," teachers should have no difficulty in making the idea of the decimal system easy of comprehension to their pupils.

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.*]

Vortex Spirals.

IT appears that a reference to Dr. W. M. Hicks's memoir on the properties of spiral fluid vortices (*Phil. Trans.*, 1898), inserted in the recent reprint of FitzGerald's Helmholtz lecture of January, 1896 ("Collected Scientific Writings," p. 353), has suggested the misconception that the idea of spiral vortices originated with FitzGerald and was subsequently developed by Hicks.

It is beyond doubt, from the context, that FitzGerald derived his knowledge of the possible existence and the properties of vortex spirals from the detailed discussion of vortex theories of matter and their difficulties, contained in Dr. Hicks's presidential address to Section A of the British Association in September, 1895; in this address, and in papers communicated to Section A, that striking extension of vortex theory was explained in illustration of the structure of optically rotational atoms. This is the more certain as Dr. Hicks's observations (*loc. cit.*) as to the possibility of the mutual absorption of a pair of Hill's spherical vortices (M. J. M. Hill, *Phil. Trans.*, 1894) were mentioned by FitzGerald in the same context. J. LARMOR.

October 13.

Bipedal Locomotion in Lizards.

THE accounts of bipedal locomo tion among lizards contributed by Mr. E. A. Green and Miss R. Haig Thomas are of high interest. This peculiar method of progression has been recorded by me of the Australian lizards *Physignathus Leseuri* and *Amphibolurus muricatus*, in addition to the frilled species *Chlamydosaurus Kingi*, all belonging to the Agamidæ. More recently I have found by experiment that a member of the American greaved lizards, *Tupinambis nigropunctatus*, possesses a like bipedal habit, and have been informed by a correspondent, Mr. H. Preston, that the same locomotive peculiarity is commonly manifested by the allied form *Amiaeva Surinamensis* and also by sundry species of the typical iguanas. Another correspondent has informed me that that singular iguanoid the basalisk is likewise bipedal, not only on *terra firma*, but that it will also run rapidly over the surface of water in an erect position. As is the case with the long-toed aquatic birds the jacanas, the feet of the running lizard are most probably in this case supported in transit by a more or less substantial substratum of water plants.

The bipedal progression attributed to *Lacerta viridis* and an allied form is, as compared with that of the above-named species, relatively incomplete; the tail is not raised clear from the ground during locomotion, and neither is the erect attitude sustained for any duration of time. The conspicuously greater length of the hind limbs that characterises all those species of which sustained bipedal locomotion has been recorded is a prominent feature in many other types which will probably be found to possess the same habit. Among these, members of the agamoid genera Goniocephalus, Otocryptis, Japalura and Calotes[1]; some of the Anolids, Uraniscodon and others among the Iguanidæ, and Cnemidophorus belonging to the Teiidæ, may be indicated as likely to yield affirmative evidence in this direction. W. SAVILLE-KENT.

Milford-on-Sea, October 9.

Theories of Heredity.

IS there not room for some provisional hypothesis which shall include both Galton's and Mendel's ideas, which are not necessarily antagonistic, but may turn out to be as simultaneously true as the laws of Boyle and Charles, so that the final results may be of the nature of a product or resultant? I mean that instead of drawing a hard-and-fast line between "recessive" and "dominant" characters we may suppose that these differ like heat and cold, in degree but not in kind. So that "*dominance*" *may be measured on some scale from* 0 *upwards, the measure of dominance being perhaps a function of the number of generations for which a character has been established.*

[1] Since writing this letter, a confirmation of my anticipation in the case of this genus has been recorded in NATURE for October 9 by Mr. N. Annandale.—W. S-K.

To take an instance. Last year (1901) I carefully hybridised two varieties of the sweet pea, using lens, paint brush and muslin nets. One variety used was "Gorgeous," of a salmon-orange colour. It is described in Burpee's catalogue as an improved "Meteor," and "Meteor" was brought out by Eckford about 1893. The other variety was a new cream white, Eckford's "Mrs. Kenyon," novelty of 1901.

The seeds formed were some pale and some dark, the colour following that of the mother parent. None of the flowers of the offspring have been cream-coloured; the seeds borne on "Mrs. Kenyon" by pollen from "Gorgeous" have all yielded purple flowers unlike either immediate parents, but probably taking their colour from the known remote purple ancestor of our sweet peas. Of seeds borne on "Gorgeous" by pollen from "Mrs. Kenyon," eight plants yielded flowers like "Gorgeous," but ten of the plants yielded purple flowers.

Here the dominant purple appears to be due to the previous long ancestry; the salmon variety of ten years' standing has several representatives, but not one single cream flower stands for the 1901 novelty. HUGH RICHARDSON.

Bootham School, York.

The Fertilisation of Linum.

IN the *Proceedings* of the Academy of Natural Sciences of Philadelphia for 1902, pp. 33-36, is a very interesting paper by the late Mr. Thomas Meehan, treating of some points in the life-history of certain plants. On p. 36, Mr. Meehan says:—"Mr. Darwin once stated that one might as well use organic dust as to endeavour to get seeds of *Linum perenne* by the aid of its own pollen. I found *Linum perenne* of our Rocky Mountains abundantly fertile with own-pollen, and said so in one of my papers." As some anti-Darwinian will probably make much of this statement, it is as well to say that the Rocky Mountain plant is a distinct species, *Linum lewisii*, Pursh.

In the same paper, Mr. Meehan has some very interesting remarks on the fertilisation of Lobelia, and shows that the Bartram Oak, *Quercus heterophylla*, Michaux, is not a hybrid, but a mutation (quite of the DeVriesian sort) of the pin oak. It will therefore be called *Quercus palustris heterophylla*. Mr. Meehan attributes such variations to "varying degrees of vital energy," and supports this view by calling attention to the fact that in the ivy, for instance, the leaves may at first be more or less lobed, but become wholly entire later on, in the same individual plant. One also recalls the great difference between the early and late leaves of many Malvaceæ, and of species of Eucalyptus. It is to be remarked, however, that these differences occur in a regular manner, and their order cannot be reversed. T. D. A. COCKERELL.

East Las Vegas, New Mexico, U.S.A., October 7.

Retention of Leaves by Deciduous Trees.

HAVING followed the interesting discussion relating to the deferred shedding of their leaves by young beeches, it seems to me that something yet remains to be said, though, as I take it, P. T. (NATURE, May 15) has come very close to the solution. The phenomenon is common here also, and much more of the same kind can be seen. The maturing of leaves appears to be retarded by two causes. In older trees the lower branches with their leaves come late to maturity by reason of the tendency of the energy of growth to expend itself toward the higher branches. With young trees, and especially such as are cultivated late in the season, maturity of the fresh growth is slow by reason of excess of vegetative activity. In both there is failure to mature the abscission layer of cork at the base of the petiole and consequent retention of the leaves. In seasons of early autumnal frosts, the late-growing and imperfectly lignified parts of trees are the first to suffer. D. T. SMITH.

Louisville, September 25.

THE SCOTTISH ANTARCTIC EXPEDITION.

THE Antarctic summer of 1902-3 will see the unprecedented number of five exploring steamers at work on the edge of the southern ice, and three of these under the British flag. The fifth expedition is on the point of departure, and it promises to be by no means the least important, its equipment for some branches of research being remarkably complete. An objection may perhaps be taken to the name given to this expedition—the Scottish National—for, so far as we are aware, no public body or learned society in Scotland has been asked to accept any responsibility and none has claimed any credit in the matter; we fear, too, that the number of subscribers is not great enough to indicate any widespread interest amongst the people of Scotland. To Mr. W. S. Bruce is due the whole credit of planning the expedition, arranging all details of equipment and organisation, and beating up subscriptions with a pertinacity which has deserved and commanded success. He now goes out as leader of the expedition, his enthusiasm in all branches of science and his unequalled experience of work in the ice of both Polar zones justifying hopes of good results. In a very full measure it is Mr. Bruce's expedition. Next to him, honour is due to the small number of munificent subscribers, all, we believe, Scotsmen, whose generosity has made the enterprise possible. The expedition is in truth Scottish throughout, but without the formal recognition and support of the leading learned societies it cannot rightly be considered national.

In a paper read to the British Association at the recent meeting in Belfast, Mr. Bruce gave details of his plans and equipment, and on this authoritative statement we base the following remarks.

While the British national expedition on the *Discovery* and the German national expedition on the *Gauss* are devoting attention in the first place to magnetism, for the study of which the ships were specially designed, and the Swedish expedition in the *Antarctic* is in large measure geological, the Scottish expedition will be mainly devoted to oceanography and meteorology. Other branches of science will, of course, be attended to in each case, and Mr. Bruce has made ample provision for turning all opportunities to account.

The ship for the expedition was an old Norwegian whaler, the *Hekla*, which might possibly have made a Polar voyage in her original state; but, on examination, it was found desirable practically to reconstruct her so as to render her absolutely safe in any circumstances that can be foreseen. She was accordingly stripped of her outer skins and resheathed, fitted with new masts and spars, and her whole internal arrangements and deck-plan remodelled, from the designs of Mr. G. L. Watson, by the Ailsa Shipbuilding Company at Troon. Her name suffered a similar sea-change, and she is now the *Scotia*. A vessel of about 400 tons, she is 140 feet long with 29 feet beam, and draws 15 feet of water. She has graceful lines, is barque-rigged, and is fitted with a new engine and boiler which have proved able to propel her at the rate of eight knots, while she is confidently expected to prove a fast sailer.

The leader, captain and scientific staff will occupy an after deckhouse, the officers will be berthed amidships and the crew forward. A large deckhouse has been built amidships containing the galley and also a large, well-lighted laboratory, where most of the scientific work will be carried on. It communicates with a zoological laboratory on the deck below, adjoining which there is a photographic dark-room. This lower deck contains two great drums each carrying 6000 fathoms of cable (presumably of steel wire, as each drum weighs six tons), which is led up to a 40-horse-power steam winch on the upper deck, and is to be used for trawling and trapping in the deep sea. Ample sounding wire is also carried. On the after deck, a special petrol engine is employed for working the winch for winding in the great meteorological kite specially designed and constructed by Mr. John Anderson, of Edinburgh, but of which no description has yet, so far as we are aware, been published. A full equipment of meteorological and oceanographical instruments of the best patterns has been provided.

The expedition has been fortunate in securing the services of Mr. Thomas Robertson, of Peterhead, as captain of the *Scotia*. Captain Robertson has been engaged in Arctic whaling for twenty years, and has made some interesting geographical surveys on the coast of Greenland. In 1892, he took part with the Dundee whaling fleet in an Antarctic voyage, and he is not likely to neglect any opportunity of exploration in the far south. While the captain is in command of the ship, the command of the expedition is in the hands of Mr. Bruce alone, and he is responsible for the plan, which he is free to vary as circumstances may require or suggest, and for the direction of all the scientific work. Mr. Bruce will be supported by a scientific staff of six, including Mr. R. N. Rudmose Brown (son of the late Mr. Robert Brown), as botanist and observer of plankton; Mr. R. C. Mossman, as meteorologist, a choice which ensures the highest efficiency in that department; and Dr. J. H. H. Pirie, as medical officer and geologist. Dr. Pirie has studied oceanic deposits with Sir John Murray and has also had experience of field-work in geology. The zoological work will be shared between Mr. Bruce himself and Mr. Wilton, an old companion on the Jackson-Harmsworth expedition. Two younger men will also go as assistants.

The plan of the expedition is stated to be as follows:—The *Scotia* is to proceed direct to the South Atlantic Ocean, and in the coming Antarctic summer she will go "as far south as is compatible with the attainment of the best results to science." The Scottish station is marked on the map accompanying Mr. Bruce's Belfast paper as in 82° S., 30° W.; but it is explicitly stated that the ship will, if possible, be kept clear of the ice and will not winter in the far south unless that course cannot be avoided. Hence we doubt whether a latitude within many degrees of that designated can be reached. The Antarctic winter of 1903 is to be spent in oceanographical work to the north of the ice-pack, an arduous programme, but one likely to secure very interesting results if the sea is not too rough for working the instruments. If funds permit, a second trip into high latitudes will be made in the following summer. We consider it is extremely important that this should be done. After providing one of the finest Polar ships afloat at great expense and bringing together a singularly competent staff of specialists, it would be most unfortunate not to utilise the opportunity for securing two years' work. In the interests of science we would appeal to those who are generously bearing the cost of this expedition to do a little more, to free Mr. Bruce absolutely from any further anxiety as to expense and leave him no excuse for not reaping fully the harvest of scientific results which lies awaiting him in the field he has succeeded at last in entering.

THE NATURAL HISTORY OF THE THAMES VALLEY.[1]

IN a series of pleasantly written and beautifully illustrated articles, a large proportion of which have previously appeared in various serials, such as the *Spectator*, *Country Life*, and the *Badminton Magazine*, Mr. Cornish introduces his readers to a number of interesting facts connected more or less intimately with the valley of the Thames and its tributaries. Indeed, if we may judge by a statement made in the preface, and the evidence afforded by the text itself, few Englishmen can be better acquainted, both from the natural history and the sporting point of view, with the basin of the Thames than the author. In the first chapter we are introduced to the Thames at Sinodun Hill, in the next the manner in which the great river receives its supply of water is discussed, while the shells, plants and insects of the Thames form the subject of the next three chapters. Perhaps the author is a little too much dominated with the idea of the great antiquity of fresh water and all its belongings, but this is a small point; and his notes on the variation of colour presented by the Thames Neritina, and the remarkable manner in which these empty shells collect in vast quantities in certain parts of the river-bed are of considerable interest. Indeed, it would be well worth while for some investigator to turn his attention to the manner in which these accumulations of shells are brought together. Several chapters are devoted to fish and fishing, the chub coming in for a special share of attention, and eel-traps being fully described. The two chapters on Wittenham Wood are specially interesting, as showing the numbers of wild mammals to be met with a few years ago in the Thames valley. From the former of these chapters we select, as a sample of the illustrations of the volume, the exquisite photograph of a pair of otters herewith reproduced.

The migratory and resident birds of the district are treated of in a couple of chapters, in the first of which the author states that, as the result of several years' observation, the river serves as the migration route of several species of birds besides swallows. "Sand-martins," he writes, "when beginning the migration, travel down the Thames in small flocks, and sleep each night in different osier-beds. How many stages they make when 'going easy' down the river no one knows. But I have seen the flocks come along just before dusk, straight down stream, and then dropping into an osier-bed." A third chapter describes the birds to be seen on the reservoirs in the valley.

The plants of the Thames valley, other than those of the river itself, receive attention in two chapters, the one treating of various poisonous kinds, while the other describes the flowering species to be met with in the meadows. Nor are economic and agricultural considerations by any means neglected. In one article, for instance, the author gives notes on the different breeds of sheep to be met with in the Thames watershed, while in a second he discourses on watercress and osier-growing. Sporting readers will find much to interest them in the account of netting red deer in Richmond Park, while the lover of picturesque scenery will be delighted alike by the author's descriptions and the photographs by which they are illustrated.

In discursive and chatty writings of this description Mr. Cornish is indeed thoroughly at home, and his book ought to command a large circle of readers who delight in our chief river and its neighbourhood. But in not a few of his chapters the author attempts more ambitious subjects, where in several places he gets sadly out of his depth. For instance, on the very first page we find it gravely stated that "there are in Lake Tanganyika or the rivers of Japan exactly the same kinds of shells as in the Thames." We may take it, charitably, that by the somewhat vague term "kinds" the author means genera and not species. But even then the reference to the molluscan fauna of Tanganyika is a most astounding and unpardonable error. Has the author, we may well ask, never heard of Mr. J. E. S. Moore's famous expedition to that lake, and the shoals of papers that have been written with regard to its so-called "halolimnic" molluscan fauna? It is perfectly true, indeed, that Tanganyika, like other African lakes, contains several widespread genera, such as Planorbis and Paludina common to the Thames and other freshwaters of Europe and Asia, but in addition to these it is the home of quite a number of peculiar generic, if not family, types of molluscs unknown at the present day anywhere else in the world. And we are told that its shells are exactly the same as those of the Thames!

In describing the freshwater "limpet" (*Ancylus fluviatilis*), the author alludes to it as "shaped like a Phrygian cap." On referring to the plate of "Thames

[1] "The Naturalist on the Thames." By C. J. Cornish. Pp. viii + 260; illustrated. (London: Seeley and Co., Ltd., 1902.) Price 7s. 6d.

Shells," facing p. 14, it will be seen that in place of this species the author has actually had figured the marine shell commonly known as *Pileopsis hungaricus!* Nor is this all, for in the same plate an Ampullaria does duty for Paludina (or Vivipara); while instead of the freshwater Thames Neritina we have the marine West Indian *Neritina radiata* depicted. Comment is superfluous!

Neither is Mr. Cornish less unfortunate when, in the chapter on "London's Buried Elephants," he essays to enlighten his readers on the fauna of the Thames valley in Pleistocene times. Passing over his misuse of the term "Prehistoric" as equivalent to "Pleistocene," which in a work of this nature may be regarded as a venial sin, we find on p. 234, in connection with the discovery of mammalian remains during the excavations for the foundations of the Victoria and Albert Museum at South Kensington, the following sentence:—

"So on the London 'veldt' there were lions, wild horses (perhaps striped like zebras), three kinds of rhinoceroses—two of which were just like the common black rhinoceros of Africa, though one had a woolly coat—elephants, hyænas, hippopotami, and that most typical African animal, the Cape wild dog!"

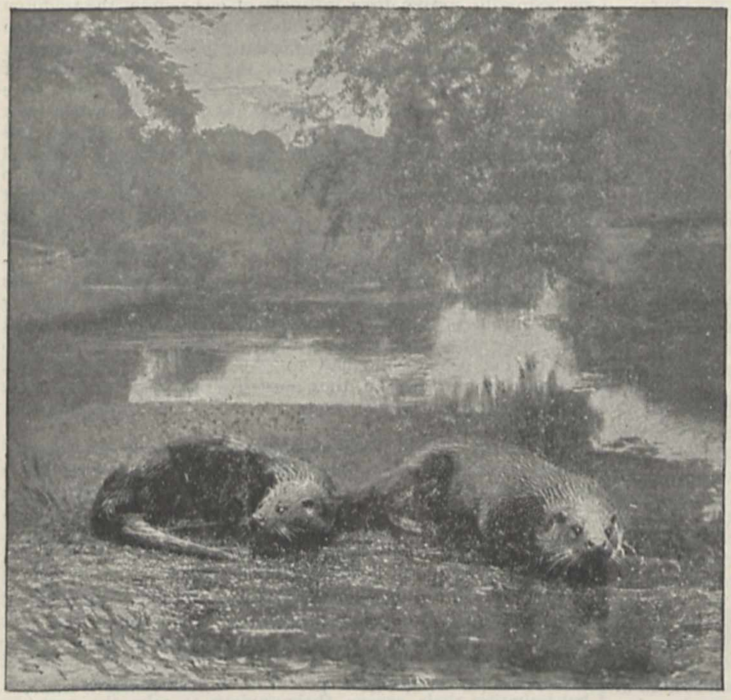

FIG. 1.—Otters.

The author may well place a note of admiration at the end of this sentence, for it is in truth a most remarkable one. To begin with, Mr. Cornish is apparently unaware that the domesticated horse, with which the Pleistocene race agrees in every particular as regards its skeleton, differs remarkably from the asses and zebras in regard to the proportionate size of the front and hind hoofs; and from this essential difference we are entitled to argue that even in Pleistocene times it was most certainly not striped, such striping as occurs on the legs of certain domesticated horses being probably due to a cross. A certain degree of obscurity veils the part of the sentence referring to the Thames rhinoceroses, but it may be confidently stated that neither was *exactly like* the living African *black* species, while the woolly-coated kind was a relative of the living *white* rhinoceros! But the most astounding statement is the one relating to the occurrence of the Cape wild, or hunting, dog in the Thames valley deposits. It is true, indeed, that the present writer has ventured to refer, provisionally, a single lower jaw from a cave in Glamorgan to the same *genus* as the animal in question, but that appears to be the only evidence of the former existence in Britain of any representative of the genus Lycaon; and we are informed by Mr. Cornish that the Cape *species* once lived in London!

But this is not all, for on p. 235 we find it stated that among the London Pleistocene fauna are included "the pika, a little steppe hare, and an extremely odd antelope now found in Thibet. This is a singularly ugly beast with a high Roman nose, and a wool almost as thick as that of a sheep when the winter coat is on. It must have been quite common in these parts, for I have had two of their horns brought to me during the last few years."

From the second sentence in this quotation it is quite clear that by the "extremely odd antelope" the author means the saiga. That animal, however, is not an inhabitant of Tibet, where it is represented by its distant cousin the chiru, with which it has evidently been confounded by the author. With reference to the statement that it was formerly common in the Thames valley, we venture to differ from the author. A frontlet has been obtained at Twickenham, and we believe one or two other specimens are known from British deposits, but these are all that have come under the observation of persons competent to decide the affinities of animals represented by fossil bones.

If the two chapters we have been compelled to criticise thus severely have been before the public previously, the repetition of such absurd mis-statements is the more unpardonable.

In his proper sphere Mr. Cornish is an entertaining and pleasant writer, and it is therefore the greater pity that he is so ill-advised as to attempt subjects of which he has no practical knowledge. R. L.

MR. BALFOUR ON TECHNICAL EDUCATION AT MANCHESTER

As announced in these columns last week, the Prime Minister opened the new Manchester School of Technology on Wednesday, October 15. For many years past, the provisions for technical education in the city of Manchester have been remarkable for their excellence, and an account of the successful efforts made by the Technical Instruction Committee of the City Council, the School Board and other educational authorities to educate Manchester citizens was given in an article published in our issue for January 31, 1901. One cause among many of the high state of development of education in Manchester is the broad view of its duties taken by the Technical Instruction Committee. On several occasions the Committee has arranged for the present principal of the school, Mr. J. H. Reynolds, to visit foreign countries to study other systems of technical instruction. In this way the Manchester educational authorities have become practically acquainted with German and American methods of education, and though they have not slavishly followed these ideas in organising their new school, they have not hesitated to adopt ideas they consider suitable for the peculiar needs of their own district. For the following extracts from Mr. Balfour's speech at the opening of the new school we are indebted to the *Times*.

Mr. Balfour said he counted it a most happy and fortunate circumstance that he had been able to take any part whatsoever in an occasion which was interesting, not merely to Manchester or merely to Lancashire, but to the whole of a country which depended in an ever-increasing degree upon its power to preserve its position as a great manufacturing centre. The building was perhaps the greatest fruit of that kind of municipal enterprise in this country, and though he would be presumptuous in saying that the brief visit he had been able to pay to it had given him any adequate or sufficient idea of all that it was capable of doing for the industries of Lancashire, still nobody could go over the building, observe its equipment, study even in the most cursory manner the care which had been devoted to it, without feeling that the corporation had set a great example worthy of the place it held in Lancashire and in Great Britain.

The great building in which they were assembled was an outward and visible sign of that awakening which had come over our people in view of the ever-changing conditions of intellectual industry. There was a time when we could flatter ourselves without any undue egotism or vanity that not only were we the first of the industrial nations, but that the rest were nowhere. That time had passed never to return again, and he was far from uttering selfish complaints at that change in the condition of the world which was absolutely inevitable, and from which they ought not to be, and in his judgment would not be, the ultimate losers. It was a profound mistake to suppose that the fact that other nations were now great producing centres was an injury pure and simple to this country. It was nothing of the kind. The growth of the wealth of the world must be a benefit to every part of the world, and all that we had to do was to see that we bore our full share in the great industrial development.

But not only was there the change in the industrial condition of the world to which he had adverted, but another change had occurred more closely connected, perhaps, with the necessity for institutions of this character. It was the change from the pre-scientific to the scientific stage of industry. When England or Great Britain first obtained its great manufacturing monopoly, it was not too much to say that the relation between science and industry was of the feeblest character. There was always, of course, the closest connection between mechanical ingenuity and invention and the great growth of our industries, but the intimate correlation between the discoveries of the laboratory and the processes of the workshop was not in existence, and it was because we had been a little slow to discover in this country how intimately speculative research is connected with manufacturing progress that we were, in some branches of our work at all events, behind our neighbours, who in this respect, although not in many others, had proved themselves more ready and more apt to learn that lesson than we had ourselves. And if anybody wanted a proof of the truth of the proposition he was laying down they had only to recall the kind of meaning which the average man attached only a few years ago to the phrase "technical instruction." In the phrase "technical instruction" there was, in the minds of the people of whom he spoke, no scientific tinge or flavour whatever, but some kind of knowledge of manual dexterity, some opportunity for learning the uses of machinery, and so forth. But the fact on which he was venturing to insist, and on which the very existence and justification of an institution like that at Manchester depended, was that henceforth and evermore there would be a closer and closer connection between the most remote and abstract scientific study of the chemist, of the physicist, of the electrician in his laboratory, and the great industries of the community of which he was a member. He wished he could be quite sure that even now, and even in the more cultivated part of the community, there was a more perfect appreciation of two capital facts which he would like to impress upon all who heard him. One was that education was, and must be, an organic whole, and that it was perfectly vain to spend vast sums upon buildings and equipments unless the student who went to those places went adequately prepared to learn the lesson they could teach. He had not the slightest intention of over-exalting or over-praising foreign nations at the expense of our own, but it must be admitted that they had grasped much more fully and much more firmly the great truth on which he was insisting—namely, that a man really to profit by the scientific training which he could get in these institutions and to be able himself to turn the learning he acquired to the purpose of original discovery, it may be of original research of his own, had to go there, not a raw product, but at all events a half-prepared human product. He should go there, not only anxious to learn, but ready to learn.

Another great truth was that, after all, the persons who were responsible for the manufactures of the country were the manufacturers. It was perfectly vain and useless to turn out highly-trained and capable servants if there were not to be employers for them when they were turned out. He did not in the least know whether in Germany, for instance, they might not have overdone the matter; he had not sufficient evidence on the point, but he was quite sure something must be very wrong when he saw the extraordinary difference in the practice of the great German and in some, at all events, of the English firms. He was speaking on a subject which he only knew at second hand to people who knew the whole thing at first hand; but, unless his information greatly erred, they would find, if they went to Germany, at all events a few years ago, and studied the equipment of one of the great German industrial concerns, electrical, chemical, optical or what not, a proportion of scientifically trained students in the German manufactory enormously in excess of anything commonly thought necessary in this country. There was not the least use in the Manchester Corporation turning out competent students if those students were not to find employment when they were turned out. With the naturally conservative instincts of our nation, the tradition of the great manufacturing establishments would rather tend to make people say that the best, the only place in which to learn was not in the lecture-room, but in the shop, not at the feet of skilled professors, but actually among the artisans who were carrying on the industry, and he did not deny there was a great deal of truth in that, and that probably we gained a great deal by our extreme anxiety to make industrial training a practical training. But he felt confident that they drove that truth too far, and that, however sound the instinct might be which lay at the bottom of it, they were working it too hard at the present time, and that, if they really did mean to turn the brains, and the muscles, and the enterprise, and the energy, and the inventive skill of their countrymen to its best purpose, it was absolutely necessary to place among the directors of industry those who had not merely that admirable and necessary practical knowledge which consisted in seeing things done from day to day by the people who had to sell the article when it was finished, but, in addition, they must give that complete scientific training which had become more the basis of our whole industrial fabric.

He did not deny that there might be dangers in that course. Every policy they adopted required watching; every policy they adopted would petrify into some stupid and pedantic rules unless they kept close to the ever-varying realities of life, and if anybody said there might be a certain danger that they would have a *quasi*-scientific and industrial orthodoxy which would stand in the way of quick development in every new discovery in mechanics or in science, he did not deny that the danger might possibly exist. The way to meet it was to remember that true theory and true practice could never be divorced without loss to both, and that the ideal for which they had to strive was not that of simply imitating the processes of those who went before, but imitating their energy, their anxiety to take the best the world had to give—the world both of practice and of theory—in the changed and ever-changing conditions of our time. Let them imitate this great quality of their forefathers, and then institutions like that school would bear all the fruit of which they were capable. They would see the marriage of science and industry far more fertile and far more productive of good, and those who had called, and not called in vain, on Manchester for this great effort of municipal liberality might feel that their labours had not been thrown away, but that they had done great things for the growth, the maintenance and the expansion of those industries on which the health and existence of the community depended.

NOTES.

THE office of Meteorological Reporter to the Government of India will become vacant in about a year by the retirement of Mr. J. Eliot, F.R.S., who has administered the office with great success for a long series of years. The selection of suitable names for consideration, with a view to the filling of the prospective vacancy after a preliminary period of training in Europe and in India, is now occupying the attention of an advisory committee of the Royal Society, nominated at the request of the Government of India. The problem of the future administration and scientific development of the department is also under consideration by the committee, in conjunction with Mr. Eliot, who is now in England for that purpose.

A BUREAU of Government Laboratories has been established in the Philippine Islands, and arrangements are being made for erecting a large building and equipping it with modern appliances for scientific work. Investigatious will be made, not only of the resources of the island, but also of tropical diseases. The laboratories will provide exceptional opportunities for scientific study in the tropics.

AT a meeting of the Cold Storage and Ice Association, to be held at the Institution of Mechanical Engineers on Wednesday, November 5, at 8 p.m., Dr. Carl Linde, of Munich, will read a paper on "The Technical Application of Liquid Air."

THE new session of the Hampstead Scientific Society will be inaugurated by a conversazione, to be held on Wednesday, October 29. Prof. Boyd Dawkins, F.R.S., will give an address on "The Forest Primeval of the Coal-measures."

THE meeting of the Geologists' Association on Friday, November 7, will be devoted to a conversazione at University College, Gower Street, W.C. Exhibits of specimens and photographs of geological interest will be on view during the evening.

AN Egyptian Medical Congress will be held at Cairo on December 19–23 under the presidency of Dr. Ibrahim Pacha Hassan. The principal object of the Congress is the study and discussion of diseases occurring in warm climates. The secretary of the English committee is Dr. W. Page May, 9 Manchester Square, London, W.

THE death is announced of Mr. Peter Brotherhood, whose invention of a new type of steam engine in 1872 made his name well known among mechanical en gineers. In this type of engine, three cylinders are set at angles of 120° round a central chamber, and all three connecting rods operate upon one crank within the central chamber. Mr. Brotherhood introduced important improvements in the pumps for compressing air on board ship for use in torpedoes, and thus assisted the development of the automobile torpedo. He was also the inventor of a vertical direct-acting engine.

WITH reference to the movement which has been set on foot in Berlin to raise a fund to defray the cost of erecting a statue to the late Prof. Virchow in that city, the *British Medical Journal* states that Prof. Waldeyer, who has taken the lead in the matter, summoned a meeting for October 15. At an early date a committee will be formed in this country, with Lord Lister as chairman, to afford the friends and admirers of Virchow in the United Kingdom the opportunity of contributing to the memorial. The Berlin Medicinische Gesellschaft will hold a special memorial meeting for Virchow on October 29, and the Berlin Verein für innere Medizin has already held a special meeting in memory of Virchow and Gerhardt, when a memorial oration was deliverd by Prof. von Leyden.

THE Soufrière of St. Vincent was again in eruption on October 16. The following records are abridged from reports published in the *Times*:—*Kingstown, St. Vincent.*—The eruption has caused even greater distress in the colony than that which prevailed before. Large areas of tillage lands which were hitherto considered to be outside the volcanic zone are now buried in hot sand. The roads in the Windward district are the only regular means of communication between Georgetown and Kingstown, a distance of twenty miles, and travel is extremely difficult. *Barbados.*—Between 2 and 3 a.m. on October 16, loud reports heard from St. Vincent; at 7 a.m. inky blackness in direction of St. Vincent, air quite still; at 9.30 a.m., volcanic dust commenced falling, with very strong smell of sulphur. Dust continued to fall for several days, producing a deposit about one-eighth of an inch thick. *Windward Islands.*—Soufrière in full eruption October 16, between midnight and 5 a.m. No loss of life reported, but heavy fall of sand and stones, principally on Windward side as far as Union; slight fall Kingstown and Leeward coast. A layer of volcanic material eight inches deep was deposited in the Carib country. *Guadeloupe.*—Loud det onations were heard, and a glimmering light was seen in the direction of Martinique in the early morning.

WE have received from Mr. P. Baracchi, Government Astronomer, the results of observations in meteorology and terrestrial magnetism made at the Melbourne Observatory and other localities in the State of Victoria for the last half of the year 1901. These periodical results form a valuable contribution to the climatology of that part of Australia, showing in a concise form the monthly means and extremes at a considerable number of stations of the second and third orders, and the monthly and yearly rainfall of all the numerous stations in the State, together with the average rainfall computed from the results of as many years as are available for the purpose. In some cases the series exceeds forty years' duration.

WE learn from the *Auto-vélo* that Captain Ferber, of Nice, has recently made some highly successful experiments in aërial gliding. His first attempts were made with a machine of the Lilienthal type, with which several glides were effected, but this machine was destroyed by a sudden gust of wind, and Captain Ferber has now adopted a form of aëroplane similar to the two-surface machine of Mr. Wilber Wright and his brother, in which the operator assumes a horizontal position and steers by means of a rudder placed in front. The newspaper states that the captain is enchanted with his apparatus and hopes to beat the record of Mr. Wright of 150 metres. He finds the machine remarkably stable and easy of manipulation, and by careful management of the rudder he is able to land without any shock.

A SECOND edition of Dr. S. P. Langley's memoir containing the results of his "Experiments in Aërodynamics" has been published by the Smithsonian Institution. The work originally appeared eleven years ago, and the principles and experiments described in it have since been used in the construction of aërodromes or flying machines. At the end of his memoir, Dr. Langley refers to the position and promise of aërial navigation in the following words:—"Since the preceding lines were written, the writer has demonstrated that mechanical flight is possible by actually performing it with steel flying machines nearly a thousand times heavier than the air, driven by steam, and employing as a rule curved sustaining surfaces. These machines, which were built by the writer, weighed from thirty to forty pounds, and they have arisen and descended in safety, their flight being limited to distances of from half a mile to three-quarters of a mile, at speeds varying from twenty to thirty miles an hour (see NATURE, vol. liv. p. 80, May 28, 1896). The 'inchoate art' of aërodynamics has since made a corresponding progress, and while leaving a great deal to be done, it is believed by the writer that the time is now very near when human beings will be transported at high velocities, though perhaps at first under exceptional conditions such as are demanded in the arts of war rather than of peace."

VERY little ice has been reported from the north-western quarter of the North Atlantic this year. The Meteorological Office pilot chart for November shows that since the beginning of September a few large bergs have been passed on the steamer route between Belle Isle and the 50th meridian, but the strait of Belle Isle appears to have been quite free since about August 20, while no ice has been met with on the banks of Newfoundland for a long time past. For the month of September, 4300 observations of North Atlantic sea-surface temperatures were discussed, the results showing that nearly the whole of the area northward of the 48th parallel was warmer than the average, while between 30° and 48° N. there was a deficiency. In the immediate vicinity of the British coasts there was a slight defect, the air temperature over the land having been from 1° to 3° below the average. Further information relating to the West Indian volcanic eruptions is given, based on reports from captains of ships and on the preliminary report to the Royal Society by Drs. Anderson and Flett. At 2.30 a.m. on May 8, volcanic ash was falling on board the barque *Jupiter*, at a distance of 930 miles east-south-east (to windward) of St. Vincent, about twenty-four hours after the violent outburst from the Soufrière, so that the upper counter current had an average velocity of about forty miles an hour. Off Martinique, at 1.15 p.m. on August 21, the s.s. *Dahomé* was enveloped in a dust cloud from Mont Pelée, the darkness being more intense than that of night, while steam was rising from the sea in localities where the hot mud from the volcano fell into the water. Captain Leutken heard no noise or rumblings.

WE have received from Messrs. Crompton and Co., Ltd., a pamphlet describing the latest pattern of Crompton potentiometer. The advantages possessed by this instrument for accurate measurements in direct-current work are well known. It can be used to measure either P.D., current, resistance or power; the actual measurement being in all cases made by balancing two potential differences. The instrument can be at any distance from the circuit under test, the lead wires introducing no error, since, when balance is obtained, no current flows through them. The form of instrument designed by Messrs. Crompton is very compact and convenient, and enables a measurement of any kind to be made with very little trouble. The shunts and volt-boxes made to accompany the potentiometer give it a very wide range, and in its latest form provision is made for easily testing its accuracy by comparing the resistance coils with the slide wire. With this instrument, a standard cell and a galvanometer, the electrical engineer has practically al he requires for accurate testing work.

AN important memoir, by Sir George King, on the flora of the Malay Peninsula, is in course of publication in the *Journal* of the Asiatic Society of Bengal, the last fasciculus received in this country dealing with the begonias and allied groups.

THE latest issue of Gegenbaur's *Morphologisches Jahrbuch* (vol. xxx. pts. i. and ii.) contains two papers on the anatomy of mammals. In the one, Herr G. Ruge continues his account of the variations of form in the liver of the Primates, dealing in this instance with the American monkeys; in the second, Herr J. Tandler discusses the development of the cranial arteries.

THE Indian Forest Department has just issued the first fasciculus of a series of tracts dealing with insects affecting the forestry of the country under the title of "Departmental Notes." The part before us is by Mr. E. P. Stebbing, the lecturer to the school of the Department at Dehra Dun, and it is proposed in later numbers to give information with regard to both injurious and beneficial species. By this means it is hoped that the officers of the Department and others interested in forestry may be able to keep abreast of modern researches connected with the subject. Several of the insects referred to in this part are new to science. For the benefit of non-entomological readers, the descriptions might, we think, have been made a little less technical.

AMONG recent papers in the *Proceedings* of the Washington Academy is one by Prof. C. H. Eigenmann on the degenerate eyes of the blind, burrowing amphisbænian lizard *Rhineura floridina*. The case is especially interesting on account of the occurrence of a fossil representative of the same genus in the Miocene of Dakota. Unfortunately, nothing is known with regard to the eyes of the extinct form, but from the fact that all the living members of the group are blind, it seems practically certain that the degeneration of the eyes took place before the differentiation of the existing genera, in other words, at least as early as the lower Miocene. In the existing form, not only is the eye invisible externally, but there is no indication of the aperture by which it formerly opened on the surface.

DR. W. BORCHERS AND MR. L. STOCKEM describe an apparatus for the electrolytic separation of calcium from the fused chloride in the *Zeitschrift für Elektrochemie* for October 2. The separation of the alkali earth metals is one of the most difficult of electrometallurgical problems, on account of the conflicting character of some of the necessary conditions. The form of furnace used in the present experiments consists of a circular carbon box serving as anode, which is supported on, but insulated from, a cooling arrangement; a thin iron rod in the centre of the box is used as kathode, and this is connected to the cooler. The floor of the box is covered with fluor-spar, on the top of which is the layer of molten calcium chloride. This arrangement allows the temperature to be so regulated that it is above the melting point of calcium chloride, but below that of calcium. The calcium separates in spongy form and can be removed by suitable tongs; if it is pressed together before it is taken out, so as to get rid of some of the chloride, a white metallic mass containing about 90 per cent. calcium can be obtained. A somewhat similar arrangement is described for the separation of strontium. The apparatus, the authors state, is suitable for lecture experiments and also for the preparation of the metal in large quantities.

THE so-called foul brood of bees was first described under that name by Schirach in 1769, but it is supposed that so far back as Aristotle it was a recognised disease and that the remarks about it made by this writer undoubtedly refer to this particular malady. It was in 1885 that Messrs. Watson-Cheyne and Cheshire, with Koch's new bacteriological methods at their disposal, submitted this destructive disease to an elaborate scientific investigation, and shortly after presented to the scientific world a certain *Bacillus alvei* which was accepted as the *fons et origo* of the foul brood of bees. The subject has occupied much attention, not only of apiarists, but also of scientific men, and in 1900 Mr. Francis Harrison, of Ontario, published an important memoir dealing with methods of effectually combating the disease. The latest contribution to the scientific work on the subject emanates from the University of Liége, and the funds for carrying it on were provided by the Belgian Government. Dr. Lambotte, as the result of his extended researches, affirms that the *Bacillus alvei* of Cheyne and Cheshire is identical with the well-known and widely distributed *Bacillus mesentericus vulgaris*, and must be placed in the same category with, for example, the ubiquitous *B. coli communis*, which, although a normal and harmless inhabitant of the intestine, may under given conditions become pathogenic and give rise to disease. The endowment of harmless micro-organisms by suitable means with pathogenic properties is, of course, a well-recognised achievement, and Dr. Lambotte has shown experimentally how the familiar so-called potato-bacillus may artificially become invested with disease-producing powers and can engender foul-brood disease in bees.

THE Department of Revenue and Agriculture of the Government of India has recently published the seventeenth issue of

"Agricultural Statistics of India for the years 1896–97 to 1900–01." The numerical data have been compiled under the supervision of the Director-General of Statistics and are issued in two parts, the first dealing with British India and the second with native States. The information is tabulated under fourteen headings, including, among others, tables showing the total area of districts; the amount of cultivated and culturable land; the gross cultivated area under each crop; agricultural stock; the principal varieties of tenure held direct from the Government; the progress made in the production of tea and of coffee; and the average yield per acre of the principal crops. The tables are accompanied by numerous short, explanatory notes which are often of an interesting nature. The following statistics referring to the cultivation and production of indigo in British India during the past few years show that a remarkable decline has occurred, doubtless in consequence of the competition of the artificial product:—

Year.	Acres under cultivation.	Production in cwts.
1897–1898	1,339,099	166,812
1898–1899	1,010,318	139,320
1899–1900	1,026,900	111,890
1900–1901	990,375	148,029
1901–1902	803,697	121,475

AN important addition to the literature of the Myxomycetes will be found in the "Monograph of the Acrasieæ," by Mr. E. W. Olive. The paper, which is published in the *Proceedings* of the Boston Society of Natural History, provides a critical summary of the data furnished by previous writers and the results of the author's investigations. Mr. Olive follows Zopf in uniting the groups of the Labyrinthulæ and Acrasieæ under the title of the Sorophoreæ, which are related to, but more primitive than, the true Myxomycetes.

A NEW edition of the first volume of Mr. William Scott Taggart's "Cotton Spinning" has been published by Messrs. Macmillan and Co., Ltd. The book deals with all processes in cotton spinning up to the end of carding.

THE lecture arrangements at the London Institution, Finsbury Circus, for the session 1902–3, have now been announced. The list includes lectures by Lord Avebury, on "The Scenery of England and the Causes to which it is Due"; by Sir Robert Ball, F.R.S., on "The Earth's Beginning"; by Dr. A. Smith Woodward, F.R.S., on "Some newly discovered Extinct Animals"; by Prof. S. P. Thompson, F.R.S., on "The Magic Mirror"; by the Rev. W. H. Dallinger, F.R.S., on "Recent Studies in the Lives of Spiders"; and by Dr. W. Hampson, on "Liquid Air." The lectures are held on Monday evenings at 5 o'clock and on Thursday evenings at 6 o'clock.

MESSRS. MACMILLAN AND CO., LTD., have published a small collection of mathematical tables for ready reference compiled by Mr. Frank Castle and printed on stout paper. The booklet costs *2d.*, and contains useful numbers and formulæ, tables of logarithms and anti-logarithms, as in similar tables published by the Board of Education, together with tables of natural sines and tangents for every five minutes of arc. In view of the encouragement now being increasingly given to the use of logarithmic and trigonometric tables at an early stage of mathematical instruction in schools and colleges, the collection should prove of use to teachers and students alike.

AN elaborate catalogue of balances and weights, containing more than one hundred pages and two hundred illustrations, has been published by Messrs. F. E. Becker and Co., of Hatton Wall, London. Balances and weights suitable for scientific work of every kind are described in the catalogue, and the prices at which they can be obtained are remarkably low in comparison with those of a few years ago. The quantitative work now carried on in the physical and chemical laboratories of schools has greatly increased the demand for students' balances sensitive to a milligramme or two, no less than six thousand of such balances having been introduced lately into Irish elementary schools. It is impossible to over-estimate the educational value of practice in the use of accurate balances, and by producing such instruments at reasonable prices firms like Messrs. Becker and Co. have done much to facilitate the introduction of such work into the school course.

THE existence of a pentafluoride of iodine was indicated by Gore and by MacIvor thirty years ago. On account of its bearing on the question of the valency of iodine, a further examination of the behaviour of this fluoride seemed desirable, and in the current number of the *Comptes rendus* M. Henri Moissan gives an account of its preparation and properties. The compound is obtained without difficulty in a perfectly pure state by the action of fluorine upon solid iodine, and forms a colourless liquid, solidifying at 8° C. and boiling without change at 97° C. Analyses show that the fluoride has undoubtedly the composition IF_5, and it is noteworthy that it can be distilled in a current of hydrogen without any reaction taking place. This fluoride possesses very great chemical activity; most elementary bodies decompose it, and it produces with compound bodies a large number of double decompositions. Iodine pentafluoride is decomposed at about 500° C., iodine being formed, and possibly a new fluoride of iodine.

IN the current number of the *Zeitschrift für physikalische Chemie* is an interesting paper by Mr. A. A. Blanchard on the decomposition of ammonium nitrite in aqueous solution by which reaction nitrogen is liberated. It is found that this decomposition only takes place with sufficient rapidity to enable the velocity to be determined under the influence of hydrogen ions or free nitrous acid. In these circumstances, the velocity with which nitrogen is evolved is proportional to the concentration of the ammonium ions and of the nitrite ions, being increased by the presence of other ammonium salts or nitrites, and the hydrogen ions have an accelerating effect on the reaction.

IT has been known for some time that the compounds which the albuminoids form with acids and bases are of true salt-like character. The aqueous solutions of these compounds are conductors of electricity, and presumably, therefore, contain electrically charged ions. In the current number of the *Zeitschrift für physikalische Chemie*, Dr. Sackur gives an account of experiments which he has made on aqueous solutions of casein sodium. From the variation of the conductivity with the dilution, the author concludes that casein is a tetrabasic acid with a molecular weight equal to 4540. Experiments on the diffusibility of casein sodium indicate that, although an electrolyte, it is incapable of passing through parchment paper, and in this respect therefore behaves as a colloid.

IN the *Journal* of the Chemical Society, Messrs. Chapman and Lidbury give an account of some interesting experiments on the decomposition of water vapour by the electric spark. A series of electric sparks was allowed to pass between two platinum wires sealed into a glass tube through which a current of water vapour was drawn. The gases from the anode and kathode sections of the tube were collected separately. As a result of the examination of the gases thus collected, the authors conclude that the separation of the constituent elements of water from water vapour is not entirely due to a process of electrolysis. If it were, hydrogen should appear at one electrode and oxygen at the other, whereas hydrogen collects at both electrodes. The quantities of the separated gases should, moreover, not exceed those of the oxygen and hydrogen, which collect in a voltameter placed in the same electrical circuit, whereas the experiments show that under certain conditions the quantity of hydrogen from the water vapour which collects at the kathode is five or six times as large as that which separates in the voltameter.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*) from South Africa, presented by Captain R. Bolton; a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, presented by Mr. F. G. Lloyd; a Getulian Ground Squirrel (*Xerus getulus*) from Morocco, presented by Mr. Arthur Gill; a Cape Hyrax (*Hyrax capensis*) from South Africa, presented by Mr. A. C. Boddam Whetham; two Egyptian Jerboas (*Dipus oegyptius*) from North Africa, presented by Mr. G. Swales; a Spotted Eagle Owl (*Bubo maculosus*) from Africa, presented by Mr. C. H. Turner; a Horned Capuchin (*Cebus apella*), a Tayra (*Galictis barbara*) from South America, a Jelerang Squirel (*Sciurus bicolor*), a Larger Racket-tailed Drongo (*Dissemurus paradiseus*), two White-throated Ground Thrushes (*Geocichla cyanonotis*), an Indian Pitta (*Pitta brachyura*), an Indian Dial-bird (*Copsychus saularis*) from India, a Common Rat Kangaroo (*Potorus tridactylus*) from Australia, a Common Water-Buck (*Cobus ellipsiprymnus*) from South Africa, four Flat-backed Tortoises (*Testudo platynota*), a Phayre's Trionyx (*Trionyx phayrii*) from Burmah, two Eroded Cinixys (*Cinixys erosa*) from West Africa, two Bell's Cinixys (*Cinixys belliana*) from Tropical Africa, three Pennsylvanian Mud Terrapins (*Cinosternum pennsylvanicum*) from North America, deposited; an Amherst's Pheasant (*Thaumalea amherstioe*) from China, purchased.

OUR ASTRONOMICAL COLUMN.

COMET *b*, 1902 (PERRINE).—The photograph of this comet which accompanies this note was secured by Dr. Isaac Roberts on the evening of October 10. It was taken with his 20-inch reflector and received less than one hour's exposure, namely, 52 minutes. A great amount of detail is shown on the original positive from which this reproduction has been made, and it

will be noticed that the comet has a multiple tail, two of comparatively large dimensions and several smaller streamers.

The rapidity with which the comet is travelling relatively to the stars can be gathered from the length of the star trails on the plate, the observer correcting the telescope for the comet's motion at short intervals.

A BRIGHT METEOR.—Mr. W. Lascelles-Scott, of Little Ilford, Essex, states in the *Times* that at about 7.52 p.m. on October 15 he observed a bright meteor and noted the following particulars as to its path:—"General course and direction of the meteor, N.W. by N. towards S.W.; general angle of course to S.W. on horizontal plane, 30°; general length of course to S.W. about 105°; general shape of course, like an inclined and attenuated letter S; apparent diameter of meteor at *maximum*, about 1-25th of that of the moon, or 4 : 100; apparent brightness at *maximum*, about ⅛th that of the moon, or 12 : 100; colour variations, from faint yellow, through blue to purplish at finish; apparent duration, about 3·8 sec. (nearly 4 sec.); coruscation, faint tripartite at finish."

OBSERVATIONS OF FIFTY-EIGHT LONG-PERIOD VARIABLES.—Part ii. of vol. xxvii. of the *Annals* of the Harvard College Observatory is devoted to the observations of fifty-eight long-period variables. The methods employed in making these observations were explained in part i. of this volume in reference to a similar research with regard to circumpolar long-period variables. Most of the stars are brighter than tenth magnitude, and these have been observed with the meridian photometer; those between the tenth and thirteenth magnitudes have been observed with the photometer attached to the 15-inch equatorial.

By taking a series of comparison stars in the immediate neighbourhood, observing their magnitudes in order of brightness and their differences in magnitude, and then plotting a smooth curve having for its abscissa these approximate brightnesses, and its ordinate the photometric magnitude, a very trustworthy value has been obtained for the magnitude of each variable.

A NEW ALGOL VARIABLE.—In No. 3820 of the *Astronomische Nachrichten*, Mr. A. Stanley Williams announces the discovery that the star B.D. + 41°·504 is a variable of the Algol type. The position of this star is R.A. = 2h. 30m. 50s., Dec. = 41° 34'·3 (1855), and its normal magnitude 9·4. At minimum the star's brightness decreases to nearly twelfth magnitude.

Owing to the various observations being interrupted by clouds and by daylight, the instant of minimum has not been finally determined, but from the observations which have been made, the following elements and ephemeris have been found:—

Minimum of 14 1902 Persei = 1902 Sept. 16, 16h. 38m. G.M.T.
+ 3d. 1h. 21m. 32s.·23 E.
= J.D. 2416009·6934 + 3d.·056623 E.

Ephemeris for every fifth minimum.

E.	Date.	G.M.T. h. m.	E.	Date.	G.M.T. h. m.
207	1902 Oct. 17	6 14	247	1903 Feb. 16	12 35
212	,, Nov. 1	13 1	252	,, Mar. 3	19 23
217	,, ,, 16	19 49	257	,, ,, 19	2 11
222	,, Dec. 2	2 37	262	,, Apr. 3	8 58
227	,, ,, 17	9 25	267	,, ,, 18	15 46
232	1903 Jan. 1	16 12	272	,, May 3	22 34
237	,, ,, 16	23 0	277	,, ,, 19	5 21
242	,, Feb. 1	5 48			

NOTES ON THE RECENT ERUPTIONS OF MONT PELÉE.

Dominica, September 24.

August 17.—A steamer passing five miles to the west of Mont Pelée met a heavy ash cloud, which rendered the day as dark as night whilst the vessel passed through it. The deck was covered with ash.

August 18 *and* 19.—News reached here of further eruptions of Mont Pelée.

August 25.—Detonations heard during the day.

August 26.—Loud detonations and sounds like growlings were heard in the afternoon and evening. To the south-west of the island there were very heavy black ash clouds like a wall with a level top. The sun set behind this cloud as though a solid mass, all rays of light being cut off. During the whole day the upper atmosphere was charged with dust, but very little fell on this island.

August 28.—In the evening there was a magnificent display of lightning from Mont Pelée, and the sky in the direction of the volcano glowed with a pinkish light. At 11 p.m., lightning shot out from the mountain in all directions, zigzagging and flickering flashes alternating with, or being accompanied by, reddish globes, which ascended and exploded, and shot out stars and long rays. Away towards the south-west was another large focus of electric energy, which appeared to me to have a distinct relation to the volcanic electric discharges from Mont Pelée. This spot was, I reckoned, at least forty miles from the volcano, from which it bore almost west two points north. This latter electrical display was similar, but less extensive than that from Mont Pelée, and it was accompanied by curious glowing globes, which burst and shot out tongues of lightning. The most curious part of the magnificent sight, however, was that occasionally long rays of light, very like to the rays of a searchlight, shot out from the direction of Mont Pelée downwards to the secondary and distant electrical display, and on this broad ray reaching the western focus, the lightning there became more vivid, intense and extensive.

The West Indian volcanic explosions are undoubtedly due to the irruption of water into the reservoirs feeding the volcanoes. There are no large rivers or lakes that could supply water in sufficient quantity to produce the phenomena observed. Clearly, then, the sea has got in by some fissure or dislocation, and it has occurred to me that the electrical display to the west of Pelée observed on the night of August 28 was caused by a fissure in the sea bottom permitting an irruption of water into the reservoir from whence the volcano has obtained the material for its solid ejecta. Anyhow, the disastrous eruption of Pelée on the 30th—that is, two days afterwards—was accompanied by an enormous discharge of steam and hot water, much greater, indeed, than in the case in the earlier eruptions.

In the neighbourhood of the volcanoes there has been much alteration of the bottom of the Caribbean Sea. The cable-repairing ships report the depth in places to have increased by half a mile. On September 19, a telegram from the West Indian and Panama Telegraph Company stated that:—

"Unprecedented difficulties have been encountered in the endeavour to repair the interrupted cables between St. Lucia and St. Vincent and St. Lucia and Grenada. The cables appear to be buried under a layer of volcanic mud, and this, combined with the great depth of water, which can only be attributed to the alteration of the sea-bed due to the late eruptions, has rendered it difficult to raise the cable to the surface in consequence of the enormous strain. The repair of the St. Lucia—St. Vincent section, which was effected on the 16th instant after several weeks' operation, has been a very costly one, necessitating an expenditure of over thirty miles of new cable, and the fresh interruption which occurred in this section during the night of the 17th is in this new cable put down only the day before, and was evidently caused by some submarine disturbance."

Since the loss of the *Grappler* during the destruction of St. Pierre, no attempt has been made to repair the cable between Dominica and Martinique, so there is no recent authentic information concerning the disturbance of the sea bottom near to Mont Pelée; but Captain McKay, the Superintendent of the Quebec Steam Ship Co., who went south in the s.s. *Korona* on August 29, reported that "the sea between Dominica and Martinique was of a light green colour, which makes one think there was shoal water." This colour was due, doubtless, to the suspended ash which has fallen into this portion of the sea in enormous quantities from time to time, and it is to be expected that there has been a subsidence instead of an upheaval of the sea bottom to the west of Martinique.

August 30.—There were detonations in the afternoon, with slight vibrations of the earth; and at 7 p.m. there were exceedingly loud detonations and growlings, which continued at intervals until 2 a.m. on August 31. Volcanic ash began to fall at 5.30 p.m., and, as the night wore on, the fall was so great that the darkness became intense. The ash came from the east, so that evidently it was shot high into the upper strata of the atmosphere and carried to the north-east before it began to fall into the lower regions swept by the "trades." Later on, news came that the fall of ash in Guadeloupe was very heavy. In Montserrat the fall was lighter, and in Antigua it was lighter still.

August 31.—The fall of ash in Roseau (at the south-western end of the island) covered the surface to the depth of a quarter of an inch; the dust penetrated everywhere, closed drawers and presses being insufficient to keep out the finer particles.

September 1.—The atmosphere is still dust-laden, and the sun was obscured all day; it could be seen only towards the evening, when it set like a dull greenish disc. In the afternoon heavy ash clouds were drifting to the west through the Martinique Channel.

September 2.—Mr. A. Robinson, the Government Officer at the eastern side of the island, reports to me that the ash fell there on the night of August 30 to the depth of from an inch to two inches, that small trees and branches of large ones were broken down by the weight of the dust, which clung tenaciously to the leaves, branches and stems, and that the cattle were suffering from hunger, as the grass was covered and grazing was impossible.

September 3.—The mail steamer came in to-day from the south, and brought some refugees from Morne Rouge, which was destroyed by the eruption of Mont Pelée on the night of August 30. There was a French priest on board who was an eye-witness of the disaster. The following statement he made was kindly written down for me by Mr. C. A. Seignoret, the Quarantine Officer:—

"The phenomena were entirely new, and hot water and red-hot dust were the principal elements of destruction amongst the inhabitants of Morne Rouge and Carbet. Several houses were completely destroyed, while others sustained no damage."

Mr. Seignoret has also kindly interviewed one of the intelligent refugees for me, and he has furnished me with the following statement made by her:—

"Miss Carra, a respectable resident at Morne Rouge, who was an eye-witness to the eruption of Mont Pelée which occurred on August 30 last, informed me that rumbling noises were heard from the crater all day, with detonations and frequent flashes of electricity, and towards evening the mountain appeared to be a mass of flame, emitting alternately jets of hot water and red-hot ashes, which ascended into the air in the form of rockets, and as the ashes fell upon the wooden housetops, the buildings at once caught fire. A great many lives were destroyed by hot ashes and water, for numbers of persons rushed from their houses into the streets to escape from the flames, and as the ashes fell upon their faces and other exposed portions of their bodies, the skin at once became red as scarlet and peeled off, causing the parts to swell to an enormous size. In most cases, portions of the legs, arms and chest were burnt, while the clothes were intact. White persons got completely charred in the face, causing them to appear like coal-black negroes. Some of the gendarmes were found dead in fixed positions with their clothing quite sound, while others were burnt in various parts of their bodies. Water! Water! was the only cry from the wounded and dying, and in many instances death ensued immediately after their thirst was quenched."

This interesting account indicates that there was an ejection of much larger quantities of steam and hot water than occurred in the earlier eruptions. Persons who shut themselves close in their houses were nearly all saved, the hot blast passing quickly, but from other accounts I have received it appears that the heat was fearful for a brief period and that the rapid evaporation of moisture from the tissues caused a thirst that was agonising until assuaged.

About 1500 persons were killed and, according to the statements of *L'Opinion* of Fort-de-France, a greater number have suffered injuries. H. A. ALFORD NICHOLLS.

ASTRONOMY AND COSMICAL PHYSICS AT THE BRITISH ASSOCIATION.

AT the Bradford meeting, in 1900, a department of astronomy was established as a subsection of Section A, in deference to a wish that had been expressed that astronomy should be better represented at the British Association. After two years' experience, it was felt that the astronomical papers that were received were scarcely enough to justify this division of Section A, and this year the subsection was strengthened by the addition of cosmical physics. On the Friday the whole section was given up to cosmical physics; on the Monday and Tuesday the subsection met separately. On all three days the room was well filled, and it was apparent that the enlarged subsection was in some ways a success. But towards the end of the meeting there was a strong expression of opinion that it is not to the advantage of the section as a whole that it should be so much subdivided, and the whole matter will have to be carefully co sidered before next year. Perhaps a solution of the difficu might be found in the division of all papers for Section A into two classes—papers that are generally intelligible and papers that are not—and in relegating the latter class only to sub-sectional meetings. It is not impossible that this might have beneficial results in more ways than one.

The address of the chairman, Prof. Schuster, has already been printed in full. His criticisms of mere routine observation raised an interesting discussion, in which the meteorologists reserved their defence.

Among the papers submitted to the subsection were several of general interest. Major S. G. Burrard, R.E., described the difficulties which are caused in the Geodetic Survey of India by the attraction of the mass of the Himalayas and the Thibet plateau, and by the existence of an underground chain of excessive density which runs across India. Contrary to the opinion that was held until a few years ago, it now seems certain that the plumb-line is deviated over the whole of India, and that all astronomical latitudes may be in error by a number of seconds of arc. The Government of India and the staff of the Survey must be congratulated on their good fortune in being confronted with problems of such interest and importance. Prof. Turner described an attempt made at Oxford to verify the suggestion put forward by Sir David Gill that the bright stars, as a whole, are rotating relatively to the fainter stars. From the Oxford astrographic catalogue plates he finds distinct evidence of such an effect, but with a sign opposite to that found by Gill in the southern hemisphere.

The feature of the meeting on September 16 was an exhibition of photographs from the Yerkes Observatory. Mr. Ritchey has made a most interesting set of pairs of photographs of star clusters, made respectively with a 2-foot reflector and with the 40-inch visual refractor fitted with a colour screen used in contact with isochromatic plates. With the latter, the densest parts of the clusters are beautifully resolved and measurable. The photographs of nebulæ made with the 2-foot are unsurpassed; and it is remarkable how, though nearly all the detail which they show *can be found* on the photographs taken at Crowborough and Daramona and Greenwich, the general effect is in some cases quite different. Mr. Percival Lowell sent three papers, one describing a scheme for sending expeditions in search of good "seeing." Mr. S. A. Saunder discussed the possibility of changes in the surface of the moon, and urged the need of cooperation in the work of describing minute detail. Mr. W. E Wilson reported failure in his search for Forbes's hypothetical extra-Neptunian planet, and showed a bolometer mounted equatorially for measuring solar radiation.

Other papers read at the meetings of the subsection have already been mentioned in NATURE in the notes of mathematical and physical papers. A. R. H.

ZOOLOGY AT THE BRITISH ASSOCIATION.

ON September 11, in addition to the reports of committees, a short series of fisheries papers was taken:—

(1) Prof. McIntosh, who was prevented from being present, sent a detailed paper discussing British fisheries investigations and the international scheme, which was read in abstract to the meeting by Mr. W. S. Green, Chief Inspector of Fisheries for Ireland. He showed the necessity for improved statistics and for a careful survey of the off-shore and in-shore fishing grounds. He considered that hydrographical work occupied too prominent a position in the international scheme and that other more important points in connection with the distribution of fish have been omitted. (2) Mr. W. Garstang then read a statement as to the proposed programme for the international investigation of the North Sea, as passed at the recent meeting of delegates at Copenhagen. He stated that in his opinion all the investigations thought desirable by Prof. McIntosh and other critics were included in the Christiania scheme, and that that scheme was going to be carried out practically unchanged. He explained that the Government had had to adopt hydrography as a part of the proposed programme, although its importance in connection with English fishery interests might be doubtful. Finally, he urged the advantages of international cooperation. (3) Dr. Noël Paton, who was prevented from being present, sent a paper criticising the methods proposed in the international scheme, and throwing doubt upon the accuracy and value of results based upon such methods. Dr. Masterman, Dr. Mill and others spoke in the discussion which followed. (4) Mr. J. Stuart Thomson had paper on the scales of fishes as an index of age.

The following were the reports of committees submitted to the Section:—

(1) "Migration of Birds," mainly the work of Mr. W. Eagle Clarke on the fieldfare and the lapwing. (2) "Naples Zoological Station," containing reports on work by Mr. E. S. Goodrich, Mr. N. Maclaren, Miss A. Vickers and Dr. R. N. Wolfenden, in addition to the usual statistics from the station. (3) "Plymouth Marine Laboratory," with a short report from Mr. H. M. Woodcock. (4) "Index Animalium." Vol. i. of this work, by Mr. Sherborn, will be issued in October. (5) "Plankton Investigation." (6) "Zoology of Sandwich Islands." (7) "Millport Marine Zoological Station." And (8) "Coral Reefs of the Indian Region." Mr. Stanley Gardiner reports considerable progress with the publication of his results.

The forenoon of September 12 was devoted to a series of papers, by Prof. Herdman and those who are helping him to work out his results, on the fauna and flora associated with the pearl oyster banks in the Gulf of Manaar. First, Prof. Herdman gave a general account, illustrated by the lantern, of his recent expedition to Ceylon, with a description of the pearl fisheries. Then followed:—Mr. A. O. Walker, on the Amphipoda, Mr. I. C. Thompson, on Indian Ocean Copepoda, Mr. W. E. Hoyle, on the cuttlefishes, and Mr. J. Lomas, on the marine deposits dredged by Prof. Herdman. Prof. Dendy, Mr. Stanley Gardiner and others took part in the discussion that followed. The remaining papers before the Section that day were:—(1) Prof. Cleland, on a hitherto unrecorded element in the occipital bone of seals. (2) Prof. Poulton, on the habits of the predaceous flies of the family Asilidæ, with exhibition of specimens. (3) Prof. E. W. MacBride read a paper on some new points in the development of *Echinus esculentus*. He stated that in order to obtain successful cultures of the larvæ it was necessary to use perfectly ripe parents and to supply the growing larvæ with an abundance of sea water, frequently changed. He pointed out that many cultures on which important conclusions were based were made under insanitary conditions. The cavity of the blastula was at first filled with a thick proteid solution which became thinner as development advanced, and this thinning was possibly connected with the infolding processes in the wall, by means of which the organs of the larva were built up. The larva showed its relationship to Tornaria by the three-fold division of the body cavity on each side and by a larval brain, which was situated at the front end and was independent of the ciliated band. The development of the nerve-ring of the Echinus from the floor of an ectodermic pit was described. A false floor formed over this by the meeting of interradial ridges gave rise to the buccal membrane of the adult. The masticatory apparatus was derived from five pocket-like outgrowths of the left posterior body cavity. Finally, the blood system was a remnant of the proteid contents of the blastocœle added to by exudation from the cells of the alimentary canal. (4) Dr. A. T. Masterman exhibited a series of wax models illustrating the transition from larva to adult in *Cribrella oculata*. The main points brought out were the complete bilaterality of the larva, the sinistral asymmetry followed by axial symmetry converting the larva into adult, and the absence of any true metamorphosis. The changes in the body cavities were shown to agree with the results of Goto for Asterina and Asterias, and to differ from those of MacBride. (5) Dr. J. Hume Patterson gave an important communication, on the causes of salmon disease—a bacteriological investigation, in which he showed that if a sound salmon is placed in water with Saprolegnia there is no result, and that the fungus is effectual only after a preliminary softening of the skin by the action of a bacillus which he had succeeded in isolating and cultivating.

On Monday, September 15, the following papers, &c., were taken:—

(1) Prof. Howes exhibited, on behalf of Mr. J. P. Hill, of Sydney, photographs of the first segmentation stages of the zygote of the native cat (Dasyurus) up to the period of first formation of the endoderm. A 16-celled stage was described, at which the embryo-cells are arranged in a couple of annuli, and later a stage suggestive of over growth of a yolk by the ectoderm. Selenka's blastopore stage was shown to be conspicuous, and in one example the endoderm appeared to arise from a single cell at the point of closure of the blastopore, after the manner of that of Didelphys. Mr. Hill has succeeded in obtaining microscopic

sections of the earlier stages by affixation of the egg to the embryonic membrane of the pig. (2) Prof. J. C. Ewart gave an account, illustrated by the lantern, of some recent inter-crossing experiments with dogs, and pointed out that unless one of the parents was highly prepotent, the first crosses were not as a rule uniform, and that when the members of the cross-bred litters were interbred, some of the offspring very closely resembled the pure-bred grandparents. (3) Mr. Nelson Annandale had a paper on flower-like insects from the Malay Peninsula, and Mr. H. C. Robinson, who had been on the same expedition, gave notes on protective resemblance—both subjects being illustrated by lantern slides. (4) Prof. Poulton then gave lantern exhibitions (1) of British insects in their natural attitudes, and (2) of three-colour slides showing mimicry, protective resemblance, seasonal forms of butterflies, &c. (5) Mr. Thos. Steel exhibited an interesting collection illustrative of Australian zoology, such as the different species of Peripatus, including forms of Ooperipatus which lay fertile eggs having a lengthy period before hatching; also a fine series of land Planarians, also marsupial embryos, the blind marsupial mole, *Notorocytes typhlops*, and the honey ant, *Camponotus inflatus*, both from the Central Australian desert. (6) Prof. R. J. Anderson gave two notes—one on a specimen of the pilot whale of a white colour, with twenty-eight teeth and a large foramen of Winslow in the abdomen; and the second on the relations of the parietal bone in Primates. He showed that the orang is in a variable condition, having sometimes, but not always, a parieto-sphenoidal suture. Other variations were discussed. (7) Mr. A. T. Watson gave a most interesting account, illustrated by the lantern, of the errant habits of the Onuphidæ (Polychæta), and described a defensive mechanism which he had discovered in the tubes. The onuphid worms drag their tubes over the sea-bottom, and protect the open ends by constructing membranous valves, like those of the veins, and so arranged that on retreat of the worm the inrush of sea water causes the valves to close automatically. (8) Mr. R. T. Leiper, on an acœlous Turbellarian inhabiting the common heart urchin. The worm was found in the accessory canal of about 5 per cent. of the *Echinocardium cordatum* at Millport. It is white, leaf-like, and 2·5 mm. in length. There is no spermotheca or vagina. A similar absence of female accessoria obtains in Haplodiscus, from which this Turbellarian differs in the following respects:—(1) shape; (2) parasitic habitat; (3) mouth in anterior fourth; (4) paired lateral testes; (5) no defined vasa deferentia; (6) penis with chitinous knob-like armature; (7) large digestive vacuole. In discussing the classification of the Acœla, the author suggests that the family Proporidæ, comprising all Acœla with one genital opening, be subdivided to form two subfamilies:—(1) Proporinæ, to include the genera (*a*) Proporus, (*b*) Monoporus, (*c*) Böhmigia, *i.e.* those with a common genital pore; (2) Avagininæ, consisting of (*a*) Haplodiscus and (*b*) the genus now recorded, *i.e.* those having a male pore only. The name *Avagina incola* is proposed for this new form.

On the Tuesday, Dr. Henry Woodward gave a note on a diagram of the skull of *Mastodon angustidens*. Dr. R. F. Scharff had an interesting paper on the Atlantis problem, in which he collected a number of facts in the distribution of animals bearing upon the possible land connection between Europe and America by way of the Atlantic islands. His investigations tended to show that Madeira and the Azores are the remains of an ancient Tertiary area of land which was joined to Europe, and that it probably became disconnected in Miocene times. As to a land bridge across the Atlantic, many reasons can be given in its favour. Uniting North Africa with Brazil and Guiana in early Tertiary times, it probably subsided during the Miocene period, leaving only a few isolated peaks as islands.

Mr. R. J. Ussher gave an interesting address, illustrated by lantern photographs taken by Mr. R. W. Welch, on the avifauna of Ireland as affected by its geography. He shows that as a result of the position and features of the country, some species breed more numerously and extensively than in England. The buzzard, bittern and capercaillie have been exterminated, and certain other British birds have never established a footing in Ireland. Winter and occasional visitants were discussed, also the list of North American species taken in Ireland. The raven, harriers and eagles are approaching extinction. The bones of the great auk found in kitchen middens in Antrim show that it was used as food.

Mr. E. J. Bles gave two communications, one on the development of Xenopus, and the other on experiments on the Axolotl, showing adaptations to life in an alkaline medium. Dr. H. W. Marett Tims had a paper on the structure of the scales in the cod. Prof. C. S. Minot, of Boston, U.S., gave an address on the significance of the embryonic cell, in which he gave the results of his observations on cellular development in guinea-pigs, mice and rabbits. Mr. J. Stanley Gardiner had a paper on the breaking up of coral rock by organisms in the tropics. First the boring algæ and sponges penetrate the living corals, extending into every septum and spine. They weaken the coral and so riddle it that it is then easy for boring Polychæta such as Polydora and Eunice to enter. Following these come various Sipunculids, the bivalve Lithodomus and the cirripede Lithotrya. Then a wave breaks off the coral mass, leaving a bare surface, which more boring animals at once take advantage of. The fallen coral mass is finally broken down into smaller and smaller fragments by the boring animals. Then the sand-feeders come into action and grind up the coral fragments into sand. Chief among these may be mentioned the sea-slugs, *Holothuria atra* and *Stichopus chloronotus*, which appear to retain within their guts the coarser fragments in the sand for long periods of time, while the finer particles are swept out along the ciliated grooves. Other sand-feeding forms are Sipunculus, Echinus and Ptychodera, the mound-like casts of the latter of which form most conspicuous features of the landscape at low tide. Much of the finer material must pass into suspension in the water and be swept out by the tidal and oceanic currents, while the smaller the sand grains the greater the area they present for solution. It will thus be clear what an important bearing the sand-feeding and boring animals have on the formation of the lagoons of atolls.

Mr. J. Graham Kerr communicated a paper, illustrated by microscopic preparations, on the early development of muscles and motor nerves in Lepidosiren. He described a stage in which the inner wall of the myotome consisted of a layer of large neuromyoepithelial cells, the cell substance of each of which was continued into a tail-like process, which was in turn continuous with the nerve rudiment. The outer wall of the myotome was shown to contribute largely to the formation of the myomere. Mr. Kerr's preparations showed that the connection between spinal cord and myotome existed at a very early period—while the two structures were still in contact—and that these primitive connections—the rudiments of the motor nerve-trunks—became gradually drawn out and lengthened as the myotome receded from the spinal cord with the interposition of mesenchyme. The motor nerve-trunk, at first naked, became later on surrounded by a sheath of mesenchymatous protoplasm.

Mr. G. H. Carpenter, of the Dublin Museum, read a paper on the insect fauna of some Irish caves, dealing especially with Collembola discovered in Michelstown Cave, co. Tipperary, and in Dunmore Cave, near Kilkenny. With the exception of *Heteromurus margaritatus*, Wankel, which has now been found to inhabit caves in Ireland, France and southern Austria, all the blind species enumerated occur in above-ground localities (albeit with a discontinuous range) as well as in various caves in continental Europe. These facts point to the conclusion that such insects may be regarded as the survivors of ancient races with wide distribution whose ancestors were destitute of eyes; now almost exterminated in the upper world by the competition of eyed forms, they still survive in the caves. This conclusion does not, of course, contradict the generally accepted view that a large proportion of the blind cave fauna of continental Europe and North America (probably including *H. margaritatus* mentioned above) must be descended from eyed ancestors.

On Wednesday forenoon there was an interesting discussion on natural selection in relation to protective resemblance and mimicry in animals, arising out of the communications made to the section by Prof. Poulton and by Messrs. N. Annandale and H. C. Robinson. Prof. Poulton, in opening the discussion, expressed his conviction that natural selection was the key to the puzzle, although it was not always possible to say how it should be applied. He gave examples of some mistakes that had been made in the past, and since rectified in attributing utility to characters. He alluded to the results he had obtained from the destruction of chrysalides in different environments, and he finally accepted natural selection as a working theory. Mr. Annandale and Mr. Robinson both brought up various cases observed by them in Siam and Malaya where the explanation by natural selection seemed very difficult. Mr. G. H. Carpenter pointed out how some of these cases might be explained. Miss M. Newbigin and others also brought up further difficulties, and some speakers discussed natural selection as a form of isolation and as being of less importance than other forms. In his reply, Prof. Poulton dealt with many of the cases cited, and showed how they could be brought under the operation of natural selection.

Finally, a paper by Mr. C. Shearer, on the early development of the head kidney in Polygordius and Eupomatus, and the usual votes of thanks to the president and officers brought a very successful meeting of Section D to a close.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

THE changed spirit that is coming over geography was in evidence at Belfast. Accounts of explorations proposed or executed were limited in number, and half of them related to the unknown Polar lands. On the other hand, papers dealing with the morphology of limited areas and with applications of geographical knowledge to economic problems, branches of geography which are rapidly growing in importance, this year outnumbered the accounts of pioneer travels.

The president, Sir Thomas Holdich, in his address on the progress of geographical knowledge, emphasised the fact that the area for pioneer work was rapidly diminishing, and that the exploration required was of a more exact and comprehensive character, which necessitated a more restricted scene of operations. He very properly insisted on the need for an exact knowledge of the previous work done in any region before attempting to carry out new investigations in it, and that the investigators should be thoroughly trained men. In much of the world, a topographical knowledge is wanted intermediate between that given by pioneer surveys and that of elaborate national surveys such as our ordnance survey, *i.e.* a knowledge sufficient to show on a fair scale the salient features, and capable of being adjusted to the triangulation of a geodetic survey. Following a recent American authority, Sir Thomas Holdich called this a geographical as opposed to a topographical survey. As geographical survey means a survey of the distribution of all phenomena within a selected area, and not merely of its topographical features, it would be well to find another term. Topography and geography are too often considered synonymous, and it does not help to an appreciation of the true significance of geography to identify it with a topography. Why not simply say large- and small-scale topographical surveys? The president of Section E is the last man to limit geography to topography, as many paragraphs in his address showed, although as a surveyor of long and special experience he naturally dwelt most fully on map making.

The travel papers were of a high standard. The audience had to listen, not to uninteresting extracts from diaries, but to well-digested summaries of results. Major Molesworth Sykes discussed the geography of southern Persia, in a paper which might equally well be classed among those applying geographical knowledge to practical needs. He pointed out the influence of the dry, barren conditions of southern Persia and Baluchistan, bounded by an inaccessible coast and so escaping invasion from the sea, in determining a hardy, warlike race, which has held in subjection the plains of Mesopotamia and even of India. He traced the influence of physical features on trade routes and the new telegraph line. Part of his paper was a contribution to physical geography, for it dealt with the changes of the bed of the Helmand River. He remarked that the desert of Lut is traditionally associated with Abraham's nephew, and condemned our maps for distinguishing between it and the Dasht-i-Kavir, as Kavir is the name of Arabic origin applied to all saline portions of Dasht-i-Lut, the general name for the whole desert area. A very serviceable paper was communicated by Captain Ryder on hilly Yünnan, in which the possibility of the much-discussed railway line from Burma was not denied, though its utility or financial success was. The natural route was by the Red River through Tongking, and a railway would soon be ready through the French territory. Mr. Hawes, an energetic young Cambridge graduate, told us how he could find out so little about Sakhalin that he visited it to discover for himself what it was like. It is almost as long as from the Shetland to Land's End, rises to about 5000 feet as Great Britain does, has two rivers each about 300 miles in length, and is covered with the forest primeval, wherein bear, wolf, fox, sable, reindeer and other animals wander. The climate is one of extremes, but popular ideas about a perpetual fog enshrouding it must be abandoned. The natives are the Ainus, Gilaks, Orochons, Yakuts and Tunguses, but the majority of the inhabitants are Russian exiles, few of whom are political prisoners. The Rev. W. S. Green brought us to a little island nearer home and showed views of Rockall. Prof. Libbey, of Princeton University, described his recent visit to Petra and showed magnificent views of its impressive rock temples, tombs and still older "high places" of Moab, and of the gorges through which this depression is reached.

Prof. Libbey read a prophetic note from Sir Clements Markham on the Sverdrup North Polar Expedition, and subsequently gave a graphic account of the expedition to renew Peary's supplies two years ago, in which he took part. Both communications expressed belief in the safety of these explorers, and were verified within a few days. Interest, however, was concentrated on the South rather than on the North Polar regions. Dr. Mill gave one of his admirably lucid expositions, in which he traced the sequence of ideas about a great southern continent and the various phases of Antarctic exploration. A crowded audience listened to Mr. Bruce's account of the plans of the Scottish National Antarctic Expedition, which will concern itself mainly with oceanographical and meteorological investigations, for which it is exceptionally well equipped. Much is hoped from the kite flying by the meteorologists, for which elaborate apparatus has been provided. The audience sympathised greatly with Mr. Bruce, who has unhappily found himself compelled practically to rebuild his ship, the *Scotia*, at the cost of transforming an estimated surplus of 2000*l*. collected above the sum required for the expenses of one year's work into a deficit of 4000*l*. A grant of 50*l*. was voted by the Association to the expedition.

Of physical papers, that which attracted most attention was Prof. J. Milne's account of world-shaking earthquakes, with special reference to the recent volcanic eruptions in the West Indies, of which 93 per cent. are submarine. He associated periods of volcanic activity with periods of upheaval, and those Antillean eruptions of which we possess records with huge readjustments of the Hispaniola-Jamaica fold or of neighbouring folds on the American continent. A report was read by the Committee on Terrestrial Surface Waves and Wave-Like Surfaces, which was drawn up by Dr. Vaughan Cornish, whose well-known recent work was outlined in it.

Prof. Libbey discussed the evolution of the Jordan Valley, the origin of which he traced to a rift at the close of the Cretaceous period. It was subsequently widened and deepened by ice action to the Sea of Galilee, if not throughout its whole length; then submerged nearly as far north as the Sea of Galilee and covered with 4000 feet of sedimentary deposits, which were afterwards gradually elevated, the stream cutting its bed through them the while. Some 3000 feet of this sedimentary rock were removed when conditions altered, and probably the glacier disappeared or the water supply failed, or the rate of elevation increased, or all three took place and connection with the ocean was blocked. After 1000 feet of rise, the present conditions were obtained. Mr. Herbertson read a note on the windings of the Evenlode, and suggested that we must look some 150 feet above the present level, where the river flowed over Oxford Clay, for their initiation. Mr. Porter traced the origin of the valleys of county Cork, which change abruptly from one strath to another, to glacial interference, and explained the meridional character of many tributary glens as the outcome of faulting plus the rapid flow of pre-Glacial streams. Prof. W. W. Watts described the features of Charnwood Forest, where old mountains rise above Triassic deposits which cover their lower slopes, these slopes being here and there exposed in the river valleys. He compared the Triassic landscape in Charnwood Forest with that of the Great Basin of North America at the present day.

A report was read from Dr. T. N. Johnston on the Scottish Lakes Survey, in which the seiches which have been recently observed were described and illustrated by curves. (See NATURE, June 12.)

The only paper on biological geography was that by Mr. Lloyd Praeger on geographical plant groups in the Irish flora. A careful analysis of the distribution of plants in Ireland reveals the existence of several fairly well-defined types. There is a marked tendency to a "central" or "marginal" distribution, the result of the configuration of the country, the central group being largely composed of lowland, calcicole, and aquatic or paludal species; the marginal of calcifuge, upland and dry-soil plants. Well-marked northern and southern, eastern and western groups also exist, the boundaries between them consisting of lines running not exactly east and west or north and south, but rather north-north-eastward from Cork to Londonderry and east-north-eastward from Galway Bay to Dundalk Bay. For these six types of distribution the author proposes the names Central, Marginal, Ultonian, Mumonian, Lagenian, Connacian, the last four being taken from the old names of the four provinces of Ireland, in each of which one of the groups attains its maximum. The characters of each plant-group, and its relations to the climatological and physiographic features of the country, were pointed out.

Two papers of economic importance were read. Prof. Johnston showed the distribution of peat bogs in Ireland by means of a new map prepared by the Intelligence and Statistical Branch of the Irish Agricultural and Technical Instruction Department. They cover 1861 square miles, chiefly in counties Donegal, Mayo and Galway, and have an average depth of 25 feet. An account was given of the character of the different layers of a bog as seen in a vertical section, and an explanation suggested of the origin of a bog-slide. Specimens of the bog-flora, of the different kinds of peat and of the economic products derivable from turf or peat, lent from the botanical collections of the National Museum in Dublin, were exhibited. The second paper, by Mr. R. B. Buckley, on colonisation and irrigation in Uganda and the British East African Protectorate, began with a clear picture of the existing physical and economic conditions of these dependencies, and enunciated comprehensive and judicious views as to their development in the future. The question of irrigation was exhaustively treated, and the author concluded that the prospects of great transformations taking place through its aid are not very hopeful.

A. J. H.

ENGINEERING AT THE BRITISH ASSOCIATION.

ON Thursday, September 11, after the president's address, a paper by Mr. H. A. Humphrey on recent progress in large gas engines was read. This paper, which was illustrated by lantern slides, gave an account of the extraordinary development of large gas engines which has taken place during the past few years, and which has, as the author said, had but few parallels in the history of engineering enterprise. In the Paris Exhibition of 1900, a 600 h.p. Cockerill gas engine was, from its size, the object of much interest. The same makers are now building engines of 2500 h.p., and they are prepared to undertake one to develop 5000 h.p. In this country it is only as recently as 1900 that engines above 400 h.p. have been made, the first two being constructed for Messrs. Brunner, Mond and Co.'s works at Winnington, yet when the paper was written (August) the two chief manufactories in Great Britain had under contract or had already delivered no less than fifty-one gas engines ranging in size between 200 and 1000 h.p. But it is on the Continent and in America that the most remarkable advance has been made. The author gave in a very complete table particulars of all engines of more than 200 h.p. capacity which have been built abroad or are under construction, the total amounting to 327 engines, developing 181,605 h.p. Slides shown by the author illustrated the various uses to which these large gas engines have been put so far, such as dynamo driving, air compression for blast-furnace work, and other similar uses. Perhaps the most interesting detail in connection with this increase in the size of gas engines has been the use of blast-furnace gas for working them. The author in the latter part of his paper explained in some detail the improvements in construction and governing which have made these large engines possible, in particular the changes which have been necessary in the old "hit and miss" governor mechanism, where, as in dynamo driving, perfect uniformity of speed is necessary. As several large engineering firms in this country have now acquired the rights for manufacturing some of the most successful foreign types of these engines, there is little doubt that we are on the eve of important developments in this country in the gas-engine industry, especially in the utilisation of producer and of blast-furnace gases.

In the afternoon of September 11, the Section made a special visit to the harbour works, under the guidance of the engineers to the Belfast Harbour Commissioners, in order that members might see for themselves some of the remarkable developments which have taken place in Belfast Harbour and have been brought about by constant increase in the size of ocean steamships.

On Friday, September 12, the first paper was a brief communication by the Hon. C. A. Parsons on steam turbines, in which figures were given to show the rapid increase in the use of the compound turbine since 1884. Up to 1890, though a number of compound turbines had already been constructed for driving dynamos, the largest size had not exceeded 120 h.p., the total h.p. at that date being 5000; by 1896 the total h.p. had increased to 40,000 and the largest individual plant to 600 h.p., and now the largest unit has increased to 3,000 hp. and the aggregate h.p. sold in Great Britain to 200,000. On the Continent, also, their use has been rapidly extending, and the total aggregate of horse-power at home and abroad for driving dynamos up to the present time is not far short of 300,000. As a proof of the remarkable economy obtained in the very large machines, the author stated that a steam consumption of 17·3lb. per kilowatt hour had been recorded during a test of a 1000 kilowatt continuous-current machine belonging to the Newcastle and District Electric Light Company; this would be equivalent to about 10·2lb. of steam per i.h.p. hour, a very remarkable figure, and he anticipates still greater economy in the future in turbines of large size when using superheated steam. Many engineers had feared that these machines would fall off notably in their economy after they had been running for some time, but the author stated that careful tests had now been made with several plants to determine the steam consumption after the machinery had been in use for several years, and no appreciable increase had been found. The second half of the paper was devoted to an account of the application of the steam turbine to marine work; seven vessels have so far been fitted with turbine engines, including the two unfortunate destroyers—the *Cobra* and the *Viper*—and the two well-known Clyde passenger boats—the *King Edward* and the *Queen Alexandra*. In addition to these, a third-class cruiser, the *Amethyst*, would shortly be completed, and orders have recently been placed on the Clyde with Messrs. Denny Bros. for the construction of two cross-channel boats which are to have turbine engines of about 8000 h.p.; this means a total of about 83,000 h.p. in use or in construction. Mr. Parsons stated that if the coal consumption of the *Duchess of Hamilton* (fitted with ordinary reciprocating compound engines) was compared with that of the *King Edward*, and if various allowances for the difference in speed of the two boats and for various other factors were made, then the turbine boat showed a saving of 20 per cent.; he again, as at the Dover meeting, prophesied the eventual use of turbine engines for Atlantic liners, cruisers and battleships. In his reply to a brief discussion, in which several points were raised with regard to the use of superheated steam in the turbines, the author stated that he estimated a gain of efficiency due to superheating of about 1 per cent. for every 10° of superheat.

The next matter dealt with by the Section was the report of the Committee on the Resistance of Road Vehicles to Traction, the first eleven sections of which were devoted to a complete *résumé* of the experimental work which has already been carried out on this subject, and to a summary of the opinions which have so far been expressed (based on these experiments) of the effects on traction on the level of the three independent elements of road resistance, namely, axial friction, rolling resistance and grade resistance. The last two sections of the report were devoted to a brief description of the special apparatus which has been designed and made by the Committee; the first series of experiments undertaken will be confined to measurements of the resistance of single wheels. The tractive force will be transmitted through a system of levers to a small ram which presses upon a rubber diaphragm enclosing a space filled with water or other liquid; the pressure exerted by the levers on the ram will vary with the tractive force, and the consequent varying fluid pressure will be registered by a recording pressure gauge of the Bourdon tube type, and since the drum of the instrument carrying the recording paper will be rotated in strict accordance with the movements of the car, a diagram will be drawn giving the tractive force at all points on the journey. The instrument has been so designed that the leverage on the ram can be altered to ensure diagrams of a reasonable size even when the tractive force is very small, and a revolution counter will be used for obtaining independently the revolutions of the experimenta wheel. Several preliminary experiments have already been carried out, but the main work of the Committee will be undertaken during the forthcoming year. It should be mentioned here that although another grant was given to the Committee by the Association, still its work will be terribly hampered, and in fact will be almost impossible, unless additional funds are forthcoming from other sources; the Committee is doing work of such great importance to the country that it is to be hoped public bodies and all those who are interested in the question of the construction and upkeep of public streets and roads and the best means of road traction will respond liberally to the appeal which the Committee has issued for financial help.

Two other important papers read on this day dealt respectively with the rainfall and water-power available in Ireland. Dr. Mill exhibited a map of Ireland coloured to show the distribution of rainfall, as ascertained from the records of the ten years 1890–1899, and pointed out that practically the whole country west of the Foyle and the Shannon, and west and south of a line drawn from Limerick to Clonmel, had a rainfall exceeding 40 inches in the year. He also gave some interesting statistics as to the number of rainfall stations in Ireland and the increase since the Belfast meeting in 1874; he calculated that 185 additional observers would be required to secure as many rain-gauge observations per 1000 of population as were now made in England. Perhaps as a result of this meeting we may again find an increase of interest taken in this important question.

Mr. Dick, in his paper on the water-power available in Ireland, considered only the cases of the Shannon, the Erne and the Bann, perhaps the most important rivers, however, from a power point of view. The dry-weather minimum flow of these rivers is the vital factor in calculations of available power, and the problem is rendered exceptionally difficult owing to the conditions which have been laid down in reference to this minimum flow in Acts of Parliament which have been passed in connection with the fishing industry in these rivers. Mr. Dick stated that very careful measurements had been made of the amount of water available under the above conditions, and he calculated that as a result the continuous water-power available on the lower Shannon would be nil, on the lower Erne 400 and on the lower Bann 800. He then dealt with the possibility of increasing this small horse-power by storage of flood waters, and came to the conclusion that this was out of the question when regard was paid to the enormous amount of money which had already been spent for the purpose of keeping these rivers at or near their summer level in connection with the requirements of arterial drainage and navigation. It will be seen that the author's figures correct the serious misconceptions that have prevailed in regard to the amount of water-power likely to be available in Ireland; no doubt these too favourable views have arisen from the erroneous figures given by Sir Robert Kane in his book on the "Industrial Resources of Ireland," since that author estimated that the available water-power on the Shannon alone between Killaloe and Limerick was 34,000. Several of those who took part in the discussion were of opinion that the author had taken a too pessimistic view of the situation, and that in several cases, at any rate if useless navigation rights were abandoned, considerable power would be rendered available.

The meeting on Monday, September 15, was, as usual, devoted to electrical papers, and the first paper dealt with was a suggestive one by Mr. J. E. Kingsbury on the future of the telephone in the United Kingdom. The author gave a short history of the various telephone companies which have been at work in this country from the date of the famous action brought against the Edison Telephone Company by the Post Office in 1880, and then went on to show that competing services which had been started in one or two towns, as for example, Dundee, Sheffield and Manchester, had not benefited the community; in fact, the people of those towns had actually derived an advantage from the amalgamation of the local competing companies with the National Telephone Company, a view, we may point out, quite opposed to the popular ideas upon that subject. Mr. Kingsbury was of opinion that competing services had ceased in the past because the absurdity of such a situation was obvious as soon as it was put into practice. Parliament, by the Act of 1899, determined to foster once more, by the help of the ratepayers, this system of competition, although when tried before under private enterprise it had proved unsatisfactory. Both in Glasgow and in Tunbridge Wells, where municipal telephone systems had been started, the author was of opinion that money had been uselessly spent simply to create a system of duplicate subscribers and duplicate subscriptions. In London, on the other hand, an admirable arrangement had been concluded by the Postmaster General by which every subscriber to the Post Office system was in connection with the existing 45,000 subscribers to the old system. In conclusion, he stated that as corporations could borrow money easily and cheaply, it would be spent on competitive systems which were wasteful, and gave the maximum of inconvenience and the minimum of public benefit. Several of those who took part in the discussion were opposed to the position taken up by the author on the question of municipal telephone systems, but Sir William Preece appeared to uphold the idea that a general telephone system could be much better worked by the Post Office than by separate municipalities. One of the speakers declared, as the result of careful inquiry, that the Glasgow telephone system, instead of being a failure as the author had stated, was a great success.

Prof. E. Wilson then read a paper on the electrical conductivity of certain aluminium alloys as affected by exposure to London atmosphere. A number of specimens of various light aluminium alloys had been placed on the roof of King's College, London, in order to investigate the effect of exposure to the atmosphere. The specimens were wires about $\frac{1}{8}$ inch in diameter, carried on a wooden frame, and had been exposed for about thirteen months. A table was presented by the author giving the results of the experiments, and as chemical analyses had been made in every case, the author was able to show the effect upon the specific resistance of each alloy of the different elements in combination with the aluminium; as a result of his work, he concluded that for exposed light aluminium alloys copper alone should not be used; on the other hand, the presence of equal amounts of nickel and copper, about 1 per cent. of each, though it slightly reduced conductivity, produced a marked improvement in power to resist corrosion. Dr. Glazebrook, in the discussion, mentioned how difficult it was in such experiments to determine accurately the specific resistance owing to the pittings and cracks which were produced on the surface by the action of the weather.

Another paper of much interest was one by Mr. W. Taylor on the science of the workshop. He said that the subject would divide itself naturally into three parts—the materials used in the workshop, the processes for their treatment, and tools; and in the section on materials he pointed out truly enough that much of the work which had hitherto been carried on in technical schools and also by original investigators had been confined to the study of the physical properties of materials from the point of view of the designer, whose chief interest is that his machine structures shall not be strained beyond the elastic limit, rather than from the point of view of the mechanic, whose business it is to shape the materials, generally by straining them beyond the elastic limit. He hoped for considerable advance in our knowledge from this latter point of view, from the photomicrographic study of the structure of materials and from such researches as those which have been carried out by the Alloys Research Committee of the Institution of Mechanical Engineers.

The last paper on the programme for the day was one by Mr. J. R. Wigham on a new flashing lighthouse light without intervals of darkness. One of these lights was placed on the top of the tower of Queen's College and was shown in operation each night during the meeting. The author stated that the cost of the new light, which was practically a continuous one, was not greater than that of any other of the first-class lights with revolving annular lenses, and that any common illuminant might be used.

The afternoon of Monday was devoted to a joint discussion with Section L on the training of engineers. The discussion was opened by the president of the Section, Prof. Perry; it was, in fact, a discussion of his presidential address to Section G. One of the points mentioned by the president was the necessity that engineers and manufacturers should interest themselves in the question of the education of the young engineer, and that until they do so engineering teachers cannot hope to meet with success. We feel sure that this want of interest is at the bottom of much of the trouble the directors of engineering schools now experience in inducing parents and guardians to consider that the profession of an engineer is one which requires in the present day as lengthy and complete a preparation as medicine or law. Several speakers raised the question as to whether it was advisable to adopt what has been called the half-time course, that is to say, the system under which students attend the university or technical college classes during the winter and work in the shops or drawing offices during the summer. We may mention that this plan has been carried out in several towns, but as a rule employers are somewhat opposed to it. Sir William Preece declared—and it is a statement which cannot be too often made—that it is at the top and not at the bottom that we require radical changes in our technical education for engineers.

On Tuesday, September 16, a number of general papers were dealt with. The first paper, by Mr. W. H. Booth, treated of the smokeless combustion of bituminous fuel, and the author contended that as a rule boiler furnaces were badly designed in respect of the prevention of smoke. Furnaces must be arranged in such a way that all the gaseous products of the furnace are swept together with the admitted air, and are not cooled down until sufficiently burnt to admit of their being used for heating purposes; and he was of opinion that there was nothing in smoke prevention to justify the assertion that it was economically impossible. Mr. J. S. Raworth, in connection with this subject, described a system for the prevention of smoke known as the "Wilson smokeless process." A small quantity of nitrate of soda in solution is injected into the furnace with sufficient air to give perfect combustion, the cost being about 3*d*. to 4*d*. per ton of coal burnt; this system has been installed in a tobacco factory in Belfast, smoke has been abolished, and the output and efficiency of the boilers improved.

Prof. G. Forbes then gave an interesting account of his experiences in the late South African war with the infantry range-finder, which he described at the Glasgow meeting last September. Both officers and men who had served at the front were unanimous in their opinion that the great want which had so often nullified the strategy of our leaders and endurance of our men was a quick, handy, trustworthy one-man range-finder. In actual service this range-finder had proved that its accuracy was all that could be desired, and it was much quicker in action than the mekometer. During a trek of 300 miles in eleven days, he had been constantly called upon to give distances, and it never took longer than one minute to dismount from his horse, set up the range-finder and give the first range, other ranges being given in a few seconds. He was in action for two days, and was able to give the ranges quickly and accurately without any unnecessary exposure. With his own eyesight, which was not particularly good, he was able to get an accuracy of 2 per cent. in 3000 yards, but many of the men had been able to get a very much greater degree of accuracy than this.

Several other short communications were read, but we have not space to deal with them. T. H. B.

SCIENCE AND LITERATURE.[1]

ON what subject ought one to speak at the beginning of the session of a College of Science which is also a School of Applied Science, speaking, not only to one's colleagues, but to new and old students who differ from one another in character, training, social position and attainments more than the students of any other college probably in the world? This college has three functions. It gives the highest possible instruction in mathematics and natural philosophy and in all the natural sciences. It gives technical instruction to mining, metallurgical and mechanical engineers. It gives pedagogic training to teachers of all subjects taught at the college. The presence of Sir Arthur Rücker, Principal of London University, reminds me of a fourth function which has recently been added—namely, the preparation of students to pass university examinations.

I am strongly of opinion that every engineer—that is, every man whose business it is to apply any of the physical sciences—ought to have a more or less thorough training as a mechanical and electrical engineer. In the address which I had the honour to deliver three weeks ago as president of the Engineering Section of the British Association, I tried to show that only a very exceptional student can obtain such training unless he spends much time in mechanical or electrical engineering laboratories such as I there described. For many years, from long before I came to Kensington, the mechanics course here has been one in mechanical engineering as well as in mechanical philosophy. My anxiety to own a laboratory has met with the utmost sympathy from the higher authorities and the council of the college. I may say that we are all as anxious that students should work with electric generators and motors and other electric-power plant as with steam and gas engines, with water turbines and pumps. I know that some of you blame me because I can give none of this necessary instruction, and sometimes, perhaps, I blame others for not affording me facilities. The curriculum at this college was arranged a great many years ago, when people aimed only at the training of the exceptionally clever student, and, indeed, before any electrical appliance was used by miners or metallurgists; before the time when a mine became filled with mechanical contrivances. Every mining or metallurgical or other technical school now established in any part of the world gives this sort of training to the students which we are unable to give. The authorities of this College are in sympathy with you and with me, and would help us to this necessary laboratory work and greater space and other facilities for instruction in my division if they possibly could. Parenthetically, I may observe that, in so far as applied mechanics and engineering theory are concerned, the courses of study here will enable any willing student to obtain the highest engineering degree of the University of London.

Some of you are extremely well read in scientific text-books, having passed most severe examinations in pure and applied science. And not mere text-books, but real scientific books have been studied by many of you; for I know that some of you have dipped into Larmor's book on the ether, and have read Thomson and Tait and Maxwell and Rayleigh. Not only have you this wonderful knowledge in science, but you have been earning your own living and you have developed an instinct for taking advantage of chances, of fending for yourselves, of making other people do what you ask, that is perfectly marvellous. Some of you remind me of great fir-trees that I saw in Norway this summer, spreading their roots over a rocky soil, gaining sustenance where no other kind of tree could exist. One power more developed than another is that of passing examinations. Nobody who is without the experience of an examiner of candidates from the evening science classes can comprehend your power of getting marks from a careless examiner for answers to questions on subjects about which your knowledge is limited. There is hardly any town in the British Islands from which our scholars—I suppose that quite a hundred scholars are here—have not come, each picked from many hundreds or thousands, each the recipient of great honour and a valuable scholarship, and your townspeople and your old companions are keeping their eyes on you, wondering whether or not it is a great man of the future that has been sent up to us. And now for the other side. You know much of what has been done, but have you the power to discover, to add to the world's knowledge? Your knowledge has been derived from books and lectures; you have now to learn that a week in the laboratory, during which you seem to crawl, during which for examination purposes you do less than in reading ten lines of a text-book, is really of more value to your scientific education than a month's hard reading. This is almost unbelievable to you who are such adepts in passing examinations; yet it is quite true. Lectures and lessons have spoon-fed you until now; lectures and lessons will in future teach you to feed yourselves.

Again, many of you think it is not only a waste of time, but a positive sin, to read novels and poetry and general literature, to cultivate in any way the imagination, to take an interest in painting or sculpture or music. You have yet to learn that although parrots and other imitative animals can get on without imagination, there is no such thing in existence as an unimaginative scientific man. That you have some imagination and individuality is evidenced by your differentiation from all other students of science classes; but have you these well developed, and have you those other qualities which are absolutely necessary for the success of a scientific worker? Imagination is far and away the most important; but there are also judgment and common sense, and the love of truth and the power of self-sacrifice, which seem always to accompany the pursuit of science. Are you fond of reading? Do you know how to use books? Can you explain with decent sketches what you observe and know? Mere learning is a poor thing, but fondness for reading leads to the greatest possible development of all one's

[1] Abridged from the inaugural address delivered at the Royal College of Science (with which is incorporated the Royal School of Mines), London, by Prof. John Perry, M.E., D.Sc., LL.D., F.R.S., Professor of Mechanics and Mathematics, on October 2.

intellectual and emotional faculties. Fondness for reading will come to you if your companions are fond of reading. English and English subjects are badly taught in schools; hardly anybody anywhere seems able to teach them; one's own reading and discussion with friends are far better for one's education than any course of lectures. However limited your past education may have been, whatever defects some hypercritical learned man may see in the school system under which you have been brought up, starting from your present conditions, if you are fond of reading and have common sense, there is nothing to prevent your becoming men of the finest kind of liberal education. But you must exert your common sense and try to distinguish clearly what is essential from what is unessential in education. English literature is equal to, if not greater than, any literature of any people that exists now or has ever been. The language of our great Empire is enough for any man who is not specially fond of language study. If you love to study foreign or dead languages, do so; but if you are not so inclined you will be acting foolishly to waste your time over them.

The average man cannot be much hurt intellectually by anything he does, but the higher intellect is, I think, easily hurt, and I know of several men who had genius, real genius, whose intellects have been permanently dwarfed by a six months' course of classics pursued with the base object—degrading to classics and to themselves—of becoming able to pass an examination. There are some kinds of moral degradation which are final; the holy of holies has been desecrated once for all. My language about this matter will not probably be understood by more than a few of my hearers, but if there is even one who understands, my message is very important. If such a one is here I would warn him that there are certain prices too large to pay for examination success. I object very much to those examination systems in which certain things are compulsory. Of course, we cannot get rid of all compulsory things. English and English subjects must be compulsory on English students. But I do say that the list of compulsory things should be made as small as possible. I am told that a knowledge of the German language must be made compulsory for chemists and biologists. I am sorry to think that this may be so. But inasmuch as the men who tell me this say that it is the case also for physicists and mathematicians and engineers, I venture to doubt the necessity for compulsion in any case whatsoever. I am perfectly certain that in these days of much publication of translations and abstracts of foreign scientific papers, no kind of physicist or engineer needs French or German or any foreign language so much that it is *imperative* on him to make a study of it. The men who insist on the study of a language other than English do not seem to know how difficult such a study is for some students. Time will not allow me to do it here, but I hope some time to have a chance of pricking this compulsory foreign language bubble which everybody is cherishing at the present time without really thinking about its intrinsic value. How often have I heard common men say that they abhor translations; that the style and real flavour of an author are only to be had in the original. I notice that such men read very little. I doubt if the average educated man ever does get that kind of appreciation of a foreign author which the author's educated countrymen get so easily. I have met all sorts of men in my life, and I have never seen reason to alter the opinion of my young days that a lover of reading can get immense satisfaction from a translation—whether it is from Greek or Latin, French or German, Spanish or Italian, Russian, Scandinavian or Hebrew; whether it is Omar Khayyum or the Rig Veda, the Talmud or the Koran, or the Bible. To the lover of English all literature is open. The man who insists on reading "the original" seems to me like a tethered cow, such as we see in Jersey; it crops the grass very closely, but surely it must sometimes sigh for a little more freedom and a more extensive range of grazing! If you had finished your course here I would say to you that we are all getting far too learned in natural science. We read far too many of the latest papers. Some of the greatest scientific workers of our times—men who are constantly advancing the boundaries of knowledge—read almost nothing of what other men do. I wish I had time to give you some interesting, and indeed absurd, examples of this. The average scientific man merely casts his eyes over the twenty or thirty scientific periodicals that every man buys every month; he does not even read that valuable periodical "Science Abstracts," or those abstracts of chemical papers published so voluminously, for he has no time. The men who read everything that is written in scientific journals, not merely in England and America, but also in Germany and France, seem to me to have no time to do anything else; they have no time for scientific work of their own. Indeed, they know so much that a simple investigation such as they might begin upon their own account seems insignificant to them and quite unworthy of the time that they would have to spend upon it. I ask only that in matters like this of foreign languages and so much reading of scientific papers you should really judge for yourselves. In these days you can recognise the manufactured men of science by their taking up a notion without thinking about it, by their inclination to follow a leader as a flock of sheep follows the bell-wether, a phenomenon studied by a famous philosopher named Sydney Ortheris.

When the Prince Consort tried to impress upon this nation those ideas of training in science and art which, if they had been attended to, would have kept us in the front of industrial progress, there was one of his ideas which took root, and which has given rise to the work of the Science and Art Department. I know the faults of the department as well as anybody, but all my life I have been pointing out its enormous services to the country. No other country in the world has anything to compare with it. When I think of our industrial supremacy before 1870, and how during thirty years some of us have been vainly warning a careless people that the combination of wisdom and knowledge which we call science, neglected in the education of all well-to-do people, would lead other nations to the capture of our industries; when I think of the utter failure of our higher educational authorities to recognise facts, I bless the Science and Art Department. For more than forty years, in towns remote from universities, it has been possible for the poorest apprentice or workman to get instruction in natural science. These science and art classes were open to the very poorest. Until lately there were no other classes open to rich, clever students. It is astonishing to me that men should be ignorant of the fact that it is the Science and Art Department which has so far saved our industries. I can speak with knowledge of the engineering industries. Of the many hundreds of thousands of pupils who have successfully passed our examinations, a very large proportion, by the combination of their scientific knowledge or scientific habits of thought with practical workshop knowledge and through their energy, became foremen and managers, and in many cases owners, of works. I need not dwell on the fact that every year since 1869 many Whitworth scholars have been sent out into the industrial world, and I affirm of my own knowledge that these men have become such captains of industry as no other country in the world has at its command.

If only our capitalists had even the most elementary technical training such as is suitable for capitalists, the men educated by the Science and Art Department would alone have enabled them to retain that industrial supremacy the loss of which is being bewailed day by day in the newspapers. Many of our best men are making bricks without straw. They discover, they invent, they project improvements. But if the owner of the works, the son or grandson of the creator of an industry, if all the directors of a company, with however scientific a manager, are quite ignorant of those natural science principles on which the industry is based, if they cannot distinguish between good and evil, there is nothing for the industry except to go upon lines that get more and more old-fashioned until the works stop through inanition. And yet I have heard of cases in which old science students, in spite of heart-breaking failures to interest their superiors, have by dogged persistence maintained works as paying concerns, in spite of competition from American and German and Swiss strategists of the best polytechnic training.

Many of the most successful students hide the source to which they owe their scientific training, because the science class fees are small; the classes are open to the poorest students, and in this country caste feeling so predominates that no man likes to have it thought that he comes of poor parents or that he ever attended a class to which poor students were admitted. If all the successful old Science and Art students comprehended how much harm is being done just now by their careful concealment of the fact that the Science and Art Department used to be, and in many places still is, the only agency through which a scientific training could be given in this country; if they knew of the development which has been going on for some years in the functions of this department; if they knew the importance to the country of a general recognition of the services of the department, they would, I am sure, refrain from hiding their enormous obligations to it. No Government department has had so much intelligent criticism, because the only people who know about it are its own students, and they have by it been brought up in an atmosphere of scientific criticism.

And here are you students—about half of you—the picked men of these science classes, caught in our net, the net that Huxley spoke of, selected from thousands of students who are themselves select, selected that we may train most of you to be leaders of scientific thought or great appliers of science, or great teachers of science! There is the idea that for the good of the country our net has caught in one of you the young man most likely to repay cultivation, and I cannot too often repeat that it is not for your sake that this is done. If one of you happens to be a potential Faraday, however poor he may be, and so far as I can see he is just as likely to be poor as to be rich, it is our duty to try to discover him and give him chances of development. We are supposed to give you enough money to live upon; we ask no fees from you; we set you as men whom the King delighteth to honour, side by side with the most promising fee-paying students—men from our public schools, men taught to admire what you have done in the past, encouraged to think you men of promise—and we ask you to develop those exceptional faculties which to you are your own, but which we believe to be national assets.

I will conclude this address by bringing another and much more important problem before your consideration. The matriculation examination of a teaching university has this meaning only—that it is inadvisable to admit men who are obviously unfit to benefit by the instruction given in the university. When in mediæval Europe all university lectures were given in the one universal language, Latin; when men from all nations came to hear the same lectures, it was evident that no man ought to be admitted who had not enough Latin to be able to comprehend the lectures. As present in Glasgow it is assumed that everybody has had the usual school training, and the only matriculation is in signing one's name in a book. Hitherto at this college men who have passed certain examinations in elementary natural science are thought to be fit and proper students, and of course you scholars who have all passed rather difficult examinations in natural science are admitted without question. I am glad to think that every student admitted to this college does always seem capable of benefiting by our instruction; but if you consider what our object is, the education of true scientific men, you will see that there is something much higher than is attempted elsewhere.

Merely to be able to benefit by the instruction, that is a small thing. Men who come here with valuable scholarships are expected, not merely to benefit, but to benefit in a very exceptional way. They are supposed to develop to the very utmost their obvious scientific ability. To test for this likelihood of development in even the roughest way is evidently difficult. Even to apply any test outside the old limits seems difficult, because of the peculiar circumstances under which you are selected for scholarships. In more than half your cases you are not aware beforehand that you have a chance of being selected. You joined science classes merely to obtain a kind of knowledge which would be useful in your daily work. Your prospects were those of a workshop with a slow rise to foremanship. Your spare time was meagre; it was stolen at enormous sacrifice from family duty and from those pursuits which make a man popular with his fellow workers; the study of language and literature was comparatively unimportant to you, and you were suddenly told that your scientific talents were such that you were selected for the higher life, the life of the seeker after truth; of the man of brains rather than muscle. In seven cases out of ten, it was quite impossible for you to prepare yourselves for any examination in language or literature in the two months before entering this college. I wish I saw clearly what ought to be done. You are valuable material, and if you come here without that training in your own language, that love of reading which leads to the power to use books and the knowledge of all subjects derivable from books, I am quite sure that you are greatly wasted. I have a solution of this problem, but I am not sure that it is the best solution, and therefore I leave the problem for you yourselves to consider.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PARLIAMENT reassembled on Thursday, October 16, for the resumed debate on the Committee stage of the Education Bill. In moving a resolution to give Government business precedence of all other matters during the remainder of the session, the Prime Minister took the opportunity to point out that the main object of the autumn sitting was to pass the Education Bill. The Committee has since its reassembly been engaged upon Clause 8 of the Bill, which defines the powers and duties of local education authorities and the managers of schools. The part of the clause passed reads as follows:—"The local education authority shall maintain and keep efficient all public elementary schools within their area which are necessary, and have the control of all expenditure required for that purpose other than expenditure for which, under this Act, provision is to be made by the managers." As we go to press the subsections of this clause are under consideration.

AN appendix to the calendar for the session 1902–3 of the University College of North Wales provides a very complete account of the agricultural department, which has been much developed since its inauguration in 1888. In addition to the ordinary entrance scholarships and exhibitions open to all students entering the College, there are five scholarships for which students proposing to take the agricultural course may alone compete. The College offers a diploma in agriculture, and students may enter for the degree of bachelor of science, in the group of agriculture and rural economy, in connection with the University of Wales. In cooperation with five county councils, a complete scheme of "out-college" work in agriculture has been organised.

THE many good results which will eventually follow the reconstitution of the University of London are heralded by the new departures in the work of University College, London, all of them explained fully in the calendar for the session 1902–3. Complete university courses of study in the various faculties included in the work of the College have now been established. Among other developments are the institution of a full sessional, instead of a terminal, course in the psychological laboratory; the endowment of the department of pure mathematics by Mr. Astor; the reorganisation of the department of chemistry and the appointment of Prof. Collie to the chair of organic chemistry; the institution of a new matriculation examination for engineering students and the reorganisation of the curriculum preparatory for the diploma in engineering.

THE University of Birmingham *Engineering Magazine* (a well-edited little paper published by the University Engineering Society) contains in its October number an article on continental methods of training engineers, from the pen of Dr. D. K. Morris. The author considers that the chief differences in the courses of study are due to the high quality of the preliminary training and to the number of students. The latter enables special courses to be held; a student can in consequence take, in a subject not actually his own, a course which is specially suited to him, and has not to rest content with taking part of the general course for students of that subject. The electrical laboratories, it is said, have outdistanced those for civil and mechanical engineering, and a special feature in some of the technical high schools is a loan collection of the latest types of machinery provided by the leading manufacturers. Certainly a striking feature of technical education abroad seems to be the cooperation of the manufacturers and the teachers.

THE calendar of the Bristol University College for the session 1902–3 reveals the existence of very satisfactory cooperation between the college and the manufacturers and other employers of labour in the district. In addition to a college engineering scholarship competed for annually, many of the local engineering firms have recently consented to give entrance scholarships to their works. The students nominated will obtain the combined college and works' education for about 50*l.* a year, whereas the ordinary premium paid by non-collegiate students in works is in general 100*l.* annually. The college council has consented to allow any firm offering these concessions to send one deserving apprentice to the college to attend the day lectures at half fees. A large number of local civil engineers, manufacturing engineers and architects have expressed approval of the courses of instruction arranged for students entering upon any of the careers they respectively represent.

IN his introductory article to the recent volumes of special reports dealing with American education and issued by the Board of Education, Sir Joshua Fitch very wisely insists that "the progress of mankind is to be secured, not by uniformity or by exact imitation even of the best models, but by differentiation, and by the evolution from time to time of new varieties of type both in principle and practice. Each nation must work out its own problems, in view of its special circumstances, its environment, its past history and its own national aspirations." It is well that English administrators of education should acquaint themselves with the work of the schools and colleges throughout the world, but there must be no attempt to transplant bodily any foreign system of instruction, for the national circumstances and genius are here different from those of other countries. Attention is directed to the fact that American educational reformers look with most confidence for help and guidance to "eminent teachers and professors rather than politicians or official personages." This, at least, is a practice which could be followed with advantage in this country.

SOCIETIES AND ACADEMIES.

MANCHESTER.

Literary and Philosophical Society, October 7.—Mr. Charles Bailey, president, in the chair.—A paper was read by Mr. R. L. Taylor on the reaction of iodine with mercuric oxide in presence of water. In a former paper he had shown that, when aqueous iodine is shaken up with precipitated mercuric oxide and rapidly filtered, the filtrate contained 80 to 90 per cent. of the possible amount of hypoiodous acid. Messrs. Orton and Blackman have stated, in a paper read before the Chemical Society, that the solutions obtained from iodine and mercuric oxide contain only a small quantity of hypoiodite, the iodine existing mainly as iodic acid. Mr. Taylor concludes from the description of these experiments that the authors overlooked the extremely unstable nature of hypoiodous acid. They used ordinary powdered iodine, which is not sufficiently finely divided, and they took a great deal too long over their experiments. Using precipitated iodine and performing the experiments as rapidly as possible, Mr. Taylor finds that with from ten to twenty-five times as much iodine in proportion to the water as he formerly used, the solution contains from 44 to 52 per cent. of the possible amount of hypoiodous acid and very little iodic acid.

PARIS.

Academy of Sciences, October 13.—M. Bouquet de la Grye in the chair.—On the laboratory registers of Lavoisier, by M. Berthelot. A *résumé* is given of the second volume of laboratory notes of Lavoisier; the contents are not so valuable as those of the first and third volumes. The most important experiments described are those dealing with the calcination of lead and tin in closed vessels.—On some peculiarities of the theory of shooting stars, by M. O. Callandreau.—A general demonstration of the construction of light rays by curved wave surfaces, by M. J. Boussinesq.—Study of iodine pentafluoride, by M. Henri Moissan (see p. 637).—On the hematozoa in marine fishes, by MM. A. Laveran and F. Mesnil.—Carbonic acid as an agent of choice in experimental parthenogenesis, by M. Yves Delage.—The fourteen large laboratory registers of Lavoisier. The register stated to be lost and which has been recently found, by M. H. Brocard. An account of the discovery in the library of Perpignan of the volume of laboratory notes referred to by M. Berthelot above.—On the reduction of the linear element of a surface to a specified form, by M. M. Servant.—The magnetic and electric deviation of the Becquerel rays, and on the electromagnetic mass of the electrons, by M. W. Kaufmann. The results of the experiments quoted are completely in accord with the theory of M. Max Abraham, and it may be regarded as proved that the mass of the electron is entirely electromagnetic, that is to say, the electron is nothing but an electric charge distributed over a volume or surface of minute dimensions, not exceeding 1 cm. $\times 10^{-13}$.—On a consequence of the kinetic theory of diffusion, by M. J. Thovert. The motion of a diffusing material being considered as proportional to the mean velocity of the molecule, the application of the kinetic theory to substances dissolved in a given solvent leads to the prediction that, at constant temperature, the product MD^2 should be constant, M being the molecular weight and D the constant of diffusion. By a method described in a previous paper, the diffusion constants of about twenty non-electrolytes have been determined in aqueous solution, and it has been found that the theoretical conclusions are fairly well borne out by experiment, the constant MD^2 varying between 55 and 67. The author suggests the practical application of the method for the determination of molecular weights.—The methyl ester of methylanthranilic acid in the vegetable organism, by M. Eugene Charabot. The essential oil from the leaf of *Citrus madurensis*, obtained by distillation with steam, contains about 50 per cent. of methyl methylanthranilate.—On cedar wood essence from *Cedrus Atlantica*, by M. Émilien Grimal. A sesquiterpene, cadinene and a ketone have been isolated from the oil.—On a new reaction of formol, serving for its detection in foods, by MM. Manget and Marion. Use is made of the colour reaction with amido-phenol.—Stimulants and nerve poisons, by M. N. E. Wedensky.—On the nerve centres in the Acephalæ, by M. Louis Boutan.—Excretion in the higher Crustacea, by M. L. Bruntz.—On the composition of some reserve hydrocarbons in the albumen of some palms, by M. E. Liénard. The albumen of the palm contains a small quantity of a reducing sugar, a little cane sugar, several condensed mannanes and a galactane.—On the geological constitution of the neighbourhood of Alexandria, Egypt, by MM. R. Fourtau and D. E. Pachundaki. The rocky bar which forms the Alexandrine coast, and which protects the Nile delta against the sea at high water, belongs to the Quaternary epoch, and rests upon the limestones of the Upper Pliocene.—On the general causes of seismic instability in India, by M. F. de Montessus de Ballore.—On a new method designed to facilitate writing and calculation in the blind, by M. Dussaud.

CONTENTS.