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GEIKIE'S GEOLOGY.

Text-book of Geology. By Sir Archibald Geikie, F.R.S. 4th Edition, revised and enlarged, 2 vols. Pp. xxi +702; ix+705 to 1472. (London: Macmillan and Co., Ltd., 1903.) Price 30*s.* net.

WHEN Sir Charles Lyell found that, owing to the rapid progress of geology, his early treatise must be extended beyond the limits of one handbook, he divided his subject into two parts. In the "Elements" he described the ancient changes of the earth and its inhabitants, as illustrated by geological monuments, and in the "Principles" he treated of the modern changes of the earth and its inhabitants considered as illustrative of geology. In the Elements we have a selection of facts upon which geologic history is founded; in the Principles we have a statement of the laws which have governed those changes based not only on the records of the past, but also and chiefly upon the observation of what is now going on in the present. Thus the Principles, which include that which we arrive at last, is, as its name implies, that which from an educational point of view we take first.

Sir Archibald Geikie has found that, in keeping his admirable text-book up to date, he has accumulated more material than could be conveniently contained in one volume, and has therefore issued it in two; but these are two volumes of one work, in fact the break takes place in the middle of one of his subdivisions of the subject—not inconveniently, however, as the first volume ends with the description of the aqueous deposits, and the second begins with the igneous rocks, both of which are included under structural geology. When, however, we look into the work, we see that its future is suggested not by its separation into two volumes, but by its subdivision into seven books.

The subject of the first book is the earth's place in the solar system, and the effect of the various cosmical forces acting upon it, in producing or modifying the geological condition of its crust. These have to be taken account of in discussing almost any geological question, whether glacial or volcanic phenomena, climatal conditions, the distribution of life, the age of the earth, or even such a question as the lateral erosion of river valleys, which, as some hold, depends largely upon the same influences as those which control the direction of the trade winds and ocean currents. The Garonne and the Volga, for instance, the one running north, the other running south, cling to their right bank, owing, it is suggested, to the rotation of the earth as they run at an ever increasing or decreasing distance from the axis of rotation. Although we must allow that this influence is a *vera causa,* always acting, and tending to deflect such running waters east or west, still, one cannot but feel that the variations in the level of the river beds, the winding of their courses, and the earth movements, which are known to have taken place in recent times over the areas in question, must have been far more important factors in regulating the course of the streams.

In the Second Book we learn about the materials of which the earth is composed, the chemical constituents of the crust, their mode of aggregation into what are known as minerals, and the methods of discrimination and classification of the sedimentary and igneous rocks; of rocks in the building up of which living organisms have played a part, and of rocks which have been altered by mechanical, chemical, or thermal agents so much that it is often difficult to recognise what their original character was. In this book we have glossaries of rock-forming minerals, of rocks of different composition and origin, and of various accessory substances, many of which are of economic value.

The author does not propose to treat specially of economic questions, but no one can understand the distribution and methods of obtaining coal, oil, metals, underground waters, and other products of the earth, without such a knowledge of their origin and mode of occurrence as may be gained from this work.

The Third Book deals with earthquakes and volcanoes, and has to do with the causes of upheaval and subsidence, the effects produced by internal heat, hydrothermal action, pressure and the accompanying chemical and mineralogical changes. These are subjects to which our author has paid special attention—"quorum pars magna fui," he might justly say of them—and for this reason as well as from their own intrinsic importance, we welcome his fuller treatment of them. In the second part of the same book he discusses denudation and its correlative deposition, and all the various forces of air, water, and ice, and of living things, by which they were brought about.

The changes which have taken place in the interior of the earth we should, at first sight, have thought to be one of the last subjects to which experimental research could have been applied; yet we learn that towards the end of the eighteenth century De Saussure set himself to study the possible derivation of rocks, by fusing samples of them, and judging whether, as had been alleged, some had arisen from the melting of others; but Sir James Hall more fully realised how far the processes of nature might be imitated by man, and about a hundred years ago described a series of ingenious experiments, by which he demonstrated the possibility of producing either a vitreous or a stony condition in fused rocks, according to the rate at which they are allowed to cool. Daubrée followed up this kind of experimental geology, and showed not only that various minerals usually found associated with volcanic and metamorphic rocks could be developed in the laboratory in their proper crystalline form, but also that enclosures and structures, analogous to those found in ancient schistose, and altered rocks could be artificially produced.

In Book IV. our author follows up his explanations of the *modus operandi* with an account of the results produced. He now describes the arrangement of the materials of the earth's crust, first of all considering the sedimentary rocks, their bedding and joints, their dip and strike, their cleavage and faults; also the pro-

trusion of solid masses and other phenomena connected with stratigraphical structure.

Here we have only just arrived at the end of the first volume of the present issue. The second volume begins in the middle of Book IV., with a continuation of the description of the manner in which the earth's crust has been built up and modified. This second part, however, refers to the action of internal heat and pressure, that is to say, it deals with rocks of igneous origin, whether superficial or deep-seated, and this leads to the consideration of earth movements, without which we should be unable to examine such rocks at all. Incidentally he here describes the mode of formation of veins and lodes.

Book V. gives a series of very much condensed, but still very useful notes on fossils and their place and use in geological investigations. This might be greatly extended.

Then follows in Book vi. the whole of systematic stratigraphy.

Our author arranges the stratified rocks under fifteen heads, and treats of their general characters, their flora and fauna, and their local development at home and abroad; but this, again, our author could easily develop into at least five volumes, representing the five groups under which the whole of historical geology could be very conveniently arranged.

In the seventh and last book he deals with the geographical features of the earth's surface, as affected by its geological character, and the arrangement of the materials of which it is composed.

There are buried in this text-book an immense number of facts vastly interesting to the general reader, and especially to the traveller who goes about with his eyes open, but without knowledge to follow the processes by which nature brings about the wonderful results observed. For instance, how seldom he realises when he sees the great blocks of travertine, so commonly used for building in Rome, that this *lapis Tiburtinus*, modified by Italian lips into travertino, is not a rock built up by the same kind of sediment as that of which most of the building stones he has seen elsewhere are composed, but that it is carbonate of lime which has been thrown down from chemical solution, and that plants have helped to collect it, while another similar rock, as commonly used elsewhere, has been collected by small animals, particle by particle, out of the sea water in which it was dissolved. Or if he is looking at those marvellous relics of volcanic activity, the geysers, which heap up silica instead of carbonate of lime, he will find that there also a small confervoid alga helps to collect the pasty material which afterwards hardens into flint. These are examples of scientific facts which would not force themselves upon the observation of the ordinary tourist, but which it would greatly add to his enjoyment of travel to know. Or, to take another more abstruse example, the study of the earth's satellite has suggested that the scars and pits upon it are due to the impact of aggregations of matter, and a similar bold hypothesis has been offered in explanation of certain depressions upon the earth. A basin-like hollow among the sandy mounds of Arizona was caused, it was suggested, by the impact of a meteoric body now possibly buried out of sight below, while the basin of the Atlantic, according to others, marks the area from which the material of the moon broke away from its moorings and commenced its long spiral spin round the earth. Such flights of imagination have often given us working hypotheses, which after pruning and shaping have found a place among the explanations of the order of the world. While we welcome all such tentative interpretations of phenomena, we must carefully weigh the evidence adduced, and not too hastily say proven or not proven.

The work is encyclopædic in character and arrangement, and, but that, alas! the question of cost has to be taken into consideration, we should gladly welcome its appearance in a dozen or more goodly volumes, the contents of which would be suggested by its present division into Books, some of which, as we have suggested, might be expanded into more than one volume. Then we might ask for larger type, instead of as now, 800 words to a page, and also for many more of the author's own clever sketches, and more illustrations such as those he has so judiciously selected from other sources.

NEW TEXT-BOOKS OF GEOMETRY.

Practical Plane and Solid Geometry. By I. H. Morris and J. Husband. Pp. viii+254. (London: Longmans, Green and Co., 1903.)

First Stage Practical Plane and Solid Geometry. By G. F. Burn. Pp. viii + 240. (London: W. B. Clive, University Tutorial Press, Ltd., 1903.) Price 2*s*.

Examples in Practical Geometry and Mensuration. By J. W. Marshall, M.A., and C. O. Tuckey, M.A. Pp. xii + 70. (London: George Bell and Sons, 1903.)

Elementary Geometry. Section ii. By Frank R. Barrell, M.A., B.Sc. Pp. viii+169 to 284. (London: Longmans, Green and Co., 1903.) Price 1*s*. 6*d*.

Theoretical Geometry for Beginners. Part ii. By C. H. Allcock. Pp. viii + 123. (London: Macmillan and Co., Ltd., 1903.) Price 1*s*. 6*d*.

Notes on Analytical Geometry. By A. Clement Jones. Pp. iv+172. (Oxford: Clarendon Press, 1903.) Price 6*s*. net.

Elementary Graphs. By W. M. Baker, M.A., and A. A. Bourne, M.A. Pp. iv+34. (London: George Bell and Sons, 1903.) Price 6*d*. net.

TEXT-BOOKS in this country which deal with the practical applications of geometry naturally follow the South Kensington division of the Board of Education, a department of the public service which has always taken a leading part in the spread of this branch of knowledge. The department has two distinct syllabuses, one for the guidance of art classes, the other for science. Both syllabuses have quite recently been revised and considerably extended, and are well abreast of the times. Although the two schemes have parts in common, there is an increasing tendency for them

to develop along divergent lines. Thus for art students one section of geometry to which great attention is paid is that relating to decorative geometrical designs, the study of which requires the drawing of many inscribed and circumscribed figures, patterns, &c. For science students this branch is of comparatively little interest. On the other hand, the geometry of vectors, a subject of first importance in science, has little attraction for the artist. Again, a student of science finds great use for his graphical constructions in the making of numerical computations, and the subject for him is becoming more quantitative in character. It is thus inadvisable to compile a text-book which shall endeavour to meet the wants of both classes of students; the first two books under review are written for science classes, and are adapted to the first stage of the revised South Kensington syllabus in Science Subject I.

The text-book by Messrs. Morris and Husband contains a large number of problems (more than 300) in plane and solid geometry, the solution of each being described in detail. The diagrams are clear and well printed, and are conveniently arranged to face the text. Each chapter closes with a useful collection of exercises. The syllabus is very completely covered as regards the matter, but the method of treatment cannot be said to correspond with its spirit. The student is told everything in minute detail. He is not sufficiently encouraged to think and invent for himself, and it is difficult to see how his interest can be maintained and his mental faculties properly developed. The method employed in problem 123 is obviously incorrect, and will no doubt be altered at the first opportunity.

In the volume by Mr. Burn, it is evident that the author's main interest centres in solid geometry, and he teaches this branch of the subject well, the student being instructed how to make simple models for himself, these being effectively used along with drawing in order to obtain a good grasp of this somewhat difficult subject. Too little attention seems to be given to plane geometry, and the student is not well grounded therein. The treatment of vectors is also meagre, and displays an inadequate conception of the scope and importance of this portion of the subject. Unfortunately some of the diagrams are needlessly small, and are trying to the eyesight.

The remaining five volumes are concerned principally with theoretical geometry. The book by Messrs. Marshall and Tuckey is a collection of nearly 550 examples arranged in groups. "The examples on practical geometry are intended primarily to lead up to geometrical reasoning, and only secondarily to give manual dexterity." Many of the examples are associated with a rider (distinguished by italic type), the truth of which will become evident as the figure is drawn, and which the reader is asked to establish by deductive reasoning. We notice with satisfaction that Euclid's method for the common tangents to two circles is discarded as unpractical. The examples in mensuration might with advantage have been a little more experimental. For instance, it would have been a satisfaction to a student to verify the numerical value of π; and an example might have been inserted asking for the area of a circle, to be obtained by the method of counting squares. The table of four figure logarithms which the authors give will prove very useful. We think that a simple table of functions of angles should also have been inserted and made use of in connection with some of the examples, especially those in mensuration. Teachers will find this large collection of examples very convenient, but its value would be enhanced by a further development on modern lines.

The second instalment of Mr. Barrell's "Elementary Geometry" comprises portions of Euclid ii., iii., iv. and vi., with some additional matter. In few of the recent text-books on the subject are the advantages of the reform in geometrical teaching more conspicuous than in this volume. While adhering to a strictly logical sequence, the author uses his new freedom to very good purpose, illustrating the propositions by experimental work, by well selected concrete examples, and by the employment of arithmetic, algebra and trigonometry. The introduction of the sine, cosine and tangent in the admirable chapter on ratio and proportion, and the subsequent judicious use of these functions, is a very good feature. The book deserves to be extensively used, and the appearance of section iii. of the work, which is in preparation, will be awaited with interest.

The first part of Mr. Allcock's geometry (corresponding with Euclid i.) was published in the early part of the year. The work is now continued, and the present part contains the equivalent of Euclid iii., 1–34, and iv., 1–9, with some additional propositions, such as the properties of the nine-point circle, and some practical applications and exercises. The title of the book correctly describes its contents and scope, comparatively little attention being given to quantitative and experimental graphical work. For those who do not wish to be tied to Euclid's sequence, and yet who desire to retain a strictly deductive system, the book will be found eminently suited. It is well written and beautifully printed; it contains a large number of easy deductive exercises distributed throughout its pages; and at the end of the volume there is a collection of practical exercises requiring numerical answers, which are given.

Mr. Clement Jones's text-book is intended for students who, having already taken an ordinary course in elementary analytical conics, wish to continue their studies and to obtain a good working knowledge of the methods of analytic research. In establishing the numerous properties of conics, the elementary theory of equations is applied in a systematic and thorough manner, in connection with which extended use is made of the single variable in the equations to the lines and curves. In a final chapter an account is given of cubic curves, the same powerful and illuminating method being employed. At the end of the volume the student will find a very useful collection of more than 200 examples, mostly taken from university examination papers, and the answers to these, with hints for solution, are appended.

The use of squared paper by schoolboys is becoming universal, and Messrs. Baker and Bourne have done

well to issue separately the chapter on graphs from their recent text-book of elementary geometry. The subject is well introduced, and the young readers are led on by easy stages and well selected examples. In connection with the plotting of sines, cosines and tangents, a short table of these functions, from which the pupils could take out their own values, would have been very instructive if it could have been provided. It seems a pity that no mention is anywhere made of the slope of a curve; comparatively few persons have yet recognised that the practice of graphing affords a valuable opportunity of helping to put into more tangible shape the idea of a *rate* which is certainly possessed in a greater or less degree even by the very young.

A CAMBRIDGE TEXT-BOOK OF PHYSICS.

Electricity and Magnetism. By R. T. Glazebrook, M.A., F.R.S. Pp. viii+440; diagrams. (Cambridge: University Press, 1903.) Price 7*s.* 6*d.*

THE present work represents a first-year course of Dr. Glazebrook's lectures in electricity and magnetism when at Cambridge. It forms one member of a series of which "Mechanics," "Heat," and "Light" have already appeared. The issue of these manuals was undertaken in response to a request that his lectures might be printed for the use, primarily, of the students attending the practical classes at Cambridge. Thus Dr. Glazebrook rather apologetically explains the publication of another book dealing with elementary electricity.

It is true that the number of elementary text-books is legion, and a man may well hesitate before adding to their number. Yet we think that there is still room, and that if a book of superlative value appears it will not fail to find a welcome.

In attempting to estimate whether the present volume is a noteworthy addition to elementary literature, let us in the first place say that it has undoubtedly many excellences. The method followed throughout is that with which we are already familiar in the other members of the series.

This method consists in mingling the theoretic and experimental sides of the subject, so that in no place is a student very far from the experimental point of view. Many of the experiments are intended apparently to be done only by the lecturer, but fifty-seven are specially described as instructions to a student. This double method involves considerable repetition, as the same statement which is made in the general text often appears again in the description of the experiment. No doubt, however, Dr. Glazebrook has found by experience that a junior student can hardly be told a thing too often, and repetition certainly does not err on the side of indefiniteness. Again, there is a considerable amount of repetition in the text itself. A general induction is made from some experiment, and this leads to a definition. The definition in many cases consists only of a repetition of the previous statements in a rather more formal shape. This, again, may be an advantage from the student's point of view, but it must be admitted that it tends to make the book rather slow. We cannot imagine anyone (except a reviewer) taking it up and reading until the small hours before putting it down. However, it is essentially a class book, and the student may acquire an enthusiasm for science from his teacher, who will amplify the somewhat categorically imparted information, hence the lack of more life is not so important.

The statements made are usually clear and logical. In some cases we are not sure of the logic. Thus, take the following sentence:—

"We have already seen that the electrification of a conductor may be the manner in which we recognise a state of stress set up in the dielectric round the conductor" (p. 40).

Should not the logic of this sentence be inverted? Is it not the stress in the medium which is directly investigated, and from which the state of electrification is inferred?

Again, in stating the law of electric force, it is asserted to follow

"as a result of the experiments, that when two similarly charged bodies are at a distance apart which is great compared with their dimensions, there is a repulsion between them which is proportional to the product of their charges," &c. (p. 44).

Is it not more logical to say that we measure the electric charges of bodies as being proportional to the mechanical forces which arise in consequence of them?

Again, the "joule" is *defined* in terms of electrical quantities. This reversal of the true logical order will mislead the student, who will fail to see that it is a purely mechanical quantity.

These may seem merely finicking criticisms, but those of us who come largely into contact with students know how difficult it is to eradicate illogical notions acquired during their early training.

In some cases the information given is not sufficient. Thus, while considerable use is made of lines of force, we are not told how they are drawn so as to represent the *intensity* of the field.

Again, the lines in the diagrams on pp. 36, 37, are drawn on a completely different system from those on pp 38, 39, and there is no hint given of this. Of course, to the ordinary student this does not matter—he is accustomed to consider physics an esoteric science; but how confusing to the real student who tries to make out what the diagrams mean.

Again, *tubes* of force suddenly appear (without introduction) on p. 186 instead of lines.

On p. 377 it is stated that

"the total E.M.F. round the secondary is proportional to the total change in the number of lines of induction linked with it."

The whole chapter on electromagnetic induction, indeed, deals only with the total E.M.F. It is nowhere defined—the student will think it identical with electromotive force.

The figures are very good and instructive. Fig. 77, which shows the screening action of an iron ring, would be improved if the *refraction* of the lines at the surface of the iron were correctly represented. Again, the lines do not crowd between the cake and cover

of an electrophorus (Fig. 39) until the cover has been earthed.

In the further editions which will certainly be called for we should like to see a proof of the equation $R=4\pi\sigma$, although Dr. Glazebrook (p. 63) considers the proof to be beyond the limits of the book. It is so easily done for a sphere, and the case of a plane is obtained at once by expanding the sphere of infinity. It will also be an advantage if graphical representations of the forces of charges and currents are given.

The concluding chapters deal with technical applications (there is no mention of electric lighting), with electric waves, and with the electronic theory of discharge.

The volume is very well printed, and is remarkably free from printer's errors. But in one particular we must speak with great emphasis—the punctuation requires most thorough revision. Many sentences are unintelligible on first reading, although the wording is quite correct. We give the shortest illustration of this fault. The time "will also depend on the restoring couple being less when this is big, than when it is small."

PROF. JOHANNSEN ON HEREDITY.

Ueber Erblichkeit in Populationen und in reinen Linien. Ein Beitrag zur Beleuchtung schwebender Selektionsfragen. By W. Johannsen. Pp. 68. (Jena: G. Fischer, 1903.)

PROF. JOHANNSEN has set himself a hard task, namely, the reconciliation of the views of Prof. de Vries on mutations with those of the biometric school, particularly with the Galtonian theory of regression. We say a hard task, because to perform the task of reconciliation requires, on the one hand, an intimate knowledge of the mathematical theory of statistics, and on the other a power of clearly defining the exact biological points which are at issue. It is not an easy matter to distinguish between a so-called mutation and an extremely improbable variation; indeed, the utmost caution is needed when we remember that in every case of continuous variation it has been shown theoretically that the extreme variations in populations of even many thousands must be separated by wide intervals, the wider the more extreme the variations.[1] Clearly it is practically impossible to distinguish straight off between a "mutation" and an extreme variation in the biometric sense. Both parties would probably agree that only observation of the results of propagating from the individual thus classified could serve as a criterion between the two views.

According to the biometricians, the type of the variation would regress in the offspring, either to the population mean if a "pure line" did not exist, or to the "type of the pure line" if such did exist; in the latter case a change in type from that of the "pure line" could then be produced by selective breeding within the line for a generation or two. According to de Vries, no further change could take place until a new "mutation" appears. Unfortunately, de Vries's own experiments are very far from conclusive in this respect. Thus in his experiments on clover he was not content with the discovery of a mutation, but went on stringently *selecting* year after year, in exactly the manner in which the biometrician would suggest that a "stock" should be formed from extreme variations. According to the biometrician, two or three generations of selection will form a stock which, while very variable about its type, will yet breed true, or with but small regression.

Prof. Johannsen seems to assume that this result of biometric theory (1898) is the view only of de Vries, who published his conception of the line "as perfectly constant and yet highly variable" three years later. Thus the criterion between the "Biometriker," as Johannsen calls them, and the "Mutators," as we may perhaps call their opponents, cannot be made to turn on the breeding true of "pure lines" or on the variability of such lines about their type. It can only turn on whether, within the "pure line," there exists regression and progression when we breed from variants which are not so extreme as to be at once classed by the "Mutators" as new mutations. Prof. Johannsen had a good opportunity for dealing with this problem in his experimental observations on the bean *Phaseolus vulgaris*, but he has unfortunately not provided the exact data on which it could be answered. He has shown that the population of bean *seeds*, as distinguished from bean *plants*, exhibits Galtonian regression; he may, more doubtfully, be held to have shown that "pure lines" breed true. But this is no reconciliation of the biometric and mutational theories, for both parties accept the breeding true of pure lines.

Unfortunately Prof. Johannsen seems to think that a single bean seed may be taken as typical of a plant, and thus the whole inner meaning of allowance for homotyposis escapes him. If his view—that pure lines show no internal regression—were correct, then the correlation between mother and daughter plants ought to be perfect, for either of them represents the "pure line," and that is "völlig konstant." Unfortunately Prof. Johannsen has not determined this correlation, but from his published material it can be indirectly worked out for the case of the mean weight of the beans produced by nineteen mother plants and their daughter plants. The correlation thus obtained is 0.59 ± 0.13; this might be equal to the imperfect correlation of the biometricians, who find the value for man, horse and dog to be 0.5, but it is very far from the perfect correlation needed by those who assert that there is no regression within the pure line to its own type. Prof. Johannsen's own investigation of this problem (pp. 36–37) is quite fallacious; and this is owing, we think, to inexperience in the use of statistical methods. From this standpoint we should like to protest against any such crude process of determining goodness of fit as that of placing a normal curve down on seven or eight blocks forming a "histogram," and judging the look of the fit. No such test is valid, and, further, he has not yet shown that the normal curve of errors itself is suited to describe the phenomena referred to.

We hope Prof. Johannsen will continue his experi-

[1] Francis Galton's Difference Problem (*Biometrika*, vol. i. p. 390).

ments, but at the same time in this, as in so many other cases, we hold that statistical methods cannot be safely used without proper training. Experiments of a most laborious character may be rendered nugatory because the observer has not started with a clear conception of what statistical processes he is going to employ to deduce his results, nor what observations are needful if any conclusions at all are to be reached by legitimate numerical arguments. The book shows the increasing interest in the problems of inheritance and in biometric methods; it is characterised throughout by a courtesy of tone which is very pleasing when contrasted with some recent controversial papers on heredity; but it fails, and fails badly, to prove any definite point, because the author has not clearly stated his problem, and had he done so has really not the knowledge needful to deal effectively with statistical data.

OUR BOOK SHELF.

Die europäischen Laubmoose. By George Roth. Lieferung i. Band i. Pp. 128. (Leipzig: Wilhelm Engelmann, 1903.)

THE second enlarged edition of Schimper's "Synopsis muscorum Europæorum" was published in 1876, and a list of European mosses was given by the same bryologist in "Revue bryologique" seven years later. Since that time, in this country there have appeared Hobkirk's synopsis, Braithwaite's "Moss-flora," and Dixon's handbook. In other countries there has been the same advance in bryological records, to mention only Limpricht's compilation for Germany, Austria, and Switzerland, and Husnot's "Muscologia gallica," so that the time is ripe for a new European synopsis. The work undertaken by Dr. Roth is, on the one hand, rendered easier by the existence of these authentic catalogues, but meantime the number of recorded species has increased, so that whereas Schimper enumerates 900, the author estimates European species, exclusive of Sphagna, at 1300; of these about 600 occur in Britain.

The greater portion of this, the first part, is given up to a general introduction, and only the last few pages are concerned with the enumeration of genera and species. The introduction is well written, and the author has throughout emphasised the various characters which are of immediate importance for identification and classification. There is an original chapter on the part which mosses play in the economy of nature, and some account of their distribution. The system of classification adopted by the author is nearly identical with that of Schimper and Limpricht, the critical features being the separation of Archidium as a special order, and the division of the Bryineæ into cleistocarpous and stegocarpous groups; British bryologists favour Lindberg's arrangement, in which the cleistocarpous mosses are split up amongst the other natural orders.

In the essential systematic part of the book there are only a few descriptions from which to form an opinion. The author leads off with the Andreæaceæ, as the Sphagnaceæ will not be included, and he makes fifteen species for Andreæa; of these several are only accorded the rank of varieties by other authorities, *e.g.* of the fifteen, nine have been found in Britain, and yet Dixon only allows at the most five species. The various countries from which the species have been recorded should, we think, be definitely stated. Another very desirable, indeed necessary, addition is the provision of tables to determine genera, and a separate species-key to each genus. The book is liberally illustrated, but the plates are far from pleasing, and the areolation of the leaves is very doubtfully shown owing to the small scale adopted for the drawings. There are obvious advantages in using a general synopsis rather than, or in addition to, the flora of a single country, so that the book is a very desirable one, but it would be made more useful by the insertion of analytical keys and critical notes dealing with the more doubtful species. The book is to be issued in eight parts at a cost of about three pounds.

Mechanics, Molecular Physics and Heat. By Robert Andrews Millikan, Ph.D. Pp. 242; diagrams. (Boston and London: Ginn and Co., 1903.) Price 7*s.*

THIS book represents the first portion of a college course in general physics, in which the primary object has been to establish an immediate and vital connection between theory and experiment. It has, therefore, been made neither a laboratory manual, in the ordinary sense of the term, nor yet a simple class-room text. Each section is introduced by a theoretic statement, and is followed by instructions with regard to an experiment to be performed. As it is only a twelve weeks' course which is represented, the experiments have had to be selected out of the large number of possible ones, and in making this selection the author has aimed at having one, and only one, experiment in illustration of each principle.

For example, there is but one general principle involved in the method of mixtures, whether it be applied to the determination of the specific heat of a solid or of a liquid, the latent heat of fusion or of vaporisation; hence only one laboratory exercise is provided in illustration of the method. This extreme pruning may sometimes be necessary in an introductory course, and where circumstances render it necessary the plan of the author is no doubt excellent. But we feel sure that such an abridgment is not to be desired. A student learns so much in finding out the variations in a method which are necessary to apply it effectively to different purposes that every opportunity for the discovery ought to be afforded.

The description of the selected experiments is excellently, if somewhat briefly, made. About half the book is devoted to mechanics, which in England is usually taken in a separate course. Each chapter is concluded with a few problems having considerable merit.

We have only to suggest that in the discussion of rotation it should be clearly brought out that the moment of the forces *must* be taken either with regard to the centre of mass or to an axis fixed in space, and further that the moment of inertia is not necessarily the same in the two cases.

Ostwald's Klassiker der exakten Wissenschaften. (Leipzig: Wilhelm Engelmann; London: Williams and Norgate, 1903.)

SEVERAL additions to Prof. Ostwald's important series of reprints of classical papers lie before us. We have space to do little more than mention the titles of the individual volumes, but, in general, we cannot forbear expressing pleasure at the increased facilities they afford for a student to become familiar with original papers connected with the exact sciences. Of course, to the English student, translations into English would be more acceptable. But, given a sufficient knowledge of German, the handiness of these volumes and the valuable annotations of the respective editors are sure to prove a great attraction.

The following are brief particulars:—

No. 135:—"Theorie der Gestalt von Flussigkeiten

im Zustand des Gleichgewichts." Gauss. Translated by R. H. Weber. Edited by H. Weber. (Pp. 73, price 1.20 marks.)

No. 138.—"Über die Bewegung der Körper durch den Stoss. Uber die Centrifugalkraft." C. Huygens. Edited by F. Hausdorff. (Pp. 79, price 1.40 marks.)

No. 20.—"Abhandlung über das Licht." C. Huygens. Second Edition. Revised by A. von Oettingen. This is a translation of the famous essay in which the wave theory of light was developed and the peculiar refraction of Iceland spar was investigated. (Pp. 115, price 2.00 marks.)

No. 134.—"Experimental-Untersuchungen über Electricität." Faraday. Edited by von Oettingen. Sixteenth and seventeenth series, in which the source of the E.M.F. of a voltaic cell is investigated. (Pp. 103, price 1.60 marks.)

No. 136.—Ditto. Eighteenth and nineteenth series, describing his investigations on the development of electricity by the friction of water and vapour in other bodies, and on the relations of magnetism and light. (Pp. 58, price 1.20 marks.)

No. 21.—"Über die Wanderungen der Ionen während der Elektrolyse." Hittorf. First Part. Edited by Ostwald. Second Edition. (Pp. 115, price 1.60 marks.)

No. 137.—"Abhandlungen zur Thermodynamik chemischer Vorgänge" (1869–1881). Horstmann. Edited by van 't Hoff. (Pp. 72, price 1.20 marks.)

No. 139.—"Thermodynamische Abhandlungen über Moleculartheorie und chemische Gleichgewichte" (1867–1872). C. M. Guldberg. Translated and edited by R. Abegg. (Pp. 85, price 1.50 marks.)

The last three numbers represent treatises which are familiar by quotation to all students of physical chemistry, and ought to be welcomed in this new form.

Principii di Stereodinamica. By Gian Antonio Maggi, Professor at Pisa. Pp. 264. (Milan: Ulrico Hoepli, 1903.)

STARTING with the formulæ connecting the coordinates of a particle of a rigid body referred to axes fixed in space with its coordinates referred to axes fixed in the body, the equations of motion of a rigid body moving in three dimensions are deduced from D'Alembert's theorem. The applications include the problems of motion under no forces, in which the equations are integrated by elliptic functions, the simple and compound pendulum, motion of a billiard ball, &c., and Lagrange's equations are also treated in this part. The second part deals with Hamilton's principle in its various forms, and the third with Jacobi's theorem. The work differs in many respects from the conventional English text-books, in which special attention is given to the properties of moments of inertia and numerical examples rather than to rigorous deductions of the fundamental equations. Those whose lot it is to lecture on "three dimensional rigid" will find a study of this book very useful and suggestive. G. H. B.

The Fields of France. Little Essays in Descriptive Sociology. By Madame Mary Duclaux (A. Mary F. Robinson). Pp. vii + 318. (London: Chapman and Hall, Ltd., 1903.) Price 5*s.* net.

THIS little book reveals the writer's love for rural France, and her anxiety "to set down chiefly the things I have seen for myself, or which have come under my own knowledge" (p. 13), is reflected in the reality of the descriptions and in their sustained interest. Though there is little of an exciting character in the pages, readers who value word pictures of the habits and customs of country folk will find pleasure in this book.

LETTERS TO THE EDITOR.

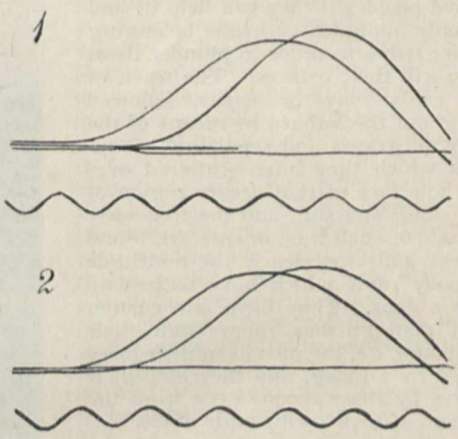
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Velocity of a Nervous Impulse.

SIR W. GOWERS's dilemma (p. 105) is of the library rather than of the laboratory, and I should hardly care to appeal to differing book-data by different observers in evidence of an acceleration of nervous processes during the last fifteen years, either in the same or in different individuals.

I happen to possess records taken on myself in 1882 and in 1903, as well as upon my son, *aet.* fifteen, in May, 1903. In all three cases the velocity comes out at about 50 metres per second, as I read the records, but can easily be taken as indicating 60 metres if the rise of each curve from the base line is spotted a little differently. It is, in fact, advisable to examine the original data very closely before quoting velocities deduced from them, since very small differences in measurement along the abscissa multiply out to large differences of velocity expressed in metres per second.

Thus in the instances enclosed, taken from my son last May in an interregnum from Greek roots, the times, as I read them, are 0·0063 and 0·0053 sec., and the velocities 51·5 and 61·75 metres per second.



May 3, 1903.—W. W. Waller, *aet.* 15; nerve-transmission velocity; excitation above clavicle and at bend of elbow; distance = 0·325 metre. Time diff. 1, 0·0063 sec.; 2, 0·0053 sec. Velocity 1, 53 metres per sec. 2, 62 metres per sec.

The more carefully the records are taken and read the less inaccurately do the velocities come out. I think that Dr. Alcock's estimate of 66 metres per second is a somewhat closer approximation to the truth than my estimate of 50 metres, and *a fortiori* than the still lower estimate of 33·9 metres, which is that originally made by Helmholtz and Baxt in 1867.

A. D. WALLER.

A Useful Empirical Formula.

THE very neat construction given by Prof. Perry in NATURE, December 3, p. 102, leads at once to the equation

$$\frac{\Delta y}{y-a} = \frac{\tan\beta}{\tan\alpha}\frac{\Delta x}{x};$$

and the assumed equation $y-a=bx^n$ gives $\frac{dy}{y-a} = n\frac{dx}{x}$.

Hence, approximately, $n=\frac{\tan\beta}{\tan\alpha}$.

Why does Prof. Perry prefer to write

$$n=\frac{\log(1+\tan\beta)}{\log(1+\tan\alpha)},$$

which is less simple for computation?

11 Leopold Road, Ealing. J. D. EVERETT.

THE MASKED TAWAREKS.[1]

THE Tawareks, in common with other African tribes which live in the northern half of Africa, have long been an object of curiosity and interest to European scholars and travellers, but in spite of all the researches which have been made into the history of their origin and language, many problems concerning them remain unsolved to the present time. One thing about them is certain, which is that they have made their name to become a real terror among the peoples who live on the borders of their country, and although they inhabit a region which is estimated by Mr. Harding King to be as large as Russia, and are, indeed, a nation which will have to be reckoned with one day by civilised nations, no systematic attempt has been made to collect facts about and statistics of their country and its resources.

There are many theories about the origin of the Tawareks, but it is not easy to pin one's faith to any of them absolutely. They belong undoubtedly to the Berber race, and live in the wild places of the Sahara, *i.e.* the great "rocky" region which lies to the south of Algeria; they never come near civilised peoples if they can help it, and they only approach caravans belonging to other tribes in order to plunder them and to kill their owners. The track of their raids may be easily followed throughout the Sahara by means of the groups of graves and sepulchral monuments which they have scattered over the whole face of that dreary region of rock, sand, and sun, and the frequency with which such monuments are found suggests only too clearly the multitude of bloody raids which have to be laid at their door. They have one custom which distinguishes them from their neighbours, *i.e.* the men keep their faces covered by a mask, and they hide their features by these means even from the members of their own family circle.

To interview members of the Tawarek tribe and to take photographs of their faces were the chief objects which Mr. Harding King had in view when he made his journey of about six hundred miles into their country, and the volume before us, which gives a full account of his travels, is extremely interesting reading. We need not here refer to the earlier part of the book, which describes the preparations he made for his journey, for they are familiar to everyone who has tramped the desert in any part of the East, especially in northern Africa and the Sûdân, and we therefore pass on to the latter half of the narrative. The principal places which Mr. Harding King passed on his way were Saada, Bir Jeffir, Shegga, Mraier, Sidi Amran, Tougourt, Hassi, Mamar, and his travels in a southerly direction ended at Wargla; on his way back he struck off to the east at Tougourt, and, having visited Gomar El-Wad and Edemeetha, he turned to the north-west and directed his steps to Shegga, where he joined the road on which he had set out from Biskra.

[1] "A Search for the Masked Tawareks." By W. J. Harding King. Pp. viii+334; with forty-one illustrations and a map. (London: Smith, Elder and Co., 1903.) Price 12*s.* 6*d.*

Tougourt, though a most interesting place to see and examine for a short time, is not a healthy one to live in, and no one will blame a traveller for leaving it as soon as possible; it is an important market town, and possesses a mosque, of the interior of which Mr. Harding King gives an excellent view. Wargla, which marks the limit of our traveller's journey, was, and still is, a town of importance, but since the slave trade has been suppressed, and the large trading caravans from the south now dispose of their wares in Morocco and Tripoli, it has lost much of its wealth and position. The streets of Wargla are open to the sky, and the houses are well built and usually fairly well kept. There is a French fort here, in one of the walls of which is a monument to the brave men who fell in the luckless expedition of Colonel Flatters into the Sahara. The Tawareks were, of course, at the bottom of the mischief, but they were no doubt helped by the Senussi, who will, if we mistake not, give trouble in northern Africa when they find the fitting opportunity. The founder of the Senussi, Sayyid Muḥammad bin 'Ali es-Senussi, was born about 1808 at Mostaganem and died in 1859, and at the present moment his followers form one of the most powerful religious and political confederacies in northern Africa; had they joined the late Mahdi at Khartûm and supported his rebellion with troops, the result of the British expedition would have been very different.

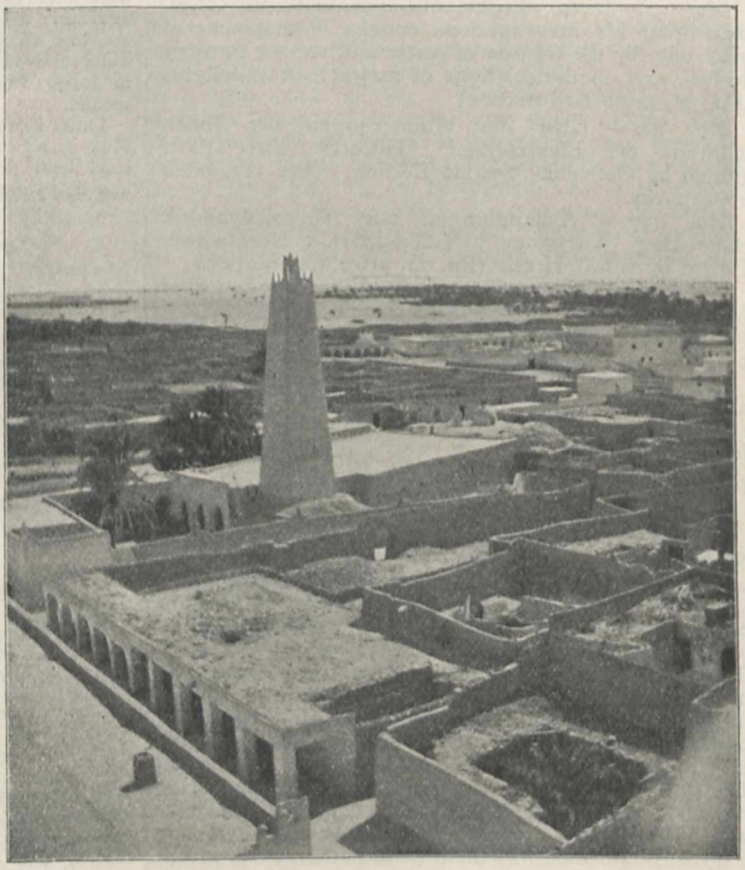


FIG. 1.—Wargla. (From "A Search for the Masked Tawareks.")

On his return journey Mr. Harding King heard with delight that about half a dozen tents of the Tawareks were pitched near Edemeetha, for if he could but manage to get their owners to receive him

and to unveil their faces, the object of his travels would be attained. As soon as possible he set out for the Tawarek tents, and he was fortunate enough not only to be received, but to be invited to take snuff with them. He found that "they were all filthily dirty," for no true Tawarek ever washes. Such ablutions as are necessary for religious purposes are performed with sand or stone; occasionally, with the view of improving his appearance, he rubs himself with indigo. Mr. Harding King found that his hosts all had "thick, purring voices," a shifty manner, and large, lustrous, furtive eyes. By and by some of them lifted their "lithams," and so exposed the upper part of their faces, and he saw that some were white skinned, some very dark, and "their aquiline noses showed that no trace of a negro stain was present in their blood."

FIG. 2.—A Tawarek Noble. (From "A Search for the Masked Tawareks.")

After a little time he was allowed to wander round their camp, and eventually succeeded in obtaining two photographs of a group of his hosts. A day or two later Mr. Harding King paid a second visit to the Tawareks, and good fortune enabled him to photograph a number of women in their tents; he found their hands small and neat, with long tapering fingers, their arms "the prettiest imaginable," their wrists "beautifully rounded," &c.; finally, the young Tawarek who was outside the tent removed his veil, and our traveller was rewarded by being allowed to take the photograph of which an excellent reproduction faces p. 315.

In a short appendix Mr. Harding King repeats a number of usually accepted statements about the Tawarek alphabet, but, naturally, contributes few new or startling facts. The Tawareks call their alphabet "Tifinagh," and they derived it from the Berbers; it may be descended from the old Libyan, but it is unlikely to be of any very great antiquity, and if it has any very close affinity with the Libyan characters on the Tugga Stone, which was set up by Atabân, the son of Yaphmatath, and which is now in the British Museum, it is not very much older, probably, than B.C. 400. Mr Harding King's narrative is very readable and modest, and is well illustrated by many good reproductions of photographs; it cannot be regarded as a scientific exposition of Tawarek lore, but it contains a great deal of knowledge collected at first hand by one who has no "axe to grind," and is therefore of value.

SIERRA LEONE.[1]

THE major portion of this work is devoted to a description of the native rising in the Sierra Leone Protectorate in 1898. Many examples are given of the hideous tortures with which the natives murdered those natives and European women and children who fell into their hands. But only those who have heard from actual word of mouth of those who had been through the insurrection can fully realise the hellish cruelty of the native. These chapters should be read by those who forget or do not know of what diabolical acts the native is capable. They should be remembered by those who nowadays urge us to "take the native with us" in our reforms. Justice to the native the Englishman will always measure out, but it will be long before the native can be treated as our social, intellectual, or moral equal. While we must not forget these terrible traits in the native character, we may yet do full justice to his many admirable points, and Captain Wallis's tribute to the men of the native frontier force who remained loyal throughout the rising is nobly deserved. It is well, too, that a book of this kind should have been written, recording, as it does, individual acts of bravery and heroic defences under the terrible conditions of the West African climate.

The portion of the book that will perhaps most interest the general reader will be the account of the secret societies, "the Alligator," "the Leopard," and others still, as Captain Wallis admits, existing, but yet much curtailed in their devilish operations. So much is here recorded of them that it would appear certain that the whole origin, meaning, and ramifications of these societies could be unravelled by a careful investigator with time and money at his disposal. "Sāss stick," the *mwavi* of British Central Africa, is still used in the protectorate, and we well remember the long journey made by us into the bush in search of the tree, which we found almost completely denuded of bark, showing that it was much in use. As the author points out, the subject of native medicine is still neglected, and although there are botanical gardens at Freetown and Songo, Aburi (Gold Coast) and at Lagos, we should be surprised to learn that any contribution to this subject ever came out of them.

[1] "The Advance of Our West African Empire." By C. Braithwaite Wallis. Pp. xv+318. (London: Fisher Unwin, 1903.) Price 21*s*.

In a chapter devoted to "our commercial policy," the native arts are considered, such as pottery and the weaving of cloths. The production of these should, in our opinion, receive all encouragement and careful direction before the trading companies have "improved" them out of existence with their cheap Manchester substitutes. Very wise, too, is Captain Wallis's advice that native customs and traditions should be cherished, except in so far as they manifestly clash with the higher ideals of Christian morality. The question of health can hardly be avoided in a book on West Africa, and the author is to be congratulated on having grasped the main facts of the mosquito malarial cycle. He is aware of the danger of camping in a native village—the almost invariable practice—for, broadly speaking, it is here only that the malarial mosquito is dangerous, because it has been infected with parasites by the native children, who form, so to speak, the great central depôts of malarial parasites in Africa. In a word, the first law of health in West

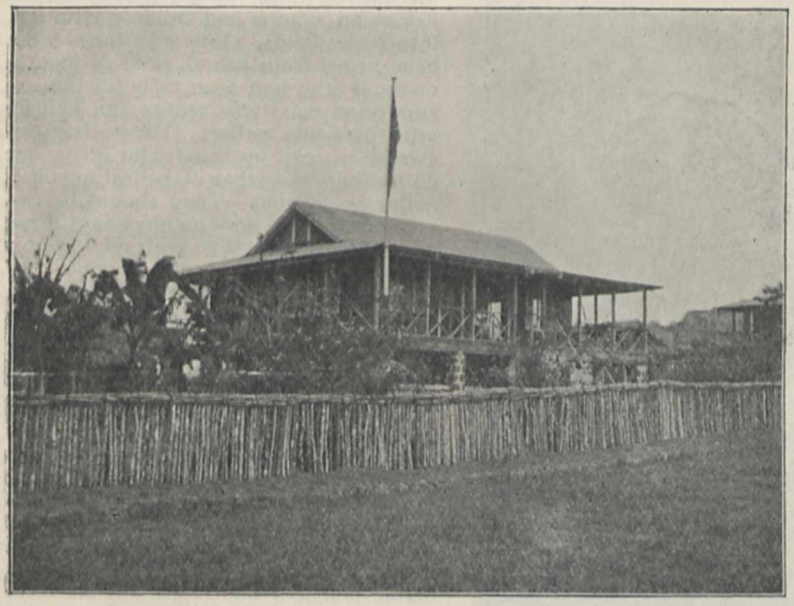


FIG. 1.—Government House, Bandajuma. (From "The Advance of Our West African Empire.")

Africa is efficient protection from this constant source of malarial fever, and a bungalow well isolated from native huts would mean many a European life saved. Our illustration of Government House, Bandajuma, on the contrary, shows things as they should not be. Those "deadly" huts (seen in the right-hand corner) mean constant danger to the European commissioner.

The book is fully illustrated, but we think many of the illustrations might have been chosen with greater care. They give but little idea of the characteristic scenery of the country. Thus we sought in vain for the magnificent cotton trees or the beautiful unmatched "lines" of the mangrove tree. We think, too, the title is too comprehensive for the nature of the book. But the author deserves our thanks for having given us a straightforward account of the rebellion and some very interesting chapters on native customs. We have read the book with much pleasure, and in our own case with an added pleasure from familiarity with many of the scenes and faces represented in the illustrations. J. W. W. S.

THE IONISATION OF ATMOSPHERIC AIR.

MESSRS. ELSTER AND GEITEL have published an important paper in the *Physikalische Zeitschrift* (No. 9, pp. 522–530), "Ueber die radioaktive Emanation in der atmosphärischen Luft." They find that the abnormal conducting power of the stagnant air of cellars and caves, and the amount of induced radio-activity which can be obtained from such air upon a negatively charged rod suspended in it vary greatly in different regions. In some places such air is no more active than ordinary atmospheric air. Air sucked through a pipe of which one end is buried in the ground is generally active, like the air of most cellars and caves; tests of the activity of samples of such ground-air from different localities showed great variations, some being no more active than ordinary air. The activity of ground-air falls off at a rate comparable with the rate of decay of the radium emanation. If a portion of the soil of a region in which the ground-air is radio-active is isolated, it gives to a volume of air in contact with it abnormal conductivity which reaches its maximum in a few days. The soil retains this power for many months at least. The phenomena are all most readily explained by supposing that substances, which have the power of producing a radio-active emanation like that of radium, are distributed in varying amount among the materials composing the soils of different regions. In the latter part of the paper is an account of some interesting observations on the dependence of the radio-activity of atmospheric air upon meteorological conditions. The increase of the activity of the air which generally accompanies a fall of the barometer is attributed to the escape of ground-air into the atmosphere.

Herr Himstedt repeated and confirmed some of Messrs. Elster and Geitel's experiments upon ground-air (*Berichte* der naturforschenden Gesellschaft zu Freiburg, vol. xiii. p. 101). In the course of this work he found that air passed through a water air-pump acquires considerable conducting power, which persists (even when the air is dried and filtered after passing through the pump) for some days. He appears to have been unaware of the previous discovery of this phenomenon by Prof. J. J. Thomson. Himstedt gets identical results from distilled water, rain-water, and tap-water, whereas Thomson found distilled water and rain-water comparatively ineffective, the action being strongest with certain waters from deep wells, and being attributed by him to a radio-active substance contained in such water. Himstedt found, as Prof. Thomson had previously shown, that the activity of the air is not removed by an electric field; he proved, however, that it can be removed by passing through a tube cooled by liquid air. He believes that water brought into intimate contact with a gas exerts an ionising action upon it.

In the *Actes* de la Société helvetique des Sciences naturelles (85me session 1902 à Genève), Prof. H. Ebert gives an account of the progress which has been made towards an explanation of the phenomena of atmospheric electricity on the "Elektronentheorie." He mentions some of the results of measurements,

made with his aspiration apparatus and by other methods, of the number of positive and negative ions present in atmospheric air under different conditions. The variations in the richness in ions of the air at different heights (studied by means of balloon observations) and the excess of positive ions in the air carried down by the Föhn are of special interest. The electrical phenomena accompanying precipitation are explained by the difference in the efficiency as condensation nuclei of the positive and negative ions. An attempt is made to treat this part of the subject quantitatively. The maintenance of the ordinary fine weather electric field is put down to the difference between the positive and negative ionic velocities.

Prof. J. A. McClelland has described in the Royal Dublin Society's *Transactions* (November) experiments upon ionisation in atmospheric air. These experiments are introductory to a study of the number of ions in the free air of the atmosphere under varying meteorological conditions. Like Prof. Ebert, he has obtained evidence from the results of preliminary experiments of a larger number of ions per c.c. of free atmospheric air than was shown by Prof. Rutherford's measurements in Canada. The latter found on some occasions no more ions per c.c. of the free air than are generally produced *per second* in each c.c. in air in closed vessels, whereas Prof. Ebert's results are more nearly what we should expect if the rate of production of ions in the free air were the same as in a closed vessel.

MEDICAL REPORT OF THE LOCAL GOVERNMENT BOARD.[1]

THE annual report issued by the Medical Department of the Local Government Board always contains matter of interest. The first half of the volume comprises an excellent summary of the contents by Dr. Power, the able head of the department, the vaccination and other statistics, and the reports of inquiries into the sanitary administration of various districts, of outbreaks of epidemic disease, and on the distribution of plague and cholera. There is a mass of information in these pages of the greatest value to the specialist.

But to the readers of NATURE the reports of the auxiliary scientific investigations carried out for the Board will prove of most interest. Dr. Klein is responsible for four of these:—(1) On the nature of the Haffkine plague prophylactic; (2) on the phenomenon of agglutination; (3) on the micro-pathology of hæmorrhagic small-pox; and (4) on the differentiation of the *Bacillus enteritidis sporogenes, B. butyricus,* and *B. cadaveris sporogenes* from one another. The cultural and other differences between these microbes are detailed, and may prove very useful in the bacteriological examination of potable waters. The *Bacillus aërogenes capsulatus* is here alluded to, but that is all. This organism is closely allied to, if not identical with, the *B. enteritidis sporogenes,* and it is hardly right that the work of the Americans in this connection should be dismissed in so summary a fashion.

Dr. Sidney Martin has once more taken up the investigation of the chemical pathology of infective diseases, dealing in this paper with the products of the *B. dysenteriae.* Experiments were performed in order to ascertain whether any toxic substance is produced when the bacillus is grown in fluid media. Indications of the presence of such a soluble toxin, proteid in nature, were obtained, but are not convincing, as no control experiments are mentioned; the most potent poison is certainly contained in the bacterial cells themselves.

Dr. Gordon contributes a useful paper on certain diphtheria-like organisms, and Dr. Houston reports on the inoculation of soil with sewage and on the examination of Chichester well water. Dr. Haldane gives further details of his method for destroying rats on shipboard with carbon monoxide, but this does not seem to be so convenient and safe as the Clayton process with sulphur dioxide.

The reports from the Board's vaccine department are of considerable interest. Nearly 1,000,000 charges of glycerinated calf lymph were supplied from the Board's laboratories during the year under review, and proved to be of excellent quality. Dr. Blaxall gives an account of an outbreak of equine variola, Mr. Fremlin describes a useful method for anaërobic cultivation, and Dr. Green discusses the action of various alcohols and other substances upon vaccine lymph. The volume is illustrated with several excellent photomicrographs.

R. T. HEWLETT.

[1] "Thirty-first Annual Report of the Local Government Board, 1901–2. Supplement containing the Report of the Medical Officer for 1901–2. Price 6*s.* 9*d.*

HERBERT SPENCER.

BY the death of Herbert Spencer England has lost the most widely celebrated and influential of her sons. He has passed away in the fulness of years and honours, having lived to complete the great work that he designed and took in hand half a century ago. Spencer was not without honour in his own country, yet our national indifference to philosophy and to all systematic thinking, and the subserviency of a great part of our professed philosophers to the great German metaphysicians, have undoubtedly prevented his receiving from his countrymen during his lifetime the full measure of recognition that is due to his splendid services to science and philosophy. And, indeed, the enthusiastic and unstinted eulogy of our great dead, voiced by the Press of every civilised country during the past week, has brought home to many of us for the first time the greatness of the man who by sheer force of intellect and character has won the tribute of the world. For in Spencer's work there was nothing designed to attract the attention of the crowd, there was no attempt to write down to the level of the multitude; it was one long and steady effort of a great intellect systematically grappling with the great problems. Yet his books have been translated into a score of languages, have been studied by hundreds of thousands of serious men, and in no small number of them have aroused admiring and enthusiastic gratitude.

Spencer's system of philosophy was broadly distinguished from other latter-day systems, save in a measure from that of Comte, by two features; firstly, his conception of philosophy as the unification of the sciences; secondly, the evolutionary standpoint from which he sought to effect that unification. While the great metaphysicians have for the most part set out with the premise that the world must be intelligible to our minds, and have held it to be their business to present it as an intelligible whole, Spencer prefaced his system of philosophy with a demonstration of the irresolvable mystery that lies behind us and before, and sought merely to discover the most general laws or statements that will express the relations of all the phenomena that science has revealed. That towards this great work he has made splendid and enduring contributions no one will deny. That there remain great gaps in his system is equally undeniable, and the most serious charge that can be made against him is that he professed, or seemed to profess, to have bridged the chasm between the inorganic and the organic worlds, between the world of mechanism and the world of volition.

When Spencer is compared with other great thinkers, he stands distinguished by the immense range of his knowledge of the facts and principles of the sciences and by that wonderful power of generalising their laws which was the instrument by means of which he sought to unify them in one grand scheme of thought. It is true that the specialist may discover shortcomings in his treatment of each one of those sciences, not less in the psychology, in which he is acknowledged as a master both of principles and of details, than in his biology and sociology; and it is true that certain of his great generalisations, for example, the ancestral-ghost-theory of the origin of religions, cannot now be regarded as well founded. Nevertheless, he has contributed to each of these sciences a wealth of illuminating and suggestive ideas, and even those of his hypotheses that have proved untenable have done so great service in provoking thought and discussion that, had he given to the world these unsuccessful suggestions only, he would still have had a great claim upon our gratitude.

On contemplating the completed System of Synthetic Philosophy there is a certain pathos in the fact that the final volumes, to which Spencer had long looked forward as the consummation and crown of his life's labour, namely, those setting forth the principles of ethics, are perhaps generally felt to be the least convincing part of the whole, a feeling which, it can hardly be doubted, was shared by the great thinker himself. But, whatever may be the final verdict as to the value of Spencer's ethical philosophy, there can be no difference of opinion as to the great moral value of his own life. He gave us an example, all too rare and too sorely needed in these days, of a life strenuously devoted through all the years of maturity and age to the realisation of a great object, the spectacle of a man working on with steadfast purpose, unmoved alike by the neglect and by the acclamation of the world, "Voyaging through strange seas of thought, alone" towards the lofty heights of Thought whose dim and cloud-capped towers had caught and fixed his eager youthful gaze.

Spencer's writings may seem to some readers cold and lacking in emotional fervour, and the man himself a little wanting in human sympathies; but can it be doubted that so grand an effort was sustained throughout the arduous years by a deep feeling for the mystery and pathos of the life of man, that tiny organism endowed with the capacity for thought and set to wonder, to labour, and to hope among the spheres that roll for ever through infinite space?

If it could be ascertained what parts of all Spencer's work do, and will, appeal most deeply to great numbers of thinking men, they would probably be found to be, firstly, the demonstration of the Unknowable Mystery that must for ever elude our grasp as the bounds of knowledge are thrown ever wider and wider, and secondly, the doctrine of Transfigured Realism that gives to the mind, painfully halting between the vain imaginings of the pure idealists and the shallow teachings of the materialists, a firm and sane standing-ground from which to view the two great orders of being, the internal and the external worlds.

Much of Spencer's way of thinking and many of his ideas have become a part of the very atmosphere we breathe and cannot but accept, and much of his work must form a part of every future system of philosophy that shall attempt the unification of the sciences. His fame is secure, for posterity can never forget that in an age in which men's minds were oppressed, and in danger of being overwhelmed, by the rapidly growing wealth and complexity of their knowledge of the phenomenal world, Spencer generalised boldly and effectively, breathing life into the dead bones of science.

NOTES.

THREE Nobel prizes for science have been awarded as follows:—for physics, Prof. Henri Becquerel divided with M. and Mme. Curie; for chemistry, Prof. Arrhenius; and for medicine, Prof. Finsen. The formal distribution of the prizes took place on Thursday, December 10, in the presence of the King of Sweden and several members of the Royal family and a distinguished gathering. It is announced that Prof. Finsen has decided to give 50,000 kroner (2753*l.*) from the amount awarded to him to the Phototherapeutic Institute at Copenhagen, and that two members of the governing body will each present it with a like sum.

MR. BRUCE, the leader of the Scottish Antarctic Expedition, which was sent out last year on board the *Scotia*, has arrived at Montevideo from the Falkland Islands. He reports that all is well on the *Scotia*, which is on the way to Buenos Ayres. Six men have been left behind in charge of a meteorological station. The meteorological station referred to is evidently the station set up by Mr. Bruce at Cape Pembroke, Falkland Islands, before the *Scotia* left for the southern seas in January last.

IT is announced that Dr. Oscar Guttmann has presented to the Chemical Society a photograph of the portrait of Roger Bacon in possession of Lord Sackville at Knole House, Sevenoaks.

DR. HANS GADOW, F.R.S., has, we learn from *Science*, accepted an invitation of the Lowell Institute, Boston, to give a course of six lectures, beginning March 29, 1904, on "Coloration of Amphibians and Reptiles." Dr. Gadow will probably give other popular lectures on zoological subjects while he is in America.

IT is reported in *La Nature* that Baron Edmond de Rothschild has sent 20,000 francs to M. Albert Gaudry, president of the Paris Academy of Sciences, to make it possible for the Museum of Palæontology to secure the very precious specimens of the Filhol collection which were obtained from the Quercy phosphate beds.

ON November 28 about three hundred teachers met at New York to form an Association of Teachers of Mathematics in the Middle States and Maryland, the prime object of which is the improvement of mathematical teaching. Prof. David Smith, of the Teachers' College, was elected president of the Association; Prof. H. B. Fine, of Princeton University, vice-president; and Dr. Arthur Schultze, of the New York High School of Commerce, secretary. After President Butler, of Columbia University, had delivered the address of welcome, papers on various aspects of mathematical teaching were read by Mr. Harry English, of Washington, D.C., Mr. Isaac N. Failor, of Richmond Hill, Dr. Arthur Schultze, and Mr. J. L. Patterson, of Philadelphia. The next meeting of the Association will be held at Columbia University, New York City, about next Easter, and applications for membership and other communications may be addressed to Dr. Schultze, No. 4 West 91st Street, New York City.

HIS MAJESTY THE KING has presented a fine stag to the University College of North Wales for its zoological museum. The animal has been specially selected for the college collection, and will illustrate fully the characters of the red deer. Prof. White has had the stag sent to Mr. Edward Gerrard, of Camden Town, to be mounted. The following gifts have reached the college during the past few weeks:—Mr. Assheton-Smith, specimens of the guanaco, St Kilda sheep, Australian swan, goshawk, grouse, and rhea; Mr. Herbert C. Hodson and Mr. James M. Reid,

bloodhounds; Dr. Corbet W. Owen, nests of the African weaver bird; Mr. Hugh O. Hughes, specimen of guano from the Chincha Islands; Mr. H. S. Forrest, small collection of fishes, &c.; Mr. J. Pugh, a fine pike; the Rev. W. S. White, small collection of bird and bat skins. Prof. White has also received a second gift of 10*l.* from Mr. Henry R. Davies for the zoological museum.

THE annual dinner of the Institute of Chemistry was held on Monday night, with Mr. David Howard, the president, in the chair. The president, in responding to the toast of the Institute, proposed by Lord Justice Cozens Hardy, remarked that the application of chemistry in our industries was a national question. Most of the successful manufacturers in Germany whom he knew were doctors of philosophy and very well educated men, who had, in addition, devoted their lives to the study of every detail of their work. It must be realised in England that the technical chemist should be at least as well educated and thoughtful as his German friends. The Institute was now considering what could be done to direct the studies of men engaged in technical work, for, while his general training must not be diminished, a technical chemist could not have too high a scientific training. Mr. Haldane proposed the toast of "Prosperity to Science and to Scientific Industries." He remarked that as a nation we needed science. It was not that we were going back; the general average was higher than ever before, and it behoved us to see that we kept our place. We needed science in our Government, in our industries, in our education. The time, then, had surely come when more science should be instilled into national methods. Why should not the grants to the university colleges, and to colleges giving scientific teaching of a university type, be increased? Any Government would be glad to do that if it felt that there was something like organised public opinion at its back. Then we suffered in England from a want of enthusiasm for science on the part of our manufacturers, and little progress could be made until this was remedied.

A PAPER, entitled "The Metrical System of Weights and Measures," was read by Mr. Alex. Siemens at the Royal Statistical Society on Tuesday. The author expressed his conviction that, though scientific men had for some time previously been discussing the subject in a general way, there is little doubt that the present metrical system is the result of the agitation of James Watt, who took the subject up in the year 1783. The history of the question in this country was traced from the year 1824, when Parliament was first approached on the subject. Last year the Liverpool Cotton Association effected the change from the binary to the decimal system of quotation, and Mr. Siemens showed how practically useful the 2000 lb. ton and other forms of reckoning on the decimal system had proved in the United States and Canada, as, indeed, in many British dependencies. In France the metric system was not really legal to the exclusion of every other until January 1, 1840, that is to say, a little more than sixty years ago. To-day only one system of measures exists in that country, and it is absolutely incorrect to say that the old measures are still employed there; even their values are becoming more unknown. The only notable exception is to be found in those industries or trades in which foreign nations which have not adopted the metric system have such a preponderating influence as to, thus far, impose the use of their own measures. Even in Germany, where the metric system has been in use not much more than half as long as it has been in France, though a few old names of weights and measures are in use, they really denote metrical measures, and may be treated as local expressions only. As regards the expense of the change, Mr. Siemens denied the suggestion that our engineering machinery for screw cutting would have to be scrapped—all that would be necessary would be to buy suitable exchange wheels. The author finally expressed his opinion that not only our own dependencies, but other nations would follow our lead if we made the change, and that thus international unity of weights and measures would at once become an accomplished fact.

THE Bradshaw lecture was delivered before the Royal College of Surgeons on December 9 by Mr. Henry Morris, the subject being "Cancer and its Origin." An admirable survey of the various theories of the nature of cancer is given, such as the "lost balance theory" of Thiersch, adopted by some recent writers, *e.g.* Foulerton, the "tumour-germ theory" of Cohnheim, and the various parasitic theories. Mr. Morris does not look with favour upon the parasitic theories; he says, "neither fission fungus, yeast fungus, nor psorosperm—neither bacterium, blastomycete, nor protozoon—has up to the present moment been satisfactorily shown, in spite of years of patient study by many skilled workers, to be in any sort of causal relation to the disease." He believes that there is "one theory which is more consistent than any other with all that we know about malignant disease, which fully explains the origin of very many non-malignant tumours," this being Cohnheim's "tumour-germ theory," which states that tumours originate from a matrix of embryonic cells which during fœtal life are cut off from their proper connections. Mr. Morris discusses the evidence for and against this theory, and the practical outcome should it be proved to be true.

ANOTHER example of the practical utility of wireless telegraphy at sea was afforded the other day as a result of the accident which happened to the *Kroonland* on her way from Antwerp to New York. The steamer disabled her steering gear when west of the Fastnet and was obliged in consequence to abandon her journey. Not only was the captain able to communicate particulars of the accident at once to the agents of the American line at Antwerp and to receive (in less than an hour and a half) instructions as to how to proceed, but the passengers were enabled to send messages to their friends and relatives assuring them of their safety. A large number of passengers made use of the wireless telegraphy installation, some telegraphing for more money, which was wired to them per the purser. The wireless installation on the *Saxonia* was useful in another way a short time back; getting into communication with the *Campania*, the latter informed the *Saxonia* that berths were waiting for English-speaking emigrants as motor-men on the surface lines of New York. These two instances serve to show the benefits that wireless telegraphy confers on travellers by sea.

THE fourth report of the National Electric Light Association's committee for the photometry of arc lamps contains some interesting results of measurements of the light distribution and mean spherical candle-power of the American pattern Nernst lamps. These lamps are made with one, three, six or more glowers in parallel; the measurements of the committee were made on the first three of these types. They show that the light distribution below the horizontal is very good, but above it is very poor. The distribution in the horizontal plane is fair; thus with the six-glower lamp the maximum horizontal candle-power is 112, the minimum only about 40 candles; the mean horizontal candle-power is 85 candles. For the same lamp the

mean spherical candle-power is approximately 170 candles, and the mean hemispherical candle-power for the lower hemisphere 290 candles. The maximum candle-power is 400 candles in a direction vertically downwards. It will therefore be seen that the efficiency varies very greatly according to the direction in which the candle-power is measured. Taking the mean spherical candle-power, which is the only value of any use for comparative measurements, the consumption of power comes out to 3·3 watts per candle; for the mean hemispherical it is 1·9, and for the mean horizontal 6·6 watts per candle. If, however, the measurement be made in the direction of maximum candle-power, the consumption of power is only 1·3 watts per candle. The general distribution of the light and the values of the mean and maximum candle-powers show that this lamp is on a par with a small (six to eight ampere) arc as a source of illumination.

We have received further copies of the *Journal* of the Meteorological Society of Japan (for September and October last), containing papers on the climatology of Formosa and other important subjects relating chiefly to Japanese meteorology. The articles are all in Japanese, but the promise of issuing some in European languages is reiterated. We look forward with pleasure to the fulfilment of the promise, as the proceedings of this energetic society will doubtless be of much interest to our readers.

The weather for the present month is proving very disappointing, and, after a few days with somewhat low temperatures at the commencement, the conditions have again become cyclonic with the usually accompanying mild and damp south-westerly winds blowing from off the relatively warm waters of the Atlantic. Disturbances are again reaching us with considerable frequency, and the rains which are occurring over the whole country are considerably augmenting the already excessive falls for the present year. At Greenwich the fall for 1903 is now approximately 35 inches, and is about an inch in excess of any previous annual record during the last sixty years. The storm areas which have arrived over us recently have had the barometer as low as 29 inches, and gales have been experienced at many places in exposed positions on our coasts.

A correspondent sends us an extract from a letter describing an aurora observed at Calgary, Canada, on October 31, when auroral displays were seen in many parts of the world (see this vol. p. 9). At Calgary a peculiar light was noticed in the sky about 6.30 p.m. Large and beautiful vertical shafts of coloured light were first seen moving about the sky. "Presently the shafts began to lower, vastly increased in size and number, until their lower tips touched the ground (objects about half a mile off could be seen through them) and the upper tips met in the zenith, losing themselves among the stars directly overhead. They formed a perfect apse, bright ruby above, and coming through purple and greenish tints to gold at the bottom. The apse shivered and shook out all sorts of colours, and literally chased me in the buggy, the nearer huge shafts being but a few yards off. A horse in a field alongside tore madly round in terror. A few minutes later there were only a few stray but grand shafts left."

Some experiments on the influence of a magnetic field on a tuning fork are described by Mr. O. Kirstein in the *Physikalische Zeitschrift*, and lead to the results that if the lines of force are perpendicular to the plane the frequency is increased; if parallel it is diminished; at an angle of 45° no change occurs; the decrease in the second case is greater than the increase in the first; the changes are in every case proportional to the field, and the action of the magnetism is only temporary. These results, some of which agree with previous investigations, have an important practical application in connection with electrically excited tuning forks.

The frequent use of silk suspension fibres in physical laboratories renders the determination of the elastic constants of silk a problem of considerable interest. This problem forms the subject of a paper by M. F. Beaulard in the *Journal de Physique*, in which hysteresis curves are drawn showing the elongations produced by traction. The most remarkable conclusions drawn are, firstly, that the curve ultimately tends to become a straight line, the hysteresis then vanishing; and, secondly, that the value of Poisson's ratio, calculated from observations of the behaviour of the fibre under traction and torsion, is about 1·56, and this high value supports the view that silk is not isotropic.

A graceful tribute to the venerable Japanese botanist, Ito Keisuki, is paid by Mr. Botting Hemsley by the establishment of a new genus of the Bixineæ under the name Itoa. Dr. Tokutaro Ito, who is associated with his grandfather in the compliment, has followed in the paths of his illustrious ancestor in his systematic contribution entitled "Plantæ Sinenses Yoshianæ."

In 1894 Prof. Carmody published a summary of the industrial resources of the island of Trinidad, and in a small pamphlet recently issued he uses this as a basis of comparison with the conditions and general trade returns of the island for the year 1902–3. The principal export, sugar and sugar products, has, of course, decreased considerably, but there is a balancing increase in the amount of cacao. Another important product is that of asphalt, which has also steadily increased in amount. A striking feature of the statistics is the rising value of imports from Canada.

The Barbados *Agricultural Reporter* of November 18 contains a report of a meeting of the Legislative Council of the island at which it was resolved to offer rewards for the destruction of mongooses. With this, it may be hoped, we shall soon hear the last of an ill-starred experiment in acclimatisation.

A circular has recently been issued by Messrs. Stejneger and Miller, the well-known American naturalists, urging the governing body of the Carnegie Institution to undertake a thorough and detailed biological survey of the eastern Holarctic region, on the plan followed by Dr. C. H. Merriam in the United States. Despite the gigantic nature of this undertaking, it is estimated that it might be completed within ten years.

Among several other articles in the *Journal* of the Quekett Microscopical Club for November, we may refer to one by Mr. W. H. Harris on the emission of musical notes by the hover-flies of the genus Eristalis, and on the habit from which they take their name. It appears that the thoracic spiracles of these insects carry a couple of crescentic chitinous rods joined by a ligament, so as to form a bow. A large bundle of muscles is attached to these rods, which supports a number of delicate membranes pleated in a complex manner. The air-chamber is kept inflated by the movements of the fly, and the musical notes are apparently produced by bringing the pleated edges of the membranes close together and expelling, by muscular action, the air from the chamber with sufficient force to set them vibrating.

We have received from Mr. E. B. Waggett a communication with reference to a proposed method of graphically indicating the duration of the residence in the British Islands of the various members of the bird-fauna. On a sheet of ruled paper two large dots, an inch apart, are marked on four of the ruled lines, the dot on the left indicating New Year's Day, and the one on the right December 31. In the case of permanent residents, the two dots are connected by a line. Winter visitors are indicated by drawing a line half an inch long on each side of the right dot, the extremities of these lines being marked above by arrow-heads, of which the one on the left points downwards, to indicate a southern migration, while that on the right points in the opposite direction, and thus implies a northern flight. Summer visitors, on the other hand, are indicated by a half-inch line midway between the two dots, with arrows on the lower side of the extremities, the direction of which indicates the migration. Species which merely rest for a short time in Great Britain during the spring and autumn migrations are indicated by drawing two quarter-inch lines some distance on each side of the right dot, with an arrow both above and below each to mark the direction of the migration. Modifications of these may be easily drawn to indicate residents which build twice, or even thrice, in a season, and also resident species building in the spring which are reinforced in autumn by migrants from the north for the winter season.

In the January number of the *Psychological Review* the tenth anniversary of the journal will be celebrated by the founding of a special literary section, to be published monthly, in which fresh, prompt treatment will be given to the literature of psychology, philosophy, and cognate subjects.

Messrs. J. and A. Churchill have now published separately the second part of "Elementary Practical Chemistry," by Dr. Frank Clowes and Mr. J. B. Coleman. The present publication is divided into three sections, dealing respectively with qualitative, volumetric, and gravimetric analysis.

The Huxley lecture for 1903, by Prof. Karl Pearson, F.R.S., "On the Inheritance of the Mental and Moral Characters in Man, and its Comparison with the Inheritance of the Physical Characters," has now been published separately by the Anthropological Institute. It will be remembered that we published an abstract of Prof. Pearson's lecture in our issue for October 22.

Mr. W. C. Fletcher, head master of the Liverpool Institute, has been appointed to the newly-established post of chief inspector of secondary schools. Mr. C. A. Buckmaster, acting senior chief inspector at South Kensington, has been appointed chief inspector of schools under the branch of the Board of Education which deals with evening schools, technology, and higher education in science and art.

The fourth volume of the "*Knowledge* Diary and Scientific Handbook" has now been published, and in this 1904 issue there is much information which will prove of use to men of science. Among many interesting contents may be noticed the numerous practical articles, which include one by Mr. William Marriott on practical meteorology, and one by Mr. Edwin Edser on the optical constants of lens combinations. The tables, too, are abundant and well selected.

We have received a copy of Prof. Robert Wallace's opening lecture of the session on October 13 to the students of the department of agriculture and rural economy at the University of Edinburgh. The lecture is entitled "Agriculture, Live Stock, and Dairying in Argentina," and deals with Prof. Wallace's observations and inquiries during his recent six months' tour in South America. The booklet is published by Messrs. Oliver and Boyd at ninepence.

The issue of "Who's Who" for 1904 contains above one hundred and fifty pages more than that for 1903, and the increase in size indicates the large number of additional biographies now included. The notable persons whose biographies are given are not exclusively British, for particulars are provided also of American men and women of eminence. Messrs. A. and C. Black are to be congratulated upon the general appearance of the book, and the editor upon the excellence of its arrangement. The price of the 1904 edition is 7*s.* 6*d.* net.

Many of our readers are acquainted with those excellent volumes of "Photograms" (Messrs. Dawbarn and Ward, Ltd., London) which have appeared yearly since 1895. The issue for the present year surpasses, if possible, the high standard which this publication had reached, and our photographic readers will find in these pages much that will be of interest. As a pictorial and literary record of the artistic photographic work of the year the compilers and publishers are to be congratulated, for the volume is high-class in every respect.

The first number, that for November, of the *Central*, a magazine edited on behalf of the City and Guilds of London Central Technical College Old Students' Association by Dr. E. F. Armstrong and Mr. Maurice Solomon, is an excellent performance. It is attractively produced, well illustrated, and interestingly written. There is an instructive article on oscillographs by Mr. Solomon, a description of the new electrical laboratories by Mr. Joseph Griffin, and an unusually large number of notes concerning the work and doings of old students; one section of these notes, dealing with chemical research, is conclusive evidence that the atmosphere of the Central Technical College is favourable for the development of investigators; and the new magazine shows that literary as well as scientific enterprise is encouraged.

In a paper read recently before the Church Society for the Promotion of Kindness to Animals, the Hon. Chas. S. Rolls remarked that at the present time those who were seeking to develop motors and motoring were experiencing exactly the same opposition from many rural communities as the promoters of railways met with earlier. Having disposed of many thoughtless and amusing objections brought against motor vehicles by opponents, he remarked that, as regards other objections, it should be remembered that the difficulties of noise, vibration, smell, and untrustworthiness must eventually be, and are rapidly being, overcome. This country has, said Mr. Rolls, been infested with a host of inferior cars, consequently these objections have been more apparent here than they are on the Continent or in America. The introduction of the motor-car will, undoubtedly, constitute the means of better intercommunication, which has always been the chief factor of civilisation. It will result, too, in the decrease of wear and tear on the roads, greater economy of space in the streets, and especially a greatly increased cleanliness of the latter.

The additions to the Zoological Society's Gardens during the past week include a Brown Capuchin (*Cebus fatuellus*) from Guiana, presented by Mr. F. J. Holmes; two Tantalus Monkeys (*Cercopithecus tantalus*) from West Africa, a Globose Curassow (*Crax globicera*) from Central America, two Brazilian Tanagers (*Ramphocoelus brasilius*) from Brazil, a Tytler's Parrakeet (*Palaeornis tytleri*) from the Andaman Islands, deposited.

OUR ASTRONOMICAL COLUMN.

THE TOTAL SOLAR ECLIPSE OF MAY, 1900.—The report of the expedition organised by a joint committee of the Royal Dublin Society and the Royal Irish Academy to observe the total solar eclipse of May, 1900, has just been published in vol. viii. (series ii.) of the *Scientific Transactions* of the Royal Dublin Society.

The instruments used were chiefly lent by Sir Howard Grubb and Mr. W. E. Wilson, F.R.S., who, with Prof. Joly, Dr. A. A. Rambaut and others, were members of the expedition. They included two cœlostats and two coronagraphs, one of the latter being of 4 inches aperture and 19 feet 4 inches focal length, the other of 6 inches aperture and 7 feet 10½ inches focal length; a special spectroscopic apparatus for securing a continuous series of photographs of the spectrum of the chromosphere was also taken. The second of the two coronagraphs was used with a coloured screen, made by "fixing" an ordinary unexposed film, and then soaking it in a bath of tartrazine, which allowed only the green light about the chief coronal radiation to be photographed. The resulting negative, which was exposed for eighty seconds, shows considerable extension of the outer corona, although the spectroscopic observations indicated that the green corona line was very faint during this eclipse.

The spectra were obtained with a kinematograph especially designed by Sir Howard Grubb to take twelve plates at the second and twelve at the third contact, in such a manner that no interval occurred between two successive exposures, the idea being to observe whether all the bright lines appeared or disappeared simultaneously, or whether some became reversed earlier than others as would be expected if their respective absorptions took place at different levels. It was found that the lines generally disappeared in the order of brightness shown on the original spectrum, although there were several exceptions to this rule, notably the strontium lines at λ 4078 and λ 4216, which disappeared earlier than other lines of the same original intensity. These differences are shown in the analytical table which accompanies Dr. Rambaut's discussion of the spectra. The wavelengths and origins given in this table seem less determinate than those which have been previously published by other observers. Several plates showing reproductions of the corona photographs, which have been discussed by Mr. Wesley, and of the spectra are given at the end of the paper.

CLOUDS ON MARS.—An article by Mr. Denning, published in the December number of the *Bulletin* de la Société astronomique de France, records the appearance of cloud-like formations on Mars during the latter half of May. On May 19 and 21 the Syrtis Major was dark and sharply defined, but on the latter date a brilliant region appeared over its southern extremity, whilst on May 23 this region was very faint and ill-defined, although other features usually less obvious were plainly seen. Mr. Denning describes the region as appearing to be covered by strongly reflecting vapours which were not dense enough to hide completely the surface, but were sufficiently dense to give it a more luminous and less definite appearance. On May 25 and 27 a luminous zone was observed to the north of the Mare Cimmerium, and during the latter part of the month an extensive luminous band was visible along the northern edge of this sea, Syrtis Major, and the Linus Sabæus. It seems probable to Mr. Denning that the clouds of white vapour which were observed on the eastern edge, south of Syrtis Major, on May 21 travelled very rapidly in a northern direction, and thus caused the lack of definition observed in the above regions on the later dates, and he connects this phenomenon with the appearance of a white projection observed by Mr. Lowell, at Flagstaff, on May 26.

Several other remarkable phenomena, notably a marked division of Nilus by a bright spot, which extended far to the south-east from the eastern edge of the Lunæ Lacus, on May 4, were observed by Mr. Denning, and, on analysing his observations, he arrives at the conclusion that *real* changes do present themselves in the details of several Martian features, although many of them may be only temporary and due to atmospheric causes.

As regards the question of Martian canals, Mr. Denning states that there is no doubt as to the objective reality of the streaked and striated appearance of the northern hemisphere, and to him the canals appear not as straight and narrow lines, but as currents of dark material with frequent condensations having the appearance of a natural rather than an artificial origin.

SEISMOLOGICAL NOTES.

THE fourteenth number of the *Publications* in European languages issued by the Earthquake Investigation Committee of Japan is entirely devoted to a profusely illustrated paper on the modulus of rigidity of rocks, by Mr. S. Kusakabe. The experiments, which are a continuation of investigations made by Prof. H. Nagaoka on the elastic constants of rocks, relate entirely to torsion, and show, amongst other things, that even for very small strains Hooke's law does not hold, that in the relationship of stress to strain, or twisting couple to twist produced, rocks exhibit a marked *hysteresis*, and that the modulus of rigidity of a rock in its virgin state is greater than is usually supposed. Inferences to be drawn from these important investigations (in which stresses are applied *slowly*) are that waves of small amplitude are propagated with a higher speed than those with a large amplitude (increase an amplitude ten times and the velocity is reduced to half or one-third), also in a strained medium, as, for example, along a mountain chain, velocity is somewhat increased. In view of the first of these inferences, Mr. Kusakabe does not see the necessity to assume that the tremors of an earthquake follow paths different from that of the large waves or shocks. Whether we agree or disagree with this suggestion, we can congratulate the author on his important memoir, which is a new leaf in seismometrical research.

Amongst other recent publications relating to earthquakes we have before us Nos. 13 and 14 of the new series of *Mitteilungen* issued by the commission appointed by the Vienna Academy of Sciences for seismological investigations.

The first of these, by Dr. R. Hoernes, gives an account of the earthquake which, on July 5, 1902, resulted in considerable destruction along a line to the east of Saloniki, and fairly parallel with the Vardar River. This is a fault line along which there are hot and other springs. From the fact that these became muddy, altered in temperature and in volume, whilst new springs were created, as at Güvezne, the inference is that the earthquake was accompanied by subterranean rearrangements of strata. A discussion of the movements along this and other fault lines in Macedonia, and of changes in level which are apparently in progress at Saloniki and its neighbourhood, leads to the conclusion that hypogenic geological processes have in this part of the world a marked activity.

The second communication, from Prof. Dr. W. Láska, is on the determination of the distance of earthquake origins from observing stations by means of seismograms. That the differences in time between the arrival of various phases of earthquake motion vary with the distance an earthquake has travelled is a fact which has received application for many years. In the reports of the Seismological Investigation Committee of the British Association (1900 and 1902), by means of curves the relationship between the time intervals and distances is expressed geometrically. Dr. Láska gives similar information by means of tables. From observations made at three stations he also gives equations the solution of which leads to the determination of a latitude and longitude for an epicentrum. In the British Association report for 1900 simpler and more certain solutions are given for the same problem.

In No. 15 of the same *Publications* Dr. Eduard Mazelle gives the results of his investigations respecting the connection between microseismical pendulum movements, the wind, barometric pressure, the state of the ocean, and other natural phenomena. The results at which the author arrives confirm the results from similar analyses made many years ago in Japan, and to be found in the *Transactions* of the Seismological Society of that country and in the reports of the British Association. We are told that it is difficult to find a direct connection between tremors and atmospheric

pressure. Tremors occur most frequently, but by no means always, with marked changes in pressure. An observation more novel in its character is that days when pendulums were much disturbed in Trieste coincided with corresponding disturbances in Strassburg. It is apparently taken for granted that the tremors recorded have a seismic origin.

In No. 16 Dr. J. Knett publishes a list of 507 shocks which were recorded between February 13 and May 6 in north-west Bohemia, which he follows in No. 18 by an account of an earthquake which on November 26, 1902, disturbed the same country.

No. 17, by Adolf Faidiga, is a lengthy description of the earthquake which, on July 2, 1898, created considerable destruction on the coast of Dalmatia, the vibrations from which reached Great Britain. It is largely of local interest.

In Nos. 2 and 3 of vol. ix. of the *Bolletino Della Società Sismologica Italiana*, the well-known earthquake register published by this body is brought up to March 5, 1902. This is supplemented by two papers. In No. 2 Dr. A. Ricco adds to the knowledge we possess respecting the crater of Etna, and changes which are taking place in the same. On August 23, 1900, the interior of the crater was described and photographed. Its depth was then 282 m. On July 21, 1903, it was again photographed, and its depth was found to be 490 m. The supplementary contribution to No. 3, by S. Costanzo, is on the relationship or want of relationship between the wind and tromometric movements. The author apparently holds with Bertelli and others that the pendulum movements have an endogenous origin, and are not produced by the wind, but that they accompany, precede, or follow falls in barometric pressure. Dr. Agamennone regards the movements in question as being in great measure influenced by the wind. Our own experience, which is detailed in the *Transactions* of the Seismological Society of Japan, reports to the British Association, and in other works, is that vertical or horizontal pendulums, chemical balances, and like apparatus are set in movement when there is a marked fall in barometric pressure, a steep barometric gradient, or a marked fall in temperature; the movements more frequently occur during the night and in winter than during the day and in summer, and they may or may not occur with heavy gales. Instruments in a close atmosphere, as, for example, in a cellar, are more likely to be disturbed than similar installations in a well ventilated or even draughty room. Burning a lamp or a gas jet in a room frequently brings so-called microseismic storms to an end, and what occurs and creates annoyance in one room may not be observed in a neighbouring apartment.

In vol. ii. of the reports of the Mathematical-Physical Society of Tokio, amongst forty-seven papers which for the most part are mathematical we find five by Dr. F. Ōmori and one by Mr. A. Imamura which relate to seismology. The former of these contributions may, to a large extent, be regarded as epitomised reproductions of papers previously published by the Tokio Earthquake Investigation Committee, which we have already noticed (NATURE, April 30, July 9, 1903). In a note on the seismograms of distant earthquakes, Dr. Ōmori tells us that the "motion consists of a series of different epochs, in each of which the period remains essentially constant, while the amplitude, on the whole, is also constant, except for the occurrence of maximum and minimum groups." In a table we find ten groups, in which the periods vary between 1·02 and 66 second. After discussing the amplitudes and durations of these various phases, it is shown that the arcual velocities vary between 2 and 11·3 km. per second; as the result of more accurate work, this last quantity is now raised to 14·1 km. per second. One argument in favour of the supposition that the preliminary tremors and other phases of earthquake motion follow arcual paths is that the durations of these successive phases are proportional to the arcual distances they have travelled, and these durations are approximately equal to each other. The speeds for certain earthquakes were determined by dividing the difference of the distances of Tokio and certain European stations from an origin by the difference of the times of the arrival of seismic waves in Tokio and Europe. This, it must be observed, involves the idea that the velocity of preliminary tremors on short paths or on long paths is equal. Lastly, it is assumed that each phase recorded at a distant station originated simultaneously at the earthquake origin.

The results to which we are led by assumptions of this nature are well illustrated in the paper, "Notes on Milne Horizontal Pendulum Seismograms," by Mr. A. Imamura. In this paper records of the Guatemala earthquake of April 19. 1902, as published in circular No. 6 by the Seismological Investigation Committee of the British Association, are analysed. One result is to show that the preliminary tremors had an arcual velocity of 15·6, whilst the eighth phase of motion had only a velocity of 2·1 km. per second. These determinations, amongst other things, depend upon the time at which this earthquake originated, which Mr. Rockstroh, in Guatemala, gives as 2·27 a.m. G.M.T. This, it must be observed, apparently depends upon a single observation made at some distance from the epicentre. As being more probably correct, Mr. Imamura adopts 2.26 a.m. as the time of origin. Curiously enough, the determination of the exact time at which this particular disturbance took place became a matter to be considered by the law. At or about the time of the earthquake a certain block of buildings insured against fire, but not, as was stipulated in the policy, against fire occasioned by an earthquake, was burned down. The owners of the block claimed that the destruction was occasioned by the overturning of a lamp immediately before the earthquake, and if this were the case, the loss naturally fell upon the insurance company. The result was that a careful inquiry was instituted to determine the time when Quezaltenango and other cities were wrecked, and, so far as the writer knows, the time given for this occurrence was 2h. 21m. or 2h. 22m., which is a time that falls in line with what we know of earthquake speeds, and the times at which this earthquake was recorded at stations cooperating with the British Association in North America and round the Atlantic. If this latter time is fairly correct, and we therefore add 4 or 5 minutes to the time ordinates given by Mr. Imamura, we see that the times for transit of the first phase of earthquake motion are *not* proportional to arcual distances. The speed over short paths is less than it is over long paths. When we look at phase 8, which occurs about twenty minutes after the maximum, and see the many phases which follow, we do not see the reason why the transit velocity of phase 9, or even of phase 20, should not have been considered.

Following the maximum, as an earthquake dies there is almost invariably a series of fairly rhythmical impulses which gradually grow less in amplitude. These are separated by intervals of from two to five minutes, and may extend over two or three hours. Inasmuch as these phenomena may be observed equally well near to an earthquake origin as at a distance from the same, it would be unreasonable to suppose that if we were at a short distance from a centrum the movements last recorded there had been two or three hours longer on their journey than those first recorded. In rocky materials waves of small amplitude may travel more quickly than those of larger amplitudes; in an earthquake there may be ripples due to surface tension together with the more pronounced compressional, distortional, and gravitational waves, all of which may originate at practically the same time, but if we consider this to be the case for the followers of the main portion of a seismic disturbance, we are led to conclusions apparently unacceptable. The fairly uniform time spacing between the expiring efforts of an earthquake as recorded at a distance from an origin or near to the same, rather than leading to the conclusion that paths are arcual, suggests a rhythmical series of surgings possibly due to interferences or reflections at or near a centrum. A collapse takes place and a mass is launched upon some substratum. Each has its natural period, and when these coincide, it seems possible that at approximately equally spaced intervals a more vigorous set of waves starts out and adds to the train of its predecessors.

The first response to the primary disturbance may be the well-known *Uri Kaishi*, or return shaking, whilst its followers, which die down rapidly in amplitude, like the swinging of a damped pendulum, resemble a family series, children with children's children decreasing in vigour, not born simultaneously, but successively.

The general criticisms on the behaviour of the Milne horizontal pendulum are made without any reference to the

object for which it was installed, which was to determine "the times at which various phases of motion are recorded" (see British Association Reports, 1897, p. 130. Copy of a circular sent to foreign Governments and colonies). This it does, and a little more. If an observer desires to have an open diagram, he must employ clockwork to drive the record receiving surface at a higher speed, whilst a longer period than the one usually employed can be obtained by adjustment. It must, however, be remembered that the period obtained at one station may, on account of the wandering of the pendulum and "tremors," be unpractical at another, and that difference in adjustment at different stations destroys uniformity. Although with the object of stimulating further research we have criticised certain portions of the work before us, the bulk of it commands the admiration and thanks of all seismologists.

THE GILBERT TERCENTENARY.

THE tenth of this month was the three hundredth anniversary of the death of Dr. William Gilbert, the celebrated Elizabethan philosopher who laid the foundations of the science of electricity. The occasion was celebrated on Thursday, December 10, at the meeting of the Institution of Electrical Engineers by the presentation of a picture by the Institution to the town of Colchester, in which place Gilbert was born and died. The picture was painted by Mr. Ackland Hood; it is a fine historical painting representing Dr. Gilbert showing his electrical experiments to Queen Elizabeth.

The proceedings were opened by the president of the Institution with a short speech. Prof. S. P. Thompson then gave a brief address, in which he outlined Gilbert's life and his contributions to science. Gilbert was born in Colchester in 1544, and was educated at the school there and subsequently at St. John's College, Cambridge, at which he became mathematical examiner and senior bursar. He took the degree of M.D. in 1569, and rapidly advanced in the profession, becoming in 1599 president of the Royal College of Physicians, and a year later physician to the Queen. He died at Colchester on December 10, 1603, and was buried there in the Church of Holy Trinity. Eminent as he was as a physician, his claim to immortality rests not on his work in medicine, but on his pioneering investigation in the then almost non-existing sciences of magnetism and electricity. To him we owe the science of terrestrial magnetism; by numerous and careful experiments upon the loadstone he discovered many of the most important principles of magnetism, such as the existence of a magnetic field—an "orbe of virtue"—around the magnet, the screening effect of iron, and the destroying effect of heat. From experiments on a globular loadstone he was able to evolve the theory that the earth is itself a great magnet. Thus many years before Bacon, who is usually regarded as the father of the inductive method, Gilbert was using this method with signal success.

Gilbert's contributions to electricity are contained in the second chapter of Book ii. of the celebrated "De Magnete." He showed that not amber alone, but many other bodies, which he put in a class called *electrics*, can attract solid bodies when rubbed; that they attract everything, not merely straws or chaff; that damp weather hinders the electrification; and that a flame destroys it, as well as many other important facts which are now the fundamental principles of the science. He invented the electroscope, and discovered that the force of attraction is in a straight line towards the electrified body. From these simple beginnings has been gradually evolved in 300 years the immense structure of pure and applied electricity.

The Mayor of Colchester thanked the Institution for its gift in a brief and humorous speech. Amongst many other distinguished men present at the meeting were Sir W. Huggins, president of the Royal Society; Sir Dyce Duckworth, treasurer of the Royal College of Physicians, an office twice held by Dr. Gilbert; Prof. J. Larmor, representing St. John's College, Cambridge; the Mayor of Westminster; and Mr. Ackland Hood, the painter of the picture.

AGRICULTURAL NOTES.

THE third report on the Woburn Experimental Fruit Farm, recently issued by the Duke of Bedford and Mr. Spencer Pickering, F.R.S., is devoted to a discussion of the effects of grass on apple trees. In previous reports it was shown that grasses prove most injurious to young apple trees, and the experiments described here were designed to throw light on the causes of injury. Up to the present time the cause, or causes, have not been discovered, but the experimenters have made considerable progress, for they have shown that their first suspicions were unfounded. Grasses might reasonably be expected to injure young fruit trees by interfering with their air, or water, or food supply, but the careful experiments recorded in the report indicate that interference with air, water, and food has little or nothing to do with the question, and that the injury "must, in all probability, be attributed to the action of some product, direct or indirect, of grass growth which exercises an actively poisonous effect on the roots of the tree." This conclusion is based partly on the negative evidence of the experiments, in which the supplies of food, air, and water were controlled, and partly on the appearance of the trees grown in grass. These trees were always very sharply marked off from the others by peculiar tints of leaf and fruit, quite unlike those due to starvation, and produced obviously by some unhealthy condition of soil. The effects of grass on apple trees have been studied only on the shallow clay soil of the Woburn Fruit Farm and on a clay soil at Harpenden, and it is possible, as the experimenters are careful to point out, that on a richer soil, and in a different climate, grass might not prove injurious, but the Woburn experiments clearly indicate that horticulturists should avoid planting apples in grass, unless there is local evidence that grass does not injure the young trees.

In their work on apple trees the Duke of Bedford and Mr. Pickering are dealing with a special and well-marked case of a general problem of great interest to agriculturists—the effects of crops and of crop residues on the quality of soil. Every observant cultivator knows that land may get "sick" or "over-cropped" when a plant is grown too often, and he also finds that certain plants "exhaust" the soil in a peculiar degree for certain other plants. He has been told that this is a "food" or a "special food" question, and that interference with the air, food, and water supply explains all the ills which plants may suffer from competition with their fellows. At the same time, he does not feel satisfied that such phenomena as the disappearance of clover from land, or the effects of rye-grass on wheat are due to straightforward competition, and the "poison" theory of the Woburn experimenters will arrest his attention. Seventy years ago agriculturists were discussing De Candolle's "excretory theory," and found in it the chief explanation of the benefits due to a rotation of crops; when the theory was abandoned the facts from which it originated were forgotten, and in connection with the effects of grass roots on apple trees the following sentence from De Candolle is worth recalling:—"Thus we know that the thistle is injurious to oats, the Euphorbia and Scabiosa to flax, the *Inula betulina* to the carrot, the *Erigeron acre* and tares to wheat, &c." Though the plant does not "excrete," it may readily influence the character and condition of the soil either directly by the decomposition of its roots, or indirectly through its effect on soil organisms, and the Woburn experiments, which deal with this subject, will be closely followed.

In a paper entitled "Recherches sur la Synthèse des Substances Albuminoides par les Végétaux," MM. Laurent and Marchal, of the State Agricultural Institute, Gembloux, give a useful *résumé* of the sources of nitrogen to plants. In doing so they point out that during the latter half of the nineteenth century there was a tendency to overlook the importance of ammoniacal compounds, and to regard nitrates as the only sources of nitrogen to the higher plants. While nitrates are of chief importance, there are many plants, even colonies of plants, such as forest trees and the vegetation of marshes, that must depend largely or entirely on compounds of ammonia for the supply of nitrogen. The authors describe experiments on cress, white mustard, chicory, asparagus, white melilot, Persian lilac, and tobacco, and among other conclusions state that sun-

light is necessary for the synthesis of albuminoids in the higher green plants, and probably in all green plants, but that amides are produced in limited quantities in darkness and in parts of the plants which contain no chlorophyll. The lower plants devoid of chlorophyll can manufacture albuminoids in darkness, the necessary energy in this case being derived from the decomposition of organic compounds.

The twenty-third volume of the *Agricultural Journal* of the Cape of Good Hope is now being published in monthly parts by the Department of Agriculture, Cape Town. Though not new, the *Journal* has recently altered and improved its form, and this sixpenny monthly may be commended to the notice of all who are interested in the agriculture of South Africa. Prospective settlers would find many useful hints in it, for by means of editorial notes, special articles, and correspondence the *Journal* gives a clear presentation of the condition of the various farming industries of Cape Colony. Diseases of live stock are very common in the colony, and young men preparing for life on a South African farm should endeavour to gain some knowledge of veterinary hygiene before going abroad. The *Journal* usually devotes one or two articles in each number to veterinary subjects and the ailments of stock bulk largely in the correspondence columns. A correspondent from Aliwal North, writing in the October number, makes an observation which is interesting in view of the importance of ticks as carriers of disease germs. He reports that he had a flock of goats badly infected, but "happened to drop" on a cure in the shape of wild garlic. He gave the affected animals a small quantity; the ticks were not killed, but they dropped off the goats, and no further loss was suffered. Next year, when the tick season came round, the goats escaped injury.

Regulations for the purpose of preventing the importation of plant pests have been in force in Cape Colony for a number of years, but experience has shown greater caution to be necessary, and after January 1, 1904, new and stringent regulations will come into force. With the view of preventing inconvenience and loss to exporters, wide publication has been given to the altered regulations. The following points are of special interest to horticulturists:—(1) All plants or parts of plants not grown in South Africa must in future be sent to Cape Colony by sea. Imported plants must not be sent overland from other colonies. (2) Certain plants are absolutely prohibited, as, for example, stone-fruits from the U.S.A. and Canada, and peaches from any foreign country. (3) Permits are granted for the importation of small quantities of fruit trees from most countries, so that stocks of new varieties may be worked up in the colony. (4) Plants will be examined on landing by a competent officer, thus minimising the risk of importing pests. Trees and woody plants will be fumigated, the expense of fumigation being borne by the consignee. Any plants or parts of plants on which the examining officer finds a specially dangerous pest will be destroyed without delay.

BUDDHISM.[1]

THE appearance of the first number of a new quarterly magazine entitled *Buddhism* is an event of some significance, for it argues that the modern tendency of western inquiry into the ethics of this ancient eastern faith is sufficiently active to justify a commercial venture.

The object of the review is stated to be, first, to set before the world the true principles of the Buddhist religion; secondly, to promote certain humanitarian activities enjoined by Buddhist precept; and, thirdly, to unite, "as by a common bond of mutual interest and brotherhood, the many associations with Buddhist aims which now exist."

These objects are well sustained in the initial number of the review. It opens, most appropriately, with a poem by Sir Edwin Arnold, whose "Light of Asia" has probably done more to popularise Buddhism in the west than any literary effort hitherto known. It continues with a series of essays by Buddhist writers, in which the doctrines of Buddhism are explained and advocated with much earnestness, and, on the whole, with an intelligent appreciation of the limitations of ordinary human understanding; and it includes notes and references which sufficiently prove what an active agency in the practical world Buddhism is becoming. Amongst the notes is an invitation to western students to join the great brotherhood of the Yellow Robe, with a very explicit statement of the conditions under which candidates will be accepted. "Bhikkus of occidental nationalities" are first invited, "who in due time would be able to return to their own countries, there to spread the knowledge of Buddhism"—in short, missionaries. Amongst these Bhikkus there may be some who may be willing to take the Robe, but they are candidly warned that the conditions of life in the order are "somewhat severe for occidentals."

All this is practical business, and it leaves an impression that the review fills a space in the ranks of modern Oriental literature which is distinctly open to enterprise.

The article on the "Faith of the Future," coupled with that on "Nibbana" (Nirvana), is a clear and intelligible exposition of the gospel of law and self-culture inculcated by Buddhism, and is, perhaps, a clearer analysis of the final conditions of nebulous existence which crowns and completes the strenuous life of the Buddhist than can be found in most theological treatises on the Christian's hereafter. Based on the unsafe assumption that the "destructive fire of science" has annihilated revealed religion, it offers the alternative of the old world ethical system which is not founded on revelation at all—"the system of ontology founded on reason rather than belief"—which advocates the culture of the highest faculties of the mind; and teaches man that, avoiding all vain speculations about God and the soul, or his future self-conscious identity, he should concentrate his attention on existence as he finds it, and learn that all evil springs, not from the life without, but from the heart within, its cravings and its desires. "The attainment of true and lasting happiness is for him alone who from his own being shall eradicate the Cause of Sorrow, shall free his heart from all this grasping at straws in life's fierce waters, and from all this thirst after its false salt waves. And the way in which this may be done . . . is Truth the Fourth," &c.

The writer of the essay would do well to avoid overstating his case. It is not the fact that Buddhism has done more towards civilising the world than any other religion, nor can the proposition be unconditionally accepted that it has added more towards increasing the great sum of human happiness and peace than any other; for it is an indisputable fact that in this imperfect world (so slowly developing towards more perfect ends through the agency, not of one, but of all reasonable religions) war has, after all, been the great civilising agent, the cleansing and purifying principle which has age after age reconstructed higher forms of civilised existence on the ashes of destroyed communities. And war is wholly and absolutely obnoxious to Buddhist principles. As for the peaceful and happy conditions of such nations of the world as still recognise the gentle rule of the Buddhist priest, we may still be open to serious doubt. The Burmese, truly, are a light-hearted race—but is this due to self-culture, or environment? In Ceylon, alas! virulent family dissensions ending in crime are (or were but a few years ago) peculiarly frequent.

It is, however, impossible to do more than note the general character of the review. It is well written (there are two delightfully descriptive articles on "The Woman of Burma" and the "Shadow of the Shwe Dagon"), well printed, and well illustrated, and will do much to familiarise the European reader with the active principles of an eastern faith which is older than Christianity, and is professed by 500 millions of his human contemporaries. In the modern world of free thought and toleration such a magazine as this should be welcome, and it would not be surprising if it attained a wide circulation.

[1] *Buddhism*, an Illustrated Quarterly Review. (Printed and published for the International Buddhist Society by the Hantnawaddy Printing Works, Rangoon, Burma.)

TECHNICAL EDUCATION IN GERMANY.

THE excellence of the German system of higher scientific and technical education has been referred to in many articles which have already appeared in NATURE, and the lavish endowment by the State in Germany of the institutions in which the education is given was dealt with in our issue for March 12 (vol. lxvii. p. 433). We are glad to find that public attention is being again directed to the same subject by the *Times*, and that an exhaustive comparison

between the supply of technical education in this country and in Germany was made in a valuable article which appeared in the issue of that journal of November 9.

Most of the English technical schools have, says the writer in the *Times*, for their principal object the teaching of actual industries. In Germany, on the other hand, the term has come to be associated more and more with pure knowledge, and is now commonly reserved for those advanced academies which teach the science underlying industries, but not the industries themselves. What we generally call technical schools are in Germany called "Fachschulen," or Gewerbeschulen, that is, "trade schools," which fall into two main groups. The first group provides instruction for apprentices in the hand trades and for artisans, and may be called "lower trade schools." The second group is large and of great direct importance to the manufacturing industries. The "technical schools" in our large manufacturing towns correspond most nearly to these institutions, which may be called "higher trade schools." Then above these is the highest class, namely, the "technical high schools," which do not correspond to any of our educational institutions. This classification gives a clear view of the special educational provision for industrial life in three broad divisions:—(1) ordinary workmen; (2) those above the grade of workmen from foremen to manufacturers; (3) the high scientific experts, consultants, and innovators.

The main differences between the higher trade schools and the corresponding English technical schools are two—they are more specialised, and are chiefly intended for and used by superior students. There is some provision for workmen, but, as a rule, comparatively little advantage is taken of it. The classes proper are held in the day, and cannot be attended by men at work; those thronged evening lecture-rooms and laboratories filled with young fellows out of the factories and workshops which may be seen in any large manufacturing town in England are almost unknown in Germany. The real meaning of this is that the English schools cater for students in a lower rank of life and teach a much larger number of subjects. The German schools of this class, on the contrary, are quite clearly differentiated. They are not quite so restricted as the description applied to them suggests. The "weaving" schools, for instance, generally embrace all the main textile processes. But they are strictly devoted to some special branch of industry, and their main function is to enable students, who are to occupy superior positions, to acquire a thorough mastery of the skilled processes. Our own textile schools do excellent work, and, so far as affording opportunities to the working classes is concerned, they do far more than the German ones, but they do not command the same superior material. The reason for this is that there is not yet the same inducement to young men who have had a superior liberal education to take up the career of manufacturers' expert. This fact is really at the bottom of the question of scientific education. Given the demand, the supply will follow. The lesson to be learnt from Germany is to make industrial science a sufficiently attractive career for those who have received a superior general education, and particularly a full classical one. The Germans have no belief in the American plan of teaching trades wholly in schools. With regard to finances, these schools are supported by fees, endowments, municipal and State grants, but the general tendency is towards more and more State support and State control.

The technical high schools, of which there are nine, with two more in preparation, represent a further step. As the superior grade of trade schools has been developed from a lower, so the high schools have been developed from trade schools to meet still higher requirements. They have the *status* of universities, are self-governing, and do for the industrial professions what the universities do for the learned professions—that is, impart the highest training in those principles which form the theoretical groundwork of practice. The technical high schools do not supersede or overlap the universities: they supplement them.

The technical high schools have no uniform curriculum, but all of them teach architecture, civil and mechanical engineering, chemistry, mathematics, and physical science. Exceptional subjects are naval architecture (Berlin), mining (Aachen), forestry (Stuttgart), agriculture (Munich). Pharmacy is taught at Brunswick, Karlsruhe, and Stuttgart, and at the last there is a railway, post, and telegraph course. Previous practical knowledge is generally required, as in the trade schools, and more rigidly insisted on. The high school is even less than the trade school a substitute for apprenticeship.

The two really important departments of the technical high schools are chemistry and electrical engineering. It is impossible to exaggerate the importance of the first; it enters into every branch of manufacture, and becomes more potent every day. At the high school teaching and experiment are pushed to the furthest theoretical limits, and the value to Germany is incalculable. Her chemical industries are reckoned to bring in fifty millions a year, but the application of chemical knowledge goes far beyond that and extends into a thousand channels. Nor can any man tell what it may bring forth to-morrow. This is the great lesson in industrial science that the high school has to teach. But it must not be forgotten that chemistry can be, and is, equally well taught at the universities. So, too, electrical engineering, which has also been of immense value to Germany; but her rapid industrial advance in that line, compared with ourselves, is due less to superior knowledge than to the gratuitous retardation of the home industry by Government regulations.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, December 11.—Mr. James Swinburne, vice-president, in the chair.—A method of mechanically reinforcing sounds, by the Rev. T. C. **Porter**. If a tuning-fork be sounded and placed in a flame, there is a very marked reinforcement of the sound. This is proved not to be due to resonance in the ordinary sense, but to the change from continuous to intermittent combustion. In certain circumstances the impulses given to the air external to the flame, by the waves of burning gas, are more forcible than those given by the unaided sounding body. Thus a new way of reinforcing the sounds given by a vibrating body is found, and the rest of the paper demonstrates this for the phonograph, a *flame* being used instead of the ordinary *trumpet*. Coal-gas and air are brought by tubes into the chamber of the "reproducer" and thence to a jet, where they are burnt. The vibrations of the reproducer are thus impressed on the issuing gas and air, which burn synchronously with them, the sounds thus emitted being easily heard over a large room. In practice it is found best to spread out the flame by a second jet of air, or of mixed air and gas, placed close to the first jet and at right angles to it. The author describes the nature and quality of the sounds emitted by the flame, and the modifications of these which may be produced.—The Simmance-Abady "flicker" photometer, by Messrs. **Simmance** and **Abady**. The principle of the flicker photometer, discovered by Prof. O. N. Rood ten years ago, has frequently been remarked on, but attempts to design a trustworthy apparatus depending upon this principle have hitherto been unsuccessful. The authors, guided by the following rules, have designed a photometer which is capable of balancing and comparing the most violently contrasted tints:—The light-effects must be in juxtaposition without any apparent division line, and must move, oscillate, or rotate so that the point of juncture of the rays of the two lights passes and returns entirely across the vision field. Any hiatus, or longer exhibition of one light than the other, biases the result. The observation surfaces, or surfaces upon which the light rays fall, must be at exactly the same distance from the eye, at exactly the same angle in relation to the line of sight, and must be of pure white, such as is afforded, for example, by a clean chalk, plaster of Paris, magnesium carbonate, or barium sulphate; any tint affects the accuracy of the result. The observation surfaces must also themselves in turn occupy the field of vision; an apparent movement or optical illusion does not afford accurate results.—Mr. Rollo **Appleyard** exhibited a "conductometer" the theory and mechanical details of which are fully described in the *Proceedings* of the Institution of Civil Engineers, vol. cliv., session 1902–3, part iv.—Prof. L. R. **Wilberforce** exhibited

a model to illustrate various properties of wave-motion. The model consists of a series of brass balls suspended in a line by spiral springs and capable of transverse or up and down motion. The balls can be set in vibration by releasing them from extreme positions by means of triggers, one set of triggers controlling the up and down motion, and another set the pendular.

Chemical Society, December 3.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The molecular formulæ of some fused salts as determined by their molecular surface energy, by Mr. J. F. **Bottomley.** Measurements of the variation of capillary rise of fused sodium and potassium nitrates with temperature have shown that these salts probably exist in a fused state in the form of complex molecules containing nine or ten of the molecules represented by the simple formulæ $NaNO_3$ and KNO_3.—The atmospheric corrosion of zinc, by Mr. G. T. **Moody.** It is shown that the semi-crystalline scale formed on the surface of the metal when zinc is exposed to the atmosphere consists of a hydrated carbonate. The same compound is formed when zinc is dissolved in a solution of carbon dioxide and the resulting solution is exposed to the air. From these experiments the author concludes that carbon dioxide is the principal agent in the atmospheric corrosion of zinc, as he has already shown it to be in the case of iron.—The formation of urea by the direct hydrolysis of lead cyanate, by Mr. A. C. **Cumming.** When lead cyanate is boiled with water it is decomposed with the formation of urea and lead carbonate.—Acid salts of monobasic acids, by Mr. R. C. **Farmer.** An account of the physical properties of some acid salts of benzoic acid and their derivatives is given.—The solubility curves of the hydrates of nickel sulphate, by Messrs. B. D. **Steele** and F. M. G. **Johnson.** Solubility curves are given for the heptahydrate, α- and β-hexahydrates, and for the dihydrate.—Action of malt diastase on potato starch paste, by Messrs. B. F. **Davis** and A. R. **Ling.** When malt diastase is heated in aqueous solution at temperatures in the neighbourhood of 60° C. its action upon starch paste is weakened, and *dextro*glucose appears among the products of hydrolysis.—The formation of phloroglucinol by the interaction of ethyl malonate with its sodium derivative, by Mr. C. W. **Moore.** It is shown that the condensation product formed in this reaction is ethyl phloroglucinoldicarboxylate, and not the tricarboxylate as stated by von Baeyer.

Mathematical Society, December 10.—Prof. H. Lamb, president, in the chair.—The following papers were communicated:—Mr. R. J. **Dallas,** Proof of a formula in elliptic functions.—Dr. E. W. **Hobson,** On modes of convergence of an infinite series of functions of a real variable. The condition of uniformity of convergence is known to be sufficient to secure the continuity of the function expressed by the sum of an infinite series the terms of which are continuous functions, but the function may be continuous without the convergence being uniform. The necessary and sufficient conditions have recently been made out, and new proofs of them are given in the paper. Another matter discussed is the nature of the conditions which are necessary and sufficient to secure that, when the terms of the series are integrable without being continuous, the function expressed by the sum of the series is integrable. The methods of proof depend upon applications of the Heine-Borel theorem in the theory of aggregates.—Mr. W. H. **Young,** On the distribution of the points of uniform convergence of a series of functions. It is proved that the points in question form an "inner limiting set," and that, conversely, given any such set of points, a series of functions can be constructed having these points, and these points only, as points of uniform convergence.—Rev. F. H. **Jackson,** A generalisation of Neumann's expansion of an arbitrary function in a series of Bessel's functions.—Prof. A. C. **Dixon,** On many-valued Newtonian potentials. The paper deals with a theory on the lines of Riemann's theory of the Abelian functions, but relating to space of three dimensions. The various values of the potential function become different one-valued functions in a bounded simply-connected region, and these various values must be supposed to exist in different co-extensive examples of this region. The chief question is that of the existence of a potential one-valued throughout all the coextensive examples of the region, and having a simple pole at an assigned point in a particular example. Two values of a many-valued potential, which are permuted by description of an irreducible circuit, may differ by a constant or by a variable function.—Mr. P. E. B. **Jourdain,** On functions all of whose singularities are non-essential.—Prof. J. D. **Everett,** On normal and anti-normal piling. The object of the paper is to exemplify a convenient method of dealing with systematic assemblages of points. Normal piling denotes a particular homogeneous assemblage, whereas the arrangement in anti-normal piling is made up of two homogeneous assemblages. Both arrangements give the maximum of compactness.—Lieut.-Colonel Allan **Cunningham** made a preliminary communication on some properties of Fermat's numbers. If $F_n = 2^{2^n} + 1$ and P is a product of F's, the smallest suffix (a) exceeding unity and the highest not exceeding $2^a - 1$, then $2^{P-1} \equiv 1 \pmod{P}$ and $2^{P(P-1)} \equiv 1 \pmod{P^2}$.

Entomological Society, November 18.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. G. C. **Champion** exhibited numerous specimens of both sexes of *Xyleborus dispar,* from Moncayo, Spain, taken out of beech-stumps.—Mr. F. B. **Jennings** exhibited (1) on behalf of Mr. H. Britten, of Great Salkeld, Cumberland, a specimen of *Tropiphorus tomentosus,* Marsh., from Great Salkeld, showing the deciduous false mandibles intact; (2) a ♀ specimen of *Anchomenus parumpunctatus,* F., from the same locality, showing a malformation of the middle right tibia which was abnormally thin, and bent in the centre, but thickened at the base; the right antenna also had the last seven joints flattened and dilated. Mr. Jennings also exhibited, on his own behalf, *Apion sanguineum,* De G., taken at Brandon, Suffolk, in August last, on Rumex.—Mr. H. St. J. K. **Donisthorpe** exhibited *Apium sorbi,* ♂, taken this year at Freshwater, Isle of Wight, and said that the ♂ of this species was extremely rare.—Mr. M. **Burr** exhibited two ♀s and two ♂s of the largest known earwig, *Anisolobis colossea,* Dohrn., from New South Wales, representing the extremes of size, the average size being between these two extremes.—Mr. A. J. **Chitty** exhibited a specimen of the beetle *Homalium testaceum,* taken in Blean Wood in 1900, and a pair of bees, *Nomada guttulata,* of which the ♂ has never been recorded hitherto in Britain, taken by him at Huntingford, Kent, in May last.—Dr. Norman **Joy** exhibited (1) *Euconnus mäklini,* Mannerh., taken at Bradfield in July, 1901, new to the British list of Coleoptera; and (2) a series of beetles taken at Bradfield at the exuding sap of trees attacked by *Cossus ligniperda.*—Colonel J. W. **Yerbury** exhibited specimens of rare British Diptera, including *Leptopa filiformis,* Lett., *Thyreophora furcata, Pelidnoptera nigripennis,* and *Lucina fasciata.*—Dr. T. A. **Chapman** exhibited specimens of *Chrysophanus phlaeas* captured at Reigate, Locarno, and in Spain, showing the apparent effects of temperature on the coloration and wing markings.—Mr. G. J. **Arrow** showed specimens and diagrams illustrating a remarkable kind of variability noticed in beetles of the Trogid genus Acanthocerus. These beetles have the faculty of rolling themselves into a ball, in the interior of which all the vulnerable parts are enclosed. The head forms a large triangular plate in which the eyes appear half on the upper and half on the lower surface. In some examples of the species exhibited (*Acanthocerus relucens,* Bates) the upper division of the eyes forms a large, nearly circular mass, while in others it is reduced to a mere thin vestige, and in extreme examples of another species of the genus it was found to vanish altogether.—Prof. **Poulton** showed an exhibit sent by Mr. A. H. Thayer, of Monadnock, N.H., U.S.A. The greyish silhouettes of two butterflies were represented in a tint nearly the same as the background, but sufficiently distinct to be easily recognisable. On one side of one silhouette a row of white spots had been placed in a submarginal position. It was evident that the adjacent border was thereby rendered far less distinct than that of the opposite side of the silhouette, or of both sides of the other silhouette. The spots in position and shape were approximately as in *Papilio asterias,* and Mr. Thayer considered they possessed a similar significance in this butterfly. Prof. Poulton also exhibited specimens of *Drurya antimachus,* together with the butterflies which he suggested as forming a group synaposematic with it. The central species

appeared to be *Acraea egina*, round which clustered a number of other species of the same genus, so much alike as to be probably indistinguishable upon the wing. Examples of these were exhibited, viz. *A. zetis*, *perenna*, *rogersi*, and *pharsalus*. Another beautiful papilionian member of the group, *P. ridleyanus*, was also shown. The pattern was nearest to that of the male *A. egina*. In fact, so close was the resemblance that Godart had been entirely misled by it, and had described the Papilio under the name of *zidora* as the female of *Acraea egina*.—Mr. Edward **Saunders**, F.R.S., communicated a supplementary note to a paper entitled "Hymenoptera Aculeata Collected by the Rev. A. E. Eaton, in Madeira and Tenerife, in the Spring of 1902."

Geological Society, November 18.—Sir Archibald Geikie, F.R.S., vice-president, in the chair.—Notes on some Upper Jurassic Ammonites, with special reference to specimens in the University Museum, Oxford, by Miss Maud **Healey**. In rearranging the Upper Jurassic fossils in this museum the prevailing misconception with regard to Sowerby's species *Ammonites plicatilis* and *Am. biplex* came under notice. The type-specimen of *Perisphinctes plicatilis* (Sow.) is refigured and described. It appears to be an Upper Corallian form, and is usually taken as the zone-fossil of that horizon. Sowerby's two figures of *Perisphinctes biplex* represent different specimens. One, probably from a Kimmeridge Clay nodule found in the Suffolk Drift, is refigured and described. It would be wisest, the paper suggests, to abandon the name, or at least to restrict it to the abnormal specimen to which it was attached. The original specimen of *Perisphinctes variocostatus* (Buckland) came from the so-called Oxford Clay at Hawnes, but evidence that it was really derived from the Ampthill Clay was given. Sowerby's *Ammonites rotundus* is doubtfully identified as a variety of *Olcostephanus Pallasianus* (d'Orb.). It was derived from the Kimmeridge Clay of Chippinghurst, and is the zone-fossil of the Upper Kimmeridge Clay.—On the occurrence of Edestus in the Coal-measures of Britain, by Mr. E. T. **Newton**, F.R.S. This genus was originally described from the United States, and was afterwards recognised in Russia and Australia. The genus was placed with Helicoprion and Campyloprion in the family Edestidæ. The specimen here described was obtained by Mr. J. Pringle from one of the marine bands between the "Twist Coal" and the "Gin-Mine Coal," in the Smallthorn sinking at Nettlebank (north Staffordshire). The specimen is a single segment of a fossil closely resembling *Edestus minor*, and consists of an elongated basal portion, bearing at one extremity a smoothed, enamelled, and serrated crown. The fossil is not to be referred to any existing species, and a new name is given to it. While it seems most in accordance with present knowledge to regard the "spiral saw" of Helicoprion as the symphysial dentition of an Elasmobranch, possibly allied to the Cestracionts, it does not seem so probable that the forms referred to Edestus are of the same nature. The author thinks the latter are more likely to be dorsal defences.

Zoological Society, November 17.—H.G. the Duke of Bedford, K.G., president, in the chair.—Mr. Henry **Scherren** exhibited and made some remarks on the largest horn of *Rhinoceros simus* yet obtained from the Soudan. He directed attention to the fact that the species appeared to be fairly numerous on the northern boundary of the Congo Free State and in the adjacent parts of the Soudan.—Mr. R. I. **Pocock** exhibited a piece of basalt, picked up on the coast of Victoria, Australia, which contained a web of the marine spider *Desis kenyonae*. This served to illustrate the habit of the spiders of the genus Desis of spinning a closely woven sheet of silk over a crevice in the rock as a protection against the rising tide.—Mr. Pocock also gave an exposition, illustrated by drawings, of a new suggestion as to the use of the white rump-patches of Ungulata, with special reference to the races of Burchell's zebra.—Mr. E. E. **Austen** exhibited and made remarks on specimens of *Glossina palpalis*, the species of tsetse-fly which is concerned in the transmission of "sleeping sickness" in the Uganda Protectorate. He also exhibited, for the sake of comparison, specimens of four other species of tsetse-flies, including *Glossina longipennis*, which occurs in Somaliland, and may possibly prove destructive to the transport animals of the Somaliland Field Force.—Mr. Oldfield Thomas, F.R.S., exhibited, on behalf of Mr. W. E. **de Winton**, a drawing of a skin of a female gazelle—probably *Gazella muscatensis*—from Sheik Oman, near Aden, which showed a perfect hair-whorl on the withers. This whorl had been found to be absent in the male.—Mr. C. Tate **Regan** read a paper entitled "A Revision of the Fishes of the Family Loricariidæ," in which nearly 200 species were recognised as valid, 35 being described as new to science.—Dr. Blanford read, on behalf of Mr. V. V. **Ramanan**, a communication entitled "Early Sanskrit References to the Tiger," in which it was pointed out that the tiger was frequently alluded to in Sanskrit literature, and that Colonel Stewart was in error in stating at a previous meeting that there was no Sanskrit name for this animal.—Mr. F. E. **Beddard**, F.R.S., read a paper on the trachea and lungs and other points in the anatomy of the hamadryad snake (*Ophiophagus bungarus*).—Mr. G. A. **Boulenger**, F.R.S., read a report on the fishes collected by Mr. Oscar Neumann and Baron Carlo von Erlanger in Gallaland and southern Ethiopia. Examples of 19 species, 4 of which were new, were contained in the collection, and these were enumerated and described.

Royal Meteorological Society, November 18.—Captain D. Wilson-Barker, president, in the chair.—Dr. H. R. **Mill** and Mr. R. G. K. **Lempfert** gave an elaborate and interesting paper on the great dustfall of February and its origin. From the maps exhibited it appears plain that the dust reported on February 21 or 22 fell over nearly all parts of England and Wales to the south of a line drawn from Anglesey to Ipswich, except in parts of north Cornwall, Somerset, Wilts, and mid-Wales. The dust usually attracted attention either in the form of a dense yellow haze, like a London fog, or as a reddish-yellow powder, lying thickly on trees and roofs. The fall was often accompanied by temperatures considerably above the average, and by remarkably low relative humidities. In order to ascertain whether the composition of the dust threw any light on its origin, about fifty samples were submitted to the Geological Survey and examined by Dr. J. S. Flett. In addition to the coarser particles, all the samples contained a very fine-grained reddish clay, the particles of which were too minute to be determined mineralogically. This clay was certainly derived from some source beyond the British Isles, but it was not distinctive enough to afford much evidence as to its place of origin. Maps have been constructed showing the distribution of the dust and the meteorological conditions prevailing over the period when it appeared. These form the basis of a discussion by Mr. Lempfert as to the place of origin and the direction of travel of the air which was passing over western Europe at the time in question. The trajectories of the air which reached the southern half of England can be traced backwards in a south-westerly direction to the neighbourhood of the Azores, but here it turns to the south, and finally to the south-east, and is carried back to the north-west coast of Africa on the morning of February 19. The authors are therefore of opinion that there is reason to believe that the air which reached the southern half of England on February 22 started from the north-west coast of Africa on February 19, and they consider this affords strong evidence of the African origin of the dust, and of its having travelled to north-west Europe by a path not very different from that indicated by the trajectories.

Linnean Society, December 3.—Prof. J. Bretland Farmer, F.R.S., vice-president, in the chair.—Dr. Eric **Drabble** gave an account of his recent researches on the anatomy of the roots of palms, illustrated by lantern-slides from his drawings. He stated that the roots of more than sixty species have been examined. Essentially similar results have been obtained from each. It appears that the "medulla" in palm-roots is merely that portion of the common ground-parenchyma, arising at the non-stratified apex, which becomes enclosed distally by fusion of the procambial strands, and hence differs in no respect from the external "cortical" parenchyma. An attempt was made to extend this idea to other vascular plants, and the suggestion was put forward that all ideas of "monostely" and "polystely," and of "medulla" and "cortex" as

separate morphological entities, are based on an artificial conception of the structures involved.—In a paper by Dr. Arthur **Willey,** F.R.S., an account was given of twenty-eight species of littoral Polychæte worms from South Africa, of which four are new. The specimens had been carefully prepared, and the author is satisfied with the results. He comes to the general conclusion that the annelid fauna of the Indo-Pacific region may be said to be composed of an assemblage of endemic, Caribbean, and Mediterranean constituents.—Notes on *Myriactis Areschougii* and *Coilodesme californica,* by Miss May **Rathbone.** The species of Myriactis in question is parasitic on *Himanthalia lorea,* forming very small tufts with a cushion of large torulose colourless cells, deeply sunk in the thallus of the host. Material was obtained from Cumbrae in March which shows penetrating rhizoids belonging to some parasitic alga; they start from the base of the cushion and travel far in the tissues of the host, and the conclusions of the author are that these rhizoids act as stolons for propagating the plant, which seems rather to be an endophyte than a parasite.

Anthropological Institute, December 8.—Mr. H. Balfour, president, in the chair.—The Rev. R. A. **Bullen** exhibited a series of polished and other slate implements from Harlyn Bay, Cornwall. The implements were found on the site of a late Celtic cemetery, the graves of which are lined with slate, buried some twelve feet beneath blown sand. Mr. Bullen was of opinion that the implements showed unmistakably the hand of man, but, in the discussion which followed, Mr. C. H. Read expressed his firm conviction that the implements had been worn, not by man, but by the sand which for centuries had been drifting continually over them. Most of the implements, he considered, were simply chippings from the slate linings of the graves, worn by the sand to their present shape.—Dr. William **Wright** read a paper on skulls from round barrows in east Yorkshire, the skulls in question being now in the Mortimer Museum at Driffield. About eighty of them were examined. The interments, from the evidence of the finds, appeared to date from the early Iron or late Stone age. As to the skulls themselves, Dr. Wright showed that almost every variety of cranial shape was found among them, such widely different types as Sergi's *Ellipsoides Pelasgicus Longissimus, Sphenoides Latus,* and *Cuboides Procerus* being present, while the cephalic index ranged from 69 to 92. In fact, so varied were the types that Dr. Wright felt that it was doubtful whether, in a community of the present day, it would be possible to find a more mixed series of skulls. A most interesting point was the extraordinary resemblance, in many cases, between the skulls from any one barrow, in fact it was so striking that Dr. Wright felt inclined to attribute it to the barrows having been family burial-grounds. The resemblance was particularly noticeable in nine skulls taken from one barrow. Four of these had the metopic suture unclosed, and it was interesting, and somewhat unexpected, to find that metopism occurred in long rather than in broad skulls. The conclusion drawn from Dr. Wright's paper was that Thurnam's dictum of "round barrow round skull" was not even approximately accurate so far as skulls from the round barrows in Yorkshire were concerned.

MANCHESTER.

Literary and Philosophical Society, November 17.—Prof. H. B. Dixon in the chair.—Prof. **Lamb** exhibited and described two photographs, taken at the Isle of Man by Mr. Hiller, one of which showed very clearly the interference between the direct and reflected waves on the sea coast. The points of intersection of the two systems of waves were particularly well marked. Mr. T. **Thorp** exhibited a small glass tube containing a little radium bromide at the sealed end, and terminating in a bulb at the other end. The whole formed a vacuum tube, and was a very convenient and portable instrument for showing the fluorescence of radium bromide on a barium platino-cyanide screen in the dark. He also stated that the bulb caused a charged electroscope to discharge very rapidly.—Messrs. R. S. **Hutton** and J. E. **Petavel** described some experimental work which they have undertaken with the view of studying the effect of high gaseous pressures upon electric furnace reactions. The investigation is being carried out in the electrochemical laboratory of the Manchester University. The preliminary results only were given, progress having been necessarily slow up to the present. The several dispositions of the furnace and of the arcs were described, and photographs of them thrown upon the screen. To obtain satisfactory results it is necessary to exceed the laboratory scale of operations. For the present the work has been confined to the production of calcium carbide, aluminium and nitric acid as effected by pressures up to 150 atmospheres.

DUBLIN.

Royal Dublin Society, November 17.—Prof. W. F. Barrett, F.R.S., in the chair.—Sir Howard **Grubb,** F.R.S., read the following papers:—(1) The adaptation of the flotation principle to large telescope mountings; a possible solution of the difficulties encountered in mounting great equatorial instruments; (2) the registration of star-transits by photography; (3) a new form of dipleidoscope; (4) a new surveying instrument for the rapid measurement of horizontal and vertical angles; (5) a new form of position-finder for adaptation to ships' compasses.—Dr. G. H. **Pethybridge** exhibited and described an improved form of potometer.—Sir Howard Grubb exhibited some new forms of geodetical instruments as already described in the *Transactions* of the Royal Dublin Society in May, 1902.

PARIS.

Academy of Sciences, December 7.—M. Albert Gaudry in the chair.—Some observations relating to the action of hydrocarbon vapours on animal microbes and on insects, and on the antiseptic *rôle* of oxidising-oxidisable agents, by M. **Berthelot.** In an experiment described by the author, the antiseptic properties usually ascribed to naphthalene were found to be non-existent. There would appear to be a relation between the oxidising power of a body and its antiseptic power.—On the electromotive forces resulting from the contact and the reciprocal action of liquids, by M. **Berthelot.**—On a new Protozoa, *Piroplasma Donovani,* the parasite of an Indian fever, by MM. A. **Laveran** and F. **Mesnil.** A description of a parasite isolated from a case of fever arising at Dum-Dum, near Calcutta. There appears to be no essential difference between this parasite and the Piroplasma already known, in particular, the type *P. bigeminum.* This genus of parasites occupies an important place in veterinary pathology, but this is the first time that a human disease has been traced to it.—On the property of emitting the *n*-rays conferred by compression on certain bodies, and on the spontaneous emission of the *n*-rays by tempered steel, tempered glass, and other bodies in a state of constrained molecular equilibrium, by M. R. **Blondlot.** Numerous substances have been found to give off *n*-rays during compression, recognisable by their action on feebly illuminated phosphorescent calcium sulphide. Substances such as tempered steel and glass, permanently under strain, appear to give off these rays indefinitely.—Observations on the Leonids and Bielids made at Athens during 1903, by M. D. **Eginitis.**—On a theorem on measurable ensembles, by M. Emile **Borel.**—Generalisation of a theorem of Laguerre, by M. A. **Auric.**—On the quality of helices used in aërostats, by M. Charles **Renard.**—On the intensity of the light produced by the sun, by M. Charles **Fabry.** The conclusion is drawn from the experiments described that the illuminating power of the sun at the zenith, at its mean distance, is, at the level of the sea, 100,000 candles.—On the direction of permanent magnetisation in certain volcanic rocks, by MM. Bernard **Brunhes** and Pierre **David.**—The effect of time in the comparison of the luminous intensity of coloured lights, by MM. André **Broca** and D. **Sulzer.** If two lights of different colours are compared in a photometer, the equality is affected by the time during which the disc is exposed to the light. The effects are due to differences in the retinal fatigue for the different colours.—On a new mode of calculating the heats of combustion of organic compounds, and on some of its consequences, by M. P. **Lemoult.**—Researches on azo-compounds. A new mode of formation of the indazylic derivatives, by M. P. **Freundler.**—The action of hydro-

cyanic acid upon aldehyde-ammonia and analogous compounds, by M. Marcel **Delépine.** The results of the experiments described show that the ordinary equations for expressing this reaction require some modification.—A new reaction of hydroxylamine, by M. L. J. **Simon.**—A new method for the preparation of aldehydes, by M. L. **Bouveault.** Disubstituted formaldehydes of the type H.CO.NR.R′ react with magnesium alkyl derivatives to form compounds which, on subsequent treatment with water and dilute sulphuric acid, yield aldehydes. The yields are good, and the method would appear to be of general application.—On the migration of the phenyl group, by M. Marc **Tiffeneau.**—On the esters of isopyromucic acid, by M. G. **Chavanne.** The methyl and ethyl esters of pyromucic acid cannot be obtained by the usual methods, but can be readily isolated by the use of ethyl and methyl sulphates.—On the hydrates of ethyl alcohol, by MM. E. **Varenne** and L. **Godefroy.** From the determination of the viscosity of alcohol-water mixtures, the existence of five hydrates of the alcohol is inferred.—The production and distribution of some organic substances in *Citrus madurensis*, by MM. Eug. **Charabot** and G. **Laloue.**—On the chemical characters of wine arising from vines which are attacked by mildew, by M. Émile **Manceau.** Such wines are distinguished from ordinary wines by several chemical differences, the most important being the increased proportion of albumenoid matters.—On the determination of the primitive form of crystals, by M. F. **Wallerant.**—The revision of the free marine Nematods of the region of Cette, by M. Etienne **de Rouville.**—A parasitic sporozoa of the mussel and other Lamellibranchs, by M. Louis **Léger.**—On the filosity of potatoes, by M. G. **Delacroix.** A study of the cause of the tendency to develop buds which lengthen considerably and remain thin.—On the Permian system in the French and Spanish Pyrenees, by M. J. **Caralp.**—Observations relating to the Tectonic in the mountain valley of Jalomita, Roumania, by M. J. **Bergeron.**

NEW SOUTH WALES.

Linnean Society, September 30.—Mr. Henry Deane, vice-president, in the chair.—The botany of Norfolk Island, by Mr. J. H. **Maiden.** No new species is described, but 45 Phanerogams (Dicotyledons 24, Monocotyledons 21) and 17 Cryptogams (ferns 6, lichens 10, fungus 1) are recorded for the first time as indigenous to the island. Of the Algæ gathered from the shores, all (with one exception) are new records for this particular locality. The paper contains a careful list of introduced plants. Section ii. of the paper deals with early general accounts of the vegetation, bibliography, Ferdinand Bauer and Norfolk Island, early Government gardens on the island, and Phillip Island. An almost complete collection of the Norfolk Island flora is now in the National Herbarium, Sydney.—The slime of *Dematium pullulans*, De Bary, by Dr. R. Greig **Smith.** A race of *Dematium pullulans* was found with *Bact. acaciae* in the gum-flux of the peach and almond. From cultures upon solid and in fluid media a slime was obtained, which proved to be a pararabin.—The physical geography of the Blue Mountains and the Sydney district, by Mr. E. C. **Andrews.** Repeated elevation of subaërially carved and successively formed plains or almost plains (peneplains) is the key to the history of the Blue Mountain and Sydney areas in late geological time. These plains, developed near sea-level, were successively raised to heights of 700–3000 feet above the same base. The elevations imposed a dome-shaped surface upon the area, the axis of the dome being drawn out in a meridional direction. The growth of the present rivers shows the revival of stream activities after a late Tertiary uplift, when the cycle of erosion immediately preceding the present one had advanced to the stage of completion.

October 28.—Prof. T. W. Edgeworth David, F.R.S., vice-president, in the chair.—The geology of the Glass House Mountains and district, Queensland, by Harald I. **Jensen.**—On a new species of Callitris from New South Wales, by R. T. **Baker.** This pine attains a height of about 20–30 feet, and a diameter of from 1–2 feet. The branchlets are slender, with a drooping habit, giving it a facies different from the other Australian species; the fruit cones are almost identical with those of *C. Muelleri*, whilst the terete branchlets are similar to those of *C. robusta*, R.Br. It appears to be a very local species, for after a botanical survey of the pines of this State it has so far never been found except on the top of the Gowie Ranges, north of Rylstone. The name *C. gracilis* is proposed for it in reference to the slender branchlets.—The effect of the Bassian Isthmus upon the existing marine fauna: a study in ancient geography, by C. **Hedley.** The union of Tasmania and Australia has been exhaustively dealt with by Mr. A. W. Howitt, and Prof. Spencer has shown how Tasmanian animals entered Victoria by this vanished landbridge. The present memoir discusses the barrier such an isthmus would oppose to migration of the marine fauna.—The gum and byproducts of *Bacterium sacchari*, by Dr. R. Greig **Smith.** The gum has been identified as a galactan. The byproducts in the fermentation of saccharose are carbon dioxide, ethyl alcohol, succinic, lauric, palmitic, acetic and formic acids.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 17.

LINNEAN SOCIETY, at 8.—On the Docoglossa; a Study in Evolution: H. J. Fleure.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The City and South London Railway; Working Results of the Three Wire System applied to Traction: P. V. McMahon.

FRIDAY, DECEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—An Inquiry into the Working of various Water-Softeners: C. E. Stromeyer and W. B. Baron.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Action of the Sea upon the Foreshore: C. B. Case.—The Causes of the Loss of Beaches: F. W. Cable.

SATURDAY, DECEMBER 19.

ESSEX FIELD CLUB, at 6.30 (Essex Museum of Natural History, Stratford).—Report on Protection of Birds in Essex: F. Dent.—Some Pictures of Bird Life at Home and Abroad: R. B. Lodge.

MONDAY, DECEMBER 21.

INSTITUTE OF ACTUARIES, at 5.—The Income Tax as affecting Life Offices, with Special Reference to some Recent Decisions: J. E. Faulks.

TUESDAY, DECEMBER 22.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On the Resistance of Plane Surfaces in a Uniform Current of Air: Dr. T. E. Stanton.

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