THURSDAY, MAY 21, 1908.

HISTORICAL GEOGRAPHY OF AUSTRALASIA.

Historical Geography of the British Colonies. Vol. vi. Australasia. By J. D. Rogers. Pp. xii+440. (Oxford: Clarendon Press, 1907.) Price 7*s.* 6*d.*

ALTHOUGH the geocentric idea of the structure and movements of the universe was abandoned ages ago, mother earth must always remain as much the focus of interest to the dwellers on the globe as if it were still regarded as the point from which the heavens radiate and round which everything revolves. It is not surprising, therefore, that geography is assuming the position of the mother science, and tends to include, not only the physical features of the earth, but all the events which have taken place upon it.

Sir Charles Lucas appropriately names the series in which he describes the Britains beyond the sea a "Historical Geography of the British Colonies." Viewed in the modern manner, geography becomes invested with a human interest, and each country is dealt with as an organic entity. Dry bones are thus made to live. The study of the science is, as it were, transferred from the anatomical museum to the biological laboratory. Disconnected gazetteer paragraphs no longer suffice even for text-books, and for a volume with any pretensions some degree of style is now demanded; nevertheless, it is not often that we open the pages of a geography compiled with such artistic skill and clothed in such literary garb as "Australasia," vol. vi. of the series. Here we have an enormous mass of closely-packed information which would defy assimilation were it not traversed and lightened by veins of fancy in the form of apt similes and ingenious images which at once arrest the attention and fix the memory.

The volume deals with the most significant of modern developments, the transformation of the mystery of the old Pacific into the modern problem which confronts the civilised world. The story opens with a graphic account of the quest of the great South land of which the ancients dreamed. Eager was the search; Spain, Portugal, Holland and England panted in the chase. The privateering enterprise of England's sea dogs vied with expeditions equipped with all the resources of the mighty State of Spain. Every human motive was enlisted in the pursuit. The great unknown was adventured for the glory of God, for lust of conquest, for greed of gold, and for prospects of trade. The adventurers sought as saints, as soldiers, as misers, as bag-men. Human lives were as dust in the balance compared with the laying up of treasure here or hereafter. Quiros, a Spaniard, landing on one of the New Hebrides, imagined he had gained the goal, and called the island Australia del Espiritu Santo; this is the first mention of the term afterwards applied to the great island continent which emerged out of the turmoil of hope and disappointment.

The actual discovery of Australia was made from the Dutch East Indies, hence the name New Holland. The best part of Australia, the east coast, guarded towards the north by the Barrier Reef, remained a sealed book until the detailed investigation narrowed down into a rivalry between France and England. But though the ships of these two great colonising nations haunted and pursued one another as shadow and substance, the sincerity and high-mindedness of the commanders led to mutual aid and admiration, and not to conflict. As La Perouse remarked, all Europeans are compatriots so far from the home land. The history of the Pacific had hitherto been regarded as an inseparable whole; henceforth this homogeneity becomes particulate. In accordance with the laws of evolution, the New Pacific advanced towards organisation by a separation into parts.

The political history of Australia falls within three epochs. The first epoch was undiluted socialism. In the beginning was the State which fed, clothed, and employed every man; but as wealth increased private enterprise grew. The State, which at that time meant England, gradually became a total abstainer from production and industry; then, as under increasing autonomy, the State became identical with the Colony, private enterprise was fostered by grants in aid; important works, such as railways and waterworks, being undertaken by governments, which extended their activity in many other directions, so that since 1890 State socialism has been reintroduced in a way which vividly recalls that of the first epoch.

This aspect of State action alternating with individual action is both interesting and instructive as bearing on the much-vexed question of socialism. Evolution advances at one time by the impulse that makes for difference, and at another by that which induces agreement; the first shows itself in the diversified activities of the individual, the second in the corporate action of the municipality or State. Thus difference in agreement becomes harmony. Both tendencies are essential, and the individuals who denounce socialism as altogether evil are no more enlightened than those socialists who seek to minimise the importance of individual initiative.

Mr. Rogers deals with the pioneer laws of Australia and New Zealand in the matter of industrial arbitration. The wages boards, which, originating in Victoria, have done so much to stamp out sweating, are of special interest at the present moment, when it seems likely that the mother country will, in this as in so many other cases, follow the lead of the daughter States. In an appendix to the first portion of the volume a graphic account is given of the constitution of the Australian Commonwealth.

The second portion of the volume is devoted to geography pure and simple, and here the method of the first, or historical, portion is reversed, for whereas the history began with continents and ends with islets, the geography, in accordance with modern custom, proceeds from the local to the general; "the wayside flower will be examined before the garden and the garden before the forest." The book is a living entity which cannot be dealt with after the

methods of the dissecting room; it must be read as a whole to be appreciated. Its perusal will be found to give both pleasure and a real acquisition in knowledge. Mr. Rogers is to be congratulated on the production of a volume in every way worthy of its place in a series designed by one so conversant with our colonial empire as Sir Charles Lucas.

JOHN A. COCKBURN.

BRITISH ASCIDIANS.

The British Tunicata. An unfinished Monograph by the late Joshua Alder and the late Albany Hancock. Edited by John Hopkinson. Vol. ii., with Lives of the Authors by Canon A. M. Norman, F.R.S., and the late Dr. Dennis Embleton. (London: Ray Society, 1907.) Price 25*s.* net.

THE first volume of this work was published in 1905, and was noticed in NATURE in the following year (vol. lxxiii., p. 508). So far as the so-called "simple" and "social" Ascidians are concerned, the work is now complete. No statement is made as to whether we are to expect a third volume on the "compound" Ascidians. We understand, however, that such a volume is in preparation, and that it will include a bibliography of the Tunicata by the editor. We may repeat our congratulations to the Ray Society for publishing this long-lost work, and to Mr. Hopkinson for his careful editorship under many difficulties. The numerous coloured and photographic plates included in this volume maintain the same high standard as in its predecessor, and the lives of the authors, by their friends Canon Norman and the late Dr. Embleton, which are prefixed to this volume, are full of interest for all who can appreciate the simplicity of nature and patient genius of two of the most distinguished pioneers in the field of British marine zoology.

Mr. Hopkinson has, with one exception, limited his notes to the addition of bibliographic and distributional records published before 1871. The monograph consequently possesses as nearly as possible the character which it would have assumed if it had been published in the latter year, two years before Hancock's death.

The present volume deals with Ciona and Corella among the Ascidiadæ, and with the families Molgulidæ, Cynthiadæ, and Clavelinidæ, in the broadest sense of these various terms. Between fifty and sixty "species" are described, of which no less than eleven are put forward as new. Three of the latter are referred to the genera Molgula, Cynthia and Clavelina respectively, two to Styelopsis, and six to Styela. In most of these cases it is more than doubtful whether the characters relied upon by the authors possess sufficient stability to serve as a criterion of specific differences. Some of these "new species" are undoubtedly mere variants from common types, together with other forms which are described in the monograph under names previously conferred upon them by the authors and other naturalists. The "new" species *Clavelina corrugata* is described as differing from the common *C. lepadiformis* merely in the wrinkling of the test and in the pinkish colour of the pharyngeal stripes, which are white or yellowish in the common type. A single tide-pool on the Devonshire coast will occasionally show half a dozen equally well-marked variants from the same type.

It would be tedious, as well as unprofitable, in this notice to enter upon a detailed comparison of the authors' nomenclature of recognised species with the systems in current use. But it is to be hoped that the publication of this monograph will not have the result of introducing further confusion into a subject already sufficiently tangled, in which the more critical revision work of the last twenty years has not yet produced complete concordance of results. The revival of Müller's *conchilega* for a species of Molgula is particularly unfortunate, for there is good reason to regard Müller's type as a common species of Ascidia, while Alder and Hancock's *Molgula conchilega* is plainly identical with Kupffer's *Molgula occulta.* It is doubtful, by the way, if Mr. Hopkinson is justified in assigning to this species the various records of *Ascidia conchilega* which have been based upon Müller's original description. The substance of a remark which I made in my previous notice may be fitly repeated, that the monograph, after all these years, must be cautiously used as a repository of descriptions and figures, but not as a guide to the classification or nomenclature of the group.

In one respect Mr. Hopkinson has departed advantageously from his rule not to add any observation of later date than 1870, since he has incorporated a definition of the genus Styelopsis, which was founded in 1882 by Traustedt for the common *Styela grossularia,* a species which Alder and Hancock themselves recognised as markedly distinct from the other species of Styela. In these circumstances the editor might well have pointed out that the form described by Victor Carus as *Thylacium sylvani,* which is included in this monograph under that name, is in all probability nothing but *Styelopsis grossularia,* of which the young individuals, fixed on the tests of the parents, had been erroneously regarded as evidence of gemmation. I can confirm all that Michaelsen has recently said on this point ("Revision der compositen Styeliden oder Polyzoinen," Hamburg, 1904), with some additions, since in 1891, with the permission of the Linacre professor, I dissected a portion of Carus's type in the Oxford Museum, and found it to be identical in structure with *S. grossularia,* while the so-called buds were true metamorphosed larvæ, possessing characteristic protostigmata (Proc. Royal Soc., li., pp. 505–13). In the following year also I searched the original locality, and many others, in the Scilly Islands, and found the same species covering the rocks in immense numbers, as described by Carus in the case of *Thylacium sylvani.* It is interesting to notice that in this monograph Alder and Hancock record the fact that they also had "seen" the original specimen in the Oxford Museum, and record their doubts as to the existence of gemmation, as well as their impression of the "very close resemblance between the *Thylacium sylvani* and some of the smaller gregarious Cynthiæ already described." The

only discrepancy in this interpretation is the fact that Carus recorded *Cynthia rustica* (=*S. grossularia*) as well as *T. sylvani* from the Scilly Islands. Presumably the former term was restricted to the less crowded clusters in which the larvæ had not fixed themselves to the bodies of their parents.

WALTER GARSTANG.

PRINCIPLES OF BREEDING.

Principles of Breeding. A Treatise on Thremmatology. By E. Davenport, with appendix by H. L. Rietz. Pp. xiii+727. Country Life Education Series. (Boston, New York, Chicago, London: Ginn and Company, n.d.) Price 12*s.* 6*d.*

THIS is the first serious attempt to present a modern scientific text-book on the principles of breeding (or, as the author prefers to call it, thremmatology) to English-speaking agricultural students, in which recognition is accorded to much of the recent work done on genetics and some other branches of the physiology of the generative system, and in which effort is made to show the essential value of that work to breeders. The book is most welcome, and our thanks are due for it to the professor of thremmatology in the University of Illinois.

The author's idea of what is needful for the education of an agricultural student is very far in advance of what is usually considered sufficient for that purpose; his book is adapted not only to convey a much wider knowledge of scientific work than has been hitherto thought necessary, but to demonstrate the direct effect such work must have on the fortunes, the ultimate success, of the modern practical breeder.

In spite of the fact that Prof. Davenport declares the breeder of the future will be a book-keeper and statistician, his book shows he has a somewhat wider appreciation of the breeder's qualifications than these words indicate. At the same time, it does seem possible that his enthusiasm for the pure science of genetics has led him to load his book somewhat too heavily with figures, and to neglect to inculcate with sufficient force the necessity for a breeder's close attention to and intimate knowledge of the capacities and peculiarities of individual members of a flock or herd. This is, in our opinion, a serious defect in a text-book for agricultural students; the power of close observation is an essential qualification for a breeder.

Similarly, the author's endeavour to induce the student to take "short cuts" to success is to be deprecated. He urges "A man must realise the fruit of his own labours." "The breeder must therefore work faster than nature." The "evolutionary principle" must be accelerated; and so forth. In so far as it is possible to gain these ends his attempts to further them are good, but he omits to point out that at the best these ends can be only partially gained, and that the evolutionary principle cannot be accelerated sufficiently to *satisfy* individual aims. He notes that "experience shows that the purposes, standards, and methods of a successful breeder are seldom handed down from one man to another," but he does not attempt to point out the means whereby this can be obviated, and yet it is the most severe handicap to progress which breeders suffer from.

There is one great opportunity which all professors of a big agricultural college have to their hand, that of organising a system of records of the practical results subsequently gained by all the students which pass through their schools. Such records, compiled by men trained by modern scientific methods and made available for use at their college, would be of incalculable value, both to the professors and the breeders of future generations; in order to carry out such a scheme, however, the student must be taught to understand that there are no short cuts to knowledge, and that the only way they can hope to accelerate the acquisition of knowledge of evolutionary principles is by pooling their experiences, their failures as well as their successes.

Part i., on variation—the author makes variation rather than heredity the initial leading thought of his scheme, putting the cart before the horse and thereby somewhat confusing the issue—is a brief *résumé* of some of the leading features of that branch of the subject, instances being given of a kind specially suitable to stimulate the interest of American students, for whom the book is written.

Part ii., on the causes of variation and the relative stability of living matter, and part iii., on transmission, constitute the bulk of the book. The author's clear and forcible writing, the thoroughness of his treatment, the arrangement of his facts, and the wealth of illustration he gives are worthy of great praise. These sections are not only a valuable summary of what is known, but contain much original thought, and deserve the attention of all students of the subject.

Part iv. is on practical problems. Those dealt with under the headings selection, systems of breeding, plant breeding, and animal breeding are full of good common sense and sound advice; any breeder would do well to consult them.

Thus if it has failings the book has great merit, and it is to be hoped the example set by Prof. Davenport will be followed in this country, where the education of agricultural students in the science of breeding is sadly behindhand.

THERMOCHEMISTRY.

Thermochemistry. By Julius Thomsen; translated from the Danish by Katharine A. Burke. Pp. xv+495. (London: Longmans, Green and Co., 1908.) Price 9*s.*

OWING to the rapid strides which have recently been made in physical chemistry, the subject of thermochemistry, which is itself of a physical nature, has been rather left in the background. At one time it was hoped that thermochemistry would be of very great help in elucidating the hidden laws governing chemical reactions, but unfortunately it has hardly realised expectations.

Although a very large amount of work has been done upon this subject, we can hardly say that it has been found possible to rely upon thermochemical methods

to give us more than a general idea as to the course of reactions. At the same time, it is by no means a subject which can be dismissed as being useless, because a very great deal of help may at times be obtained by the study of thermochemical data. For example, in manufacturing operations, it is of the first importance to know heats of combustion, because the number of calories required to decompose a substance is of course a guide to the manufacturer in connection with the energy required in a given process.

Quite recently Prof. J. W. Richards contributed a very useful and interesting series of papers in an American technical journal upon the thermochemistry of metallurgical processes. Furthermore, the subject is of great importance to the electrochemist, who is able to determine the voltage necessary to be employed in an electrolytic process if he knows the heats of combination of the compound. Or we might take another example. In aluminothermics it is owing to the very high heat of formation of aluminium oxide that such an enormous amount of heat is given out when aluminium reacts with certain metallic oxides, and consequently one can tell beforehand whether a given oxide will be readily reduced by means of aluminium or not.

Of all the workers in the field of thermochemistry none has done such thorough, careful, and pioneering experimental work as Julius Thomsen, and it was a happy idea of Sir William Ramsay to include a translation of Thomsen's Dutch work in the well-known text-books on physical chemistry which are now finding such an important place in the chemical literature of the country; and we may say at once that Miss Burke has done her part of the work extremely well. As she states in the preface, it has been necessary at times, owing to the advance in other branches of physical chemistry, slightly to alter the reading of certain sentences; for example, taking her own illustration, where Thomsen has used the expression "Neutralisation is regarded as a union of acid and base, with formation of water," Miss Burke has changed this to "Neutralisation is regarded as a union of acid hydrogen and basic hydroxyl to form water." Undoubtedly some chemists will take exception to such an alteration, and will say it is pedantic and unnecessary, particularly those who are not attached to the ionic theory, and, after all, there are a goodly number who consider there are many difficulties which require to be cleared up before the ionic hypothesis can be considered fundamental.

The first portion, the introduction, introduces the subject with an explanation of experimental calorimetric methods, the apparatus being described and illustrated, and the methods of using it fully gone into. Chapter i. deals with the absorption of gases and the heat produced when they, liquids or solids are dissolved in water, and a number of tables are given, with the thermochemical data. The next chapter deals with the rather complicated question of heat of hydration; the methods of calculation for obtaining the heat formation of different compounds, provided the heat formation of certain substances is known, are carefully set out throughout the pages. The book not only deals with inorganic compounds, but also with a very large number of organic substances, the tables in chapter xii. being exceedingly full. An interesting part of this chapter is that in which the heat formation of isomeric compounds is given. Thus the difference of heat formation of propyl and isopropyl alcohol is 5·3 cal., that between isobutyl alcohol and trimethyl carbinol being 17·15 cal.

In fact, the book deals with Thomsen's work, and will undoubtedly be found extremely useful to any investigator who wishes to study this branch of the subject, and as a book of reference to be kept in all chemical libraries, though hardly, we think, for general reading, as it is rather too full for this purpose. F. M. P.

MATHEMATICAL TEXT-BOOKS.

(1) *The Elements of the Geometry of the Conic.* By Prof. G. H. Bryan, F.R.S., and R. H. Pinkerton. Pp. xi+270. (London: J. M. Dent and Co., 1907.) Price 3*s.* 6*d.*

(2) *Geometry, Theoretical and Practical.* By W. P. Workman and A. G. Cracknell. Part ii. Pp. ix+(330–535). (London: W. B. Clive, 1908.) Price 2*s.*

(3) *Practical Integration for the Use of Engineers, &c.* By A. S. Percival. Pp. vi+86. (London: Macmillan and Co., Ltd., 1907.) Price 2*s.* 6*d.* net.

(4) *Integration by Trigonometric and Imaginary Substitution.* By C. O. Gunther. Pp. vi+79. (London: A. Constable and Co., Ltd., 1907.) Price 5*s.* net.

(5) *A Course in Mathematics for Students of Engineering and Applied Science.* By F. S. Woods and F. H. Bailey. Vol. i., Algebraic Equations, Functions of one Variable, Analytic Geometry, Differential Calculus. Pp. xii+385. (Boston, New York, Chicago, London: Ginn and Co., n.d.) Price 10*s.* 6*d.*

(1) THIS is an attractive little book on geometrical conics. The argument is very clear, and presents the subject to a beginner in the simplest possible manner. The difficulty in writing a text-book of this sort lies in the fact that many properties of conics are far more easily treated by analytical than geometrical methods. The authors have met this difficulty by putting first those results which lend themselves more readily to geometrical proofs; other theorems are left until later on, and then the methods, if not the nomenclature, are analytical. A reasonably large number of examples is given, which are nearly all of a graphical or numerical nature. This is a pleasing innovation, and theoretical examples can be supplied by the teacher, if required, from almost any other text-book. A property of the parabola is discussed at the same time as the corresponding property of a central conic; much might be said both for and against this course. Many of the proofs are ingenious; the construction of the hyperbola by means of string and pins alone is worth noticing. A chapter is given in which are discussed those properties of the cycloid, catenary, &c., which can be proved without the aid of the calculus.

(2) This book covers the ground of Euclid ii., iii. 35 to 37, iv., and vi., together with the properties of harmonic (but not of anharmonic) ranges, the nine-point circle, the radical axis, poles and polars, inverse figures, &c. The text is on the whole more theoretical than practical; the examples are divided into theoretical riders, practical constructions, and calculations, a good and sufficient collection of each being given. The book contains rather more than the average student will require; the authors asterisk some of the less necessary sections, and probably the teacher will advise the omission of others also. The properties of rectangles are developed from the geometrical standpoint; algebraic methods are, however, also given. In the theory of proportion only commensurable quantities are dealt with at first, the extension to incommensurables being given in the last chapter. The book is sound and sensible throughout, and deserves to hold its own easily in the severe competition which text-books on elementary geometry have to face at present.

(3) The author starts by defining integration as the inverse of differentiation, and then shows how to find the indefinite integrals of all the usual standard types. This part of the book may be quite useful, but the latter portion is not so satisfactory. The author has attempted too much for the space at his disposal, and sacrifices in places not only soundness but intelligibility also. Definite integrals are introduced without any adequate explanation, and the connection between definite and indefinite integrals is obscure. It is almost impossible to make applications of the calculus to geometry clear without a single diagram or without proving that a definite integral may be considered as the limit of a sum; this is, however, what the author attempts. In fact, the argument is too condensed to be followed by the type of student for whom the book is written; for instance, such a step as "$-d\theta/dt=a\theta$, $\therefore d\theta/\theta=-adt$" is sure to give trouble if unexplained.

Minor errors are the statement of the "test-ratio" rule on p. 36, and misprints at the bottom of pp. 42, 43. A book which aims at being "practical" should not calculate the temperature of a cup of tea to four places of decimals.

(4) This book is very short; for the margins and print are large, while twenty-six of its seventy-nine pages are occupied by a somewhat superfluous introduction, and fifteen by solutions of examples. The remainder is devoted to the indefinite integral of $\cos^m x \sin^n x$ (m and n integral) without the aid of reduction formulæ, and to the integral of expressions involving $\sqrt{a^2-x^2}$, $\sqrt{a^2+x^2}$, &c. This latter part is done better in other books; for surely in integrating $\sqrt{a^2+x^2}$ the substitution $x=a\sinh\theta$ is preferable to $x=2a\sin\theta$.

(5) This book is intended to cover the mathematics learnt in the first year of a two years' course at an engineering school. The authors disregard the traditional division of mathematics into distinct subjects, and introduce the principles of each subject as needed. By thus developing algebra, analysis, and calculus side by side the student has his interest stimulated, realises the interdependence of different parts of mathematics, and learns the art of choosing the best method of attacking any given problem. Against this must be set the fact that the conventional division of mathematical study has the great advantage of helping the student to systematise his knowledge. If once we admit the principle of no division, we could hardly wish for a better book. The subjects are very skilfully coordinated; the treatment throughout is sound and mathematical without ceasing to be interesting or "practical." The examples are useful and very numerous, and answers are given. In this first year's course is covered a good deal of the more elementary parts of the theory of equations, determinants, graphs, analytical geometry as far as the general equation of the second degree, and differential calculus, including curvature and critical values of functions, but not asymptotes. Conics, especially geometrical conics, are treated less fully than usual; their place is partly taken by other interesting curves. Excellent and interesting though the book is, it makes heavy demands on the reader's attention; and would probably require considerable ability on his part if it is to be mastered in one year.

OUR BOOK SHELF.

Nephilim. By William J. H. Bohannan. Pp. 236. (New York: Reeve A. Silk, 1908.) Price 1.50 dollars.

"THIS book is written," so we are told, "to show the error of 'science,' and to point out the truth of statement of the Bible concerning physical phenomena."

It certainly does show the error of "science," as understood or misunderstood by the author of the book. The following extracts are given merely as examples of the style in which the book is written:—

"The more the thermic dominates in structural composition of a body, the more penetrable it is to the magnetic entities of the field of another and the less to the thermic of that field."

"The earth's thermic entities of field, emitted from her equatorial region, her southward geographical pole being toward the sun, were taken outward from him, under the action of the entities of his field, her inseparable thermic entities of field enveloping the separable of her northern regions."

As a further example, we are informed by way of correction that "Nephilim," p. 154, fourth sentence, should read: "The planet Jupiter, on the other hand, had three tails, two visible to human eye, passing outward from the poles of the planet and from the sun; the other one magnetic and invisible, but vastly greater than the visible, passing from the equator of the planet toward the sun."

Some of the chapters suggest a kind of vortex theory, while others profess to deal with the theory of the tides. The author of "Nephilim" would have stood a better chance of recognition if he had made a careful study of the whole existing literature on one or other of these two subjects. The mere quotation of extracts from articles in popular encyclopædias, the contributors of which were probably limited to 1000 or 2000 words, is a very small step in that direction. Such short articles were never intended to give a complete explanation of all the difficulties which have been studied in connection with these theories;

e.g. the difficulties which the author raises in connection with the energy of wave motion. No good can come of ignoring the vast number of papers that have been published dealing with such difficulties.

There are hundreds of books already written in the same polemic spirit as "Nephilim." The author of each of these books believes himself to be right and everyone else to be wrong, and nearly every possible permutation of the words "force," "energy," "atom," "ether," "gravitation," and such like is represented in the different meanings (if any) the different writers attach to these terms. It would be well if future would-be writers of such books would try their hand at evolving some kind of order out of this tangled mass of mutually contradictory tirades before adding to the collection.

Le Principe de la Conservation de l'Assise et ses Applications. By George Matisse. Pp. 65. (Paris: Libraire scientifique, A. Hermann, 1907.) Price 2.50 francs.

THIS small pamphlet describes clearly and simply certain applications of Carnot's principle to physical problems. The unique feature of the book is indicated in the title. The word "assise" groups together certain variables which refer to distinct physical quantities, but which enter into the equations of energy in the same manner. The only equivalent English word we can suggest is the word "fundamental." The solution of many types of problem may then be said to depend on the two principles of the conservation of the fundamental and the conservation of energy. The differential of energy depends in general on a product of the form xdy, the precise meaning of x and dy depending on the kind of problem under contemplation, electrical, thermal, elastic, mechanical, or chemical, as the case may be. In these several cases the "assise," symbolised above by dy, is respectively electric quantity, entropy, volume, length, and mass. Such quantities all obey the conservation law, which the author concisely defines in these words:—Under the action of physical and chemical phenomena there can be no creation of electricity, of space (linear or cubical), of entropy, or of matter. Four applications are given in which the principle of the Carnot cycle is ingeniously utilised. The novel use of the word "assise" seems to be the main feature of the pamphlet; otherwise there is not much which calls for special remark.

The Case for the Goat. With the practical experience of twenty-four experts. By "Home Counties." Pp. x+162. (London: George Routledge and Sons, Ltd., 1908.) Price 3*s.* 6*d.*

IT is hoped this little book may help to remove ignorant prejudice against the goat, and induce small holders, labourers, and many rural residents to keep this valuable animal. The advantages to be derived from the "poor man's cow" are very imperfectly known in England, and the author sets himself to show what they really are. Goat's milk, he points out, is often as rich again as cow's milk; it may practically be guaranteed to be free from the bacillus of tuberculosis, and is a very valuable food for children, especially for those who cannot digest cow's milk. Moreover, the amount of milk goats yield, and the ease with which food is to be found for them—they will pick up a living in the hedgerows—ensures a very cheap supply of food for rural owners; while they thrive as hand-fed occupants of back yards in the suburbs, and require no more space than a big dog.

The author complains that the Board of Agriculture does not see its way to include the goat in its agricultural census, treating it as a negligible quantity, while a further bitter grievance against the Board is due to its refusal to permit the importation of new blood under guaranteed restrictions, when the goat stock of the kingdom is suffering from in-breeding to a deplorable extent. Less than a score of stock goats are urgently required for this purpose, and the Board's action is not inaptly described as "an oppressive absurdity."

The different breeds of goats suitable for this country, their management, breeding, and the substantial profit to be made out of them is clearly set forth. It is an interesting little book, and the author surely proves his case.

Confessio Medici. By the writer of "The Young People." Pp. xi+158. (London: Macmillan and Co., Ltd., 1908.) Price 3*s.* 6*d.* net.

"CONFESSIO MEDICI," a title which naturally recalls that of another book by a great physician, need not fear comparison even with Sir Thomas Browne's immortal work, and surely no higher praise can be accorded it. In a series of essays on such subjects as "vocation," "hospital life," "practice," "retirement," "the very end," &c., the author presents to the reader a survey of the responsibilities, the foibles, the hopes, the failures of medical practice. We wish that every student of medicine during his student days would read, mark, learn, and inwardly digest their practical wisdom and happy maxims, and many a practitioner whose finer feelings have perhaps become blunted by too close contact with a stringent life would rise up the better from their perusal.

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.]*

Who Built the Aberdeen Stone Circles?

IN an article in NATURE of April 9 dealing with the orientation of the Aberdeen stone circles, Sir Norman Lockyer says:—"Another of the associated inquiries will be to see if the area of the recumbent stone has also special ethnological or craniological characteristics." It may be of interest, in this connection, to point out that the short cist skeletons in the anatomical museum of Aberdeen University have been derived from an area coinciding very closely with that of the Aberdeen stone circles. These skeletons have been recently measured by Dr. Low (see Proceedings of the Anatomical and Anthropological Society, University of Aberdeen, 1902–6), and the measurements, as I showed in a paper read before the British Association at York, reveal the existence, in the early Bronze age, in this district, of a race significantly different from all the prehistoric racial types previously determined in Britain. This race is hyperbrachycephalic, having an average cephalic index of 85, and it is of short stature, 5 feet 3 inches. It differs from the Neolithic race, which was markedly dolichocephalic, and it also differs from the Bronze age race of the round tumuli, whose index was 78 and stature 5 feet 9 inches.

The origin of this prehistoric Aberdeenshire race, with a cephalic index so much higher than that of all known races in neighbouring countries, is at present one of the unsolved problems of British ethnology. Its close association with a special form of stone circles may help to throw some light on the origin of these interesting monuments, as well as on its own.

J. GRAY.

London, S.W., May 11.

Radio-activity of Potassium and other Alkali Metals.

PROF. MCLENNAN'S letter in NATURE of May 14 (p. 29) makes it desirable that I should record that my experiments continue to be in contradiction to those he describes. Whether the activity of potassium is due to an extraneous impurity or to the element itself, it is to be expected that some separation of the activity should be possible. For the last year and a half I have been trying to effect such a separation without result. All samples of the same pure salt which I have procured or prepared are identical in activity. In one experiment a sample of the sulphate was crystallised twenty-two times, in another a sample of the nitrate was crystallised eighteen times without introducing any difference between the final products; in a third a sample of potassium sulphate was prepared direct from wood ashes, and found to agree with a commercial sample prepared from the Stassfurt deposits. I propose now to prepare a third sample direct from felspar.

The only difference which I can detect between Prof. McLennan's experiments and my own lies in the fact that he places the active material inside the ionisation vessel, while I place it outside an aluminium window. If he were measuring the effect of very soft rays, the difference between our results might be explained.

NORMAN R. CAMPBELL.

Trinity College, Cambridge, May 14.

On Dispersion and Spectrum Series.

IN reply to Mr. Campbell's letter of April 30, it must suffice to point out that my letter of March 5 was limited to infinite spectrum series and to luminous gases. This seemed to me at the time of writing obvious from the context, as well as from the express reference to the finiteness of the refractive index of *luminous* hydrogen. Apparently I was mistaken; anyhow, Mr. Campbell's suggestion that I confused the emission lines of luminous with the absorption bands of dark hydrogen rests on a misconception of my meaning.

To avoid further misunderstanding, I will add that by "electrical theory of absorption and dispersion, of magnetic rotation and Zeeman effect," I mean, of course, the theory of Drude, together with its extension by Voigt to *all* magneto-optic phenomena; I do not mean theories such as those of Lorentz and Ritz, which deal with the Zeeman effect alone. I know no reason for confining that theory to one member only of a series, *e.g.* the D lines of sodium, and contend that it leads to contradictions when applied to all the members of an infinite series of similar lines.

The remaining points raised by Mr. Campbell seem to me foreign to my argument. I cannot discuss them in the space at my disposal here, but hope to do so elsewhere.

Bonn, May 8. G. A. SCHOTT.

Secondary Waves of Light.

IT has hitherto been held that, so long as the diffraction apertures used (cut in perfectly opaque or perfectly reflecting screens) are large compared with the wave-length of light, Fresnel's expression for the amplitude of the disturbance due to a surface-element gives us a close approximation to the observed diffraction effects, and that the exact value for the obliquity factor is of little importance (*e.g.* see Schuster's "Optics," sec. 48). That this is true only in the special case in which the apertures are held normal to the waves of light, and not in other cases, is shown by some new diffraction phenomena that I have made the subject of study.

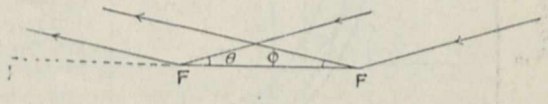
The only experiment so far known which might seem to show effects due to the obliquity factor is the well-known one with the circular disc, but it is really inconclusive. The observed fact, that the illumination along the axis of the disc decreases as the disc is approached, is more or less entirely due to minute irregularities in the rim of the disc, and not, as is sometimes stated, to the increasing obliquity of the secondary waves producing the illumination.

The theoretical grounds on which my experiments were based were these:—if diffraction bands are produced and observed in a direction in which the amplitude of the disturbance in the secondary waves varies rapidly from point to point, we might expect effects due to varying obliquity. Such effects would obviously not occur if the diffraction aperture or mirror is, as is usual, held normal to the waves of light incident on it, but might if it be held obliquely.

In the *Philosophical Magazine* for November, 1906, I showed that the diffraction bands due to a rectangular aperture held very obliquely are not equidistant, that the band-width increases progressively from one side of the pattern to the other, and that the number of bands on one side of the pattern is limited. They are most easily seen on the spectrometer if the image of the slit of the instrument formed by light reflected very obliquely from the face of a prism is observed. The positions of the minima of illumination, actually observed, are closely in agreement with those calculated from the usual formula ($\cos\theta - \cos\phi = \pm n\lambda/a$), θ, ϕ being the complements of the angles of incidence and diffraction. Further observations have elicited the following:—from the expression for the intensity of the illumination in the pattern deduced by the ordinary method

$$I = a^2 \sin^2 \frac{\pi a}{\lambda} (\cos\theta - \cos\phi) \div \frac{\pi^2 a^2}{\lambda^2} (\cos\theta - \cos\phi)^2,$$

it would appear that the maxima of illumination in corresponding bands on either side of the middle one should be of equal brightness. This is flatly contradicted by observation, both visual and photographic. It is found that the bands on one side are considerably fainter than those on the other, and this difference becomes very large as the light approaches grazing incidence. The illumination in the diffraction pattern (with a given angle of incidence) decreases and dies away as we approach the limiting plane of the fringes, which is the plane of the reflecting surface (FF in the diagram).



This effect is inexplicable if the question of the variation of the amplitude in different directions of the secondary waves, supposed to be sent out by the elements of the reflecting surface FF, is not taken into account. It must be remembered that we are not dealing with apertures small compared with the wave-length; both the aperture and its projection are large compared with λ, and there are no polarisation effects observed. The question may be attacked analytically, and it can be shown that an element of the surface of a reflecting body is equivalent in its effect to a double source of appropriate intensity which, it is known, produces zero effect in its equatorial plane and a maximum along its axis. The effect of an element of the surface FF is therefore zero along the line FF, and in other directions increases as we move away from the line FF. Remembering that the elements are not in the same phase, and integrating their separate effects, we get an explanation of the phenomenon observed.

A fuller discussion and a mathematical investigation will be published in due course. I found that similar effects are observed when the transmitting aperture is used. Some experiments with coarsely ruled gratings are in progress which seem to point in the same direction.

C. V. RAMAN.

Science Association Laboratory, Calcutta, April 2.

The Corrosion of Iron and Steel.

IN NATURE of May 14, Dr. J. Newton Friend alludes to *Gallionella ferruginea* as obtaining its life's energy by oxidising ferrous carbonate and organic ferrous salts, causing the precipitation of rust, or ferric hydroxide. May I point out that *Gallionella ferruginea* can live and grow well without any iron at all, and so cannot be a vital factor in the metabolism of the bacterium, using the term "bacterium" in its widest sense? The oxidation which takes place can be simply explained by the fact that ferrous carbonate in solution is very unstable, becoming very rapidly oxidised. W. F. MACFADYEN.

54 Dunard Street, Glasgow, May 16.

INVESTIGATION OF THE UPPER ATMOSPHERE.

THE work carried out in England in connection with the investigation of the upper atmosphere forms part of a wide and well-organised scheme. On certain days appointed by an international committee, balloons and kites are sent up from some thirty stations scattered all over the world. The kites are used for the study of the lower layers, and free balloons for greater altitudes. In a discussion bearing on the isothermal layer we have therefore only to deal with the latter.

Abroad, instruments of many types have been designed and improved by Hergesell, Assmann, Teisserenc de Bort, and de Quervain. The fact that nearly twenty different modifications exist is sufficient excuse for not undertaking here an analysis of their respective merits. These instruments cost from 10*l.* to 12*l.*, and their weight, which exceeds a pound, involves the use of relatively large and expensive balloons.

In Continental countries but few instruments are permanently lost, and as very substantial Government grants are in most cases available, the question of working expenses is not of vital importance. In England we are financially and geographically less favourably situated, and there is little doubt that but for the energy and inventive genius of one man, little work would have been attempted.

The Dines balloon meteorograph costs one-tenth and weighs one-eighth of the corresponding Continental instruments. The record, though microscopic, is nearly *indestructible*, for it is engraved by two sharp styles on a sheet of copper. This constitutes an important improvement, for the ordinary smoked record is not infrequently obliterated by the time the instrument is returned.

The record consists of fine lines, which remain parallel as long as the temperature remains constant. The bimetallic thermograph is carried on a support which is moved by the barograph. In ordinary circumstances a curve is obtained for any point of which the abscissa measures the deflection of the barograph, and the ordinate minus a constant the deflection of the thermograph.

The calibration of the thermograph is a simple matter, the deflection being practically a linear function of the temperature. The calibration of the barograph, on the other hand, offers considerable difficulties.

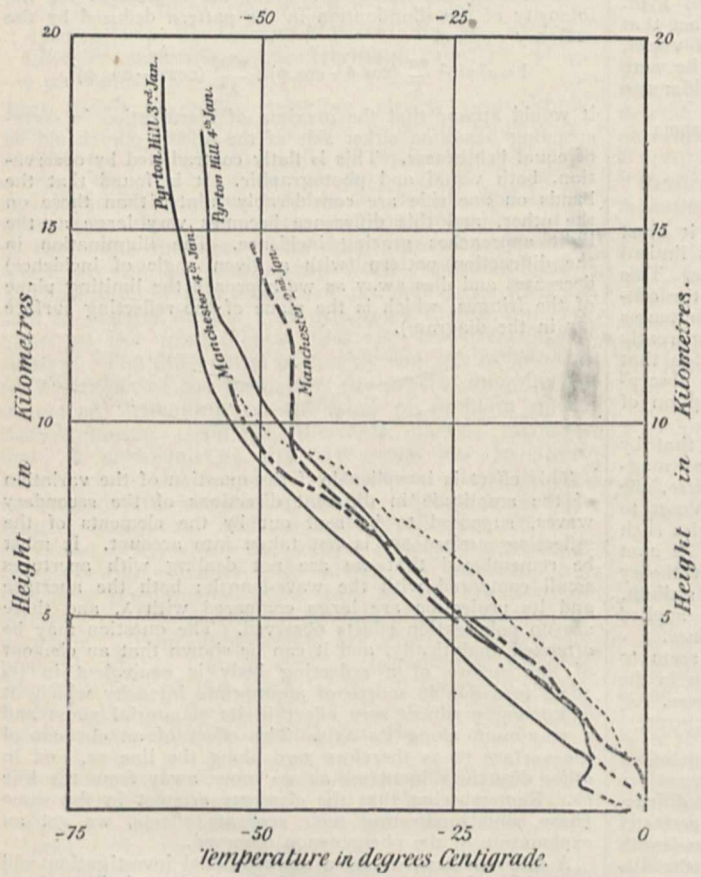
In order to increase the sensitiveness of the instrument without adding to its weight, it is necessary to leave a certain amount of air in the aneroid box. This, as also the change of elasticity of the metal, causes the calibration of the instrument to vary considerably with temperature, and adds materially to the labour involved in reducing the results.

After trying and abandoning various methods of approximation, Mr. W. A. Harwood, who is in charge of this branch of the work at Manchester, now draws out for each instrument a number of independent calibration curves, each one referring to one definite temperature. These form a series of nearly parallel curves, which cover the range of temperature and pressure over which the instrument is used. The calibration made before the ascent is verified after the return of the meteorograph.

The accuracy obtainable of course decreases with the density of the air; over the first few kilometres a difference of level of less than a hundred metres is easily measured, but when the height attained is such that the prevailing pressure is only one-tenth of an atmosphere, the possible error becomes considerable.

The diagram here given, which refers to the last date on which balloons were sent up on three consecutive days, is a typical example of the results obtained. The Manchester record for January 2 lies between the Pyrton Hill curves for January 3 and 4 up to about 9 km., above which height the temperature remains constant for some distance. Two traces were inscribed by the instrument sent up from Manchester on January 4. Probably in this case, as occasionally occurs, the balloon did not burst and fall at once on attaining the maximum height, but drifted down slowly as the gas diffused out. In such cases the time to which the second trace applied cannot be determined, and the rise of temperature might well be due to the next day's solar radiation. Trustworthy or otherwise, this trace has its place on the present diagram, the primary object of which is to give a complete collection of the results obtained from one set of ascents. The Pyrton Hill balloons were sent up at 3 p.m., and the Manchester ones at 6 p.m.

It is noticeable that during the three days the average temperature gradients between 2 and 8 kilometres (*i.e.* above the disturbing influence of the ground, but below the level of the isothermal layer) remained practically constant, whereas a considerable



Variation of Atmospheric Temperature with height on April 2, 3 and 4, 1903.

difference existed between the temperature of the isothermal layer as measured on January 2 and 3.

Generally speaking, many improvements of the methods and instruments are doubtless still required, but it must be remembered that the work in England was commenced less than a year ago, and perfection can hardly be expected within so short a time.

J. E. PETAVEL.

HOME AND FOREIGN BIRD-LIFE.[1]

THE authors of these three excellent little works are evidently enthusiastic bird-lovers and accomplished and patient observers. In the case of the first two, at any rate, their highest enjoyment appears, indeed, to consist in sitting for hours watching the movements and ways of their feathered favourites. Moreover, either they or their friends are well accomplished in the use of the camera, and they have thereby been enabled to make permanent records of many of the fascinating sights that have come under their observation for the benefit of those who have neither their patience nor their opportunities.

Mr. Gordon's favourite species appear to be the golden eagle and the ptarmigan, the photographs of both of which are claimed to be nearly, if not indeed completely, unique. To obtain the picture of the golden eagle's eyrie the author underwent considerable difficulty not unmingled with danger, while peril of another type was experienced when a fog suddenly descended as he was wandering among snow-clad precipices in search of ptarmigan. The photographs have therefore more than their apparent face-value, which is of itself considerable. Where all are interesting it is difficult to make a selection, although personally we have been much interested in the series of photographs of a young golden eagle at various stages of growth, one of which is here reproduced.

FIG. 1.—Golden Eagle six weeks old. The bird fell from the original eyrie and is here shown in one made by parent birds at the foot of the cliff. From "Birds of the Loch and Mountain."

Mr. Charles Barrett, in "From Range to Sea," covers comparatively new ground, and has attempted to accomplish for some of the birds of Australia what has already been done for those of our own islands. It must be confessed, however, that the illustrations in his booklet (whether from the fault of the photographs themselves, of the reproductions, or of the printer we cannot say) are by no means up to the level of those in some books of English bird-life. In the tiny and exquisitely built nests of such species as the rufous and the white-shafted fantail, with the parent-bird in attendance, the author has subjects quite different from any met with in this country, and in portraying these novelties he appears to have availed himself to the full of his opportunities. The nest of the lyre-bird forms, perhaps, a still more striking subject, which was the scene of an altogether unexpected incident. "On inserting my hand in the nest," writes the author, "a piercing cry, like the whistle of a steam-engine, rang down the gully. It was difficult to realise that the half-fledged lyre-bird which I could feel inside the nest was the cause of this unearthly clamour."

The present booklet is an excellent beginning in Australian bird-photography, and we shall look in the future for more work in the same style from the author and his artist, Mr. Mattingley.

The book standing third on our list is of a somewhat different type from either of the two already noticed, presenting in some degree an approximation to a popular history of South African birds generally. It may serve, in fact, as a kind of popular representative of the volumes on birds in the "Fauna of South Africa," and should be of the greatest value to a large number of persons who for one reason or another are unable to refer to the latter. Indeed, by means of the numerous excellent photographs with which it is illustrated, this volume will enable the sportsman and amateur naturalist in South Africa to determine without any great difficulty a very considerable proportion of the birds with which he may be brought in contact. The illustrations (of which a sample is reproduced) are for the most part excellent, while the text contains a sufficient amount of anecdote and local colouring to redeem it from the charge of dulness.

Personally we have found special interest in the author's account of the eggs and parasitic habits of the honey-guides and cuckoos. Honey-guides, it appears, actually storm the breeding-holes of the species upon which they are parasitic, as was witnessed by the author in the case of a pair of barbets, which offered a fierce resistance to the intruder. As regards cuckoos, it is absolutely certain that in South Africa these birds must generally lay their eggs on the ground and transport them in their beaks to the foreign nests, which they are too large to enter. All the African cuckoos normally lay coloured eggs, but when they lay in nests of species with white eggs, their own eggs are also often white. In the case of the golden cuckoo the author states that "a pure white egg was taken from the oviduct of a female

[1] "Birds of the Loch and Mountain." By Seton P. Gordon. Pp. xvi +181; illustrated. (London: Cassell and Co., Ltd., 1907.) Price 7*s.* 6*d.* net.

"From Range to Sea; a Bird-lover's Ways." By C. Barrett. Pp. 62; illustrated. (Melbourne: T. C. Lothian, 1907.) Price 1*s.*

"Sketches of South African Bird-life." By A. Haagner and R. H. Ivy. Pp. xxiv+181; illustrated. (London: R. H. Porter, 1908.) Price 20*s.* net.

shot at the Crocodile River; a white egg was also found in the nest of a Cape wagtail, which was allowed to hatch to make identity certain; further, we took a white egg from the nest of the little red-vented tit-babbler. . . . The usual host is the Cape sparrow, both of us having taken the cuckoo's eggs—coloured like those of the sparrow—from the nests of this bird." Unfortunately, there is no information as to whether there are "white-egged" and "coloured-egged" strains of cuckoos in Africa, or whether the same bird may lay white or coloured eggs according to circumstances.

FIG. 2.—Black-shouldered Kite. From "Sketches of South African Bird-life."

The book is a welcome addition to South African ornithological literature.

THE ROYAL SOCIETY'S CONVERSAZIONE.

THE first of the two conversaziones given annually by the Royal Society was held at Burlington House on Wednesday of last week, May 13. The guests were received by Lord Rayleigh, president of the society, and included leading representatives of many branches of intellectual activity. There were a large number of exhibits, illustrating methods and results of recent scientific work, and in the course of the evening demonstrations were given in the meeting room by Mr. C. V. Boys, F.R.S., on the dynamics of the game of diabolo, Mr. Francis Fox, on the operations involved in the saving of Winchester Cathedral and other ancient buildings, and Mr. C. Gordon Hewitt, on the natural history of the house-fly. Following our usual practice, we give a summary, with a few additions, of the descriptive catalogue of exhibits, and so far as possible have grouped together the exhibits referring to related subjects.

The British Contribution to the International Investigation of the Upper Air, 1907–8: The investigation of the upper air under the auspices of the "Commission internationale d'Aérostation scientifique" is now fully organised. This country has taken part in the work unofficially since 1902, and officially since 1904. The investigation as carried on in this country is three-fold. The first part consists in measurements of temperature, humidity, and wind velocity at different levels up to about 10,000 feet, by meteorographs raised by kites. For the second part, automatic traces of the relation between pressure (height) and temperature are obtained by means of meteorographs borne by unmanned balloons (*ballons-sondes*). The balloons are arranged to reach heights up to 22 kilometres in about two hours, and then to burst and descend. The finder is invited to return the instruments and claim a reward. For the third part, the bearing and elevation of small pilot balloons are observed at measured intervals of time by one or two theodolites, and the motion of air currents at different levels is computed from the observations. The exhibits were by Dr. W. N. Shaw, F.R.S., Mr. J. E. Petavel, F.R.S., and Mr. W. A. Harwood, Mr. C. J. P. Cave, Captain C. H. Ley, Mr. Eric S. Bruce, and the Director-General of the Survey Department, Egypt; they illustrated the methods referred to and the results obtained by British investigators.

The Astronomer Royal: (1) Photograph on which the new eighth satellite of Jupiter was discovered by Mr. P. Melotte, showing also the sixth and seventh satellites, and photograph of the ninth satellite of Saturn (Phœbe); (2) diagrams of positions of Jupiter's and Saturn's distant satellites, from photographs taken at the Royal Observatory, Greenwich, with the 30-inch reflector; (3) drawings of the solar corona at the eclipses of 1898, 1900, 1901, and 1905, made by Mr. W. H. Wesley from the original negatives; (4) eclipse of 1901, May 18, from photographs taken in Mauritius, and eclipse of 1905, August 30, from photographs taken at Sfax, Tunisia.—*Solar Physics Observatory, South Kensington*: (1) Enlarged photographs of stellar spectra; (2) spectrum of a sun-spot; (3) spectro-heliograph disc photographs, taken in "K" light; (4) photographs of prominences, taken in "K" light; (5) photograph of Aberdeenshire stone circle with Cornish circle for comparison.—*Mr. J. Franklin-Adams*: (1) Machine for counting stars upon the 15 inch by 15 inch plates of the Franklin-Adams chart. As the number of stars upon this chart is estimated at 23,000,000, only special areas—selected by Prof. Kapteyn, of Gröningen—will in the first instance be counted. This machine, by Troughton and Simms, is designed to work with such accuracy that regions adjacent to the selected areas may afterwards be added without omissions or overlappings. (2) Machine for drawing precession lines upon the plates of the Franklin-Adams chart. This machine has been designed to draw to a hundredth of a millimetre, if necessary, precession lines giving star places at epochs 1855, 1875, 1900, and 1925, both in Right Ascension and Declination.

Mr. J. S. Wilson and Mr. W. Gore: India-rubber models and apparatus used for the investigation of the distribution of stress in dams (Fig. 1). The model, which rests on the top of the trestle, consists of a slab of india-rubber cut to represent the section of a masonry dam, together with its foundation and substratum. The water pressure against the dam is reproduced by plates pulled against the upstream face of the model by cords passing over pulleys and attached to weights. The correct ratio between the density of the fluid represented by that pressure and the density of the masonry (1 : 2·25) is maintained by suspending a large number of weights from pins passing through the model at uniformly distributed points. To obtain strains large enough to measure, both densities are magnified forty times. Photographs are taken of the model and the system of lines ruled on it, one when unstrained

and the other when strained by the various forces. The strains are determined by measuring corresponding lengths and angles on the two photographic negatives by means of the optical projection micrometers which are exhibited. The stresses are calculated from the measured strains by the equations relating them, which have been experimentally verified.

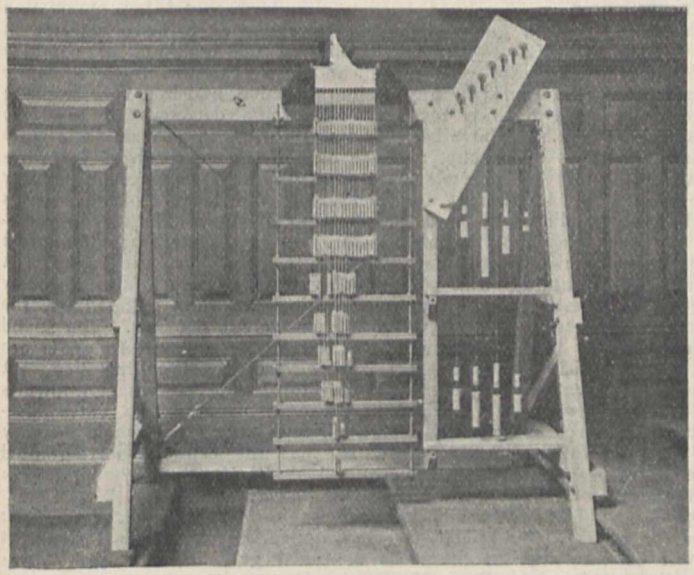


FIG. 1.—India-rubber model and apparatus used for investigations of distribution of stress in dams.

Sir John Thornycroft, F.R.S.: An instrument to indicate the relative rate of turning of two bodies. A sphere supported on two equal revolving cylinders rotates on axes in the same plane as the axes of the cylinders; the angular position of the axis of the sphere depends on the relative velocities of the two cylinders, and is indicated by a hand controlled by a roller touching the sphere.—*Mr. C. V. Boys, F.R.S.:* (1) A modification of the well-known hypocycloidal straight line motion of very simple construction, and requiring guides only $2\sqrt{2}$ (0·6 nearly) inch long for a 4-inch stroke. (2) An artificial horizon in which the mercury is spread out into a very thin film on a surface which it does not wet, its edge being held by deeper mercury in a peripheral trough. The film is adjusted in thickness by means of a floating plunger actuated by a screw. Ripples set up by vibration die out almost instantaneously, and altitudes of stars may be taken in towns where with deeper mercury that would be impossible. The mercury is not contaminated by its dry supporting surface.—*Mr. H. G. King and Mr. R. Kerr:* "Master gauges" or "standards" for extremely accurate measurements, the invention of Mr. C. E. Johansson, of Sweden. By using these gauges separately or combined together, more than 80,000 different sizes can be obtained, any of which sizes are accurate to within 0·00004 inch at 66° F. The steel is so treated as to reduce to a minimum any chance of change after being hardened.—*Prof. H. L. Callendar, F.R.S., and Prof. W. E. Dalby:* Apparatus for measuring temperatures in the cylinder of a gas engine.—*Mr. Joseph Goold:* A uniformly symmetrical twin-elliptic pendulum. As the deflector consists of a pair of cross-bars, its mass can be virtually elongated by fixing the bars at any other than a right angle. By this means any rate of change of phase is easily secured. The resulting figures are made available for stereoscopic effects by taking two similar figures and inverting one of them, so that each half figure becomes associated (in the stereoscope) with the complementary half of the other figure.—*Mr. Charles E. Benham:* Stereoscopic effect of twin-elliptic figures.

Cambridge Scientific Instrument Co.: The Cambridge patent extensometer. No mirrors or microscopes are used for magnifying the movement, but the extension of the test-piece is measured by a micrometer screw and a modified form of contact measurement. The instrument is made in two separate pieces; the lower piece carries the micrometer screw shown in Fig. 2, and the upper piece carries a spring tongue. These are fixed to the test-piece by pressing the conical points of hard steel rods into centre punch marks in the side of the test-piece, these points being mounted in strictly geometric slides. Both the upper and lower pieces are held in the definite positions shown in the illustration. If the test-piece stretches, the upper piece rotates about the conical points in the depressions in the test-piece, and the end of the tongue approaches the point on the micrometer screw head, the upper piece forming a lever. The arms of the lever are such that the part of the tongue opposite the point on the micrometer head moves five times the amount of the extension of the test-piece. By means of an adjustment the ratio of the arms of the lever can be adjusted so that this multiplication of the extension can be made exact. One arm of the lever is the flexible steel tongue which carries a hardened steel knife-edge near its outer end. If the tongue is bent sideways the knife-edge is moved across the hard steel point, which is carried from the centre of the divided head. To adjust the instrument the screw is turned and the point advanced until contact is made. Relative movement of the lower piece carrying the micrometer screw and the tongue is thus measured, and is proportional to the extension of the test-piece. It can, however, be adjusted more accurately by causing the spring to vibrate and noting the sound caused by it touching the point each time it passes over it. If the point is advanced by 1/1000 mm. nearer the screw the sound produced by contact as the spring vibrates is louder, and the final adjustment of the micrometer screw can be made quickly and accurately. The micrometer screw has a pitch of $\frac{1}{2}$ mm., and the head is divided into 100 parts; each division on the head corresponds to an extension of 1/1000 mm., and as the tenths of divisions can be estimated by eye, readings can be taken to 1/10,000 mm., although it is not claimed that the results are trustworthy to this degree of accuracy.

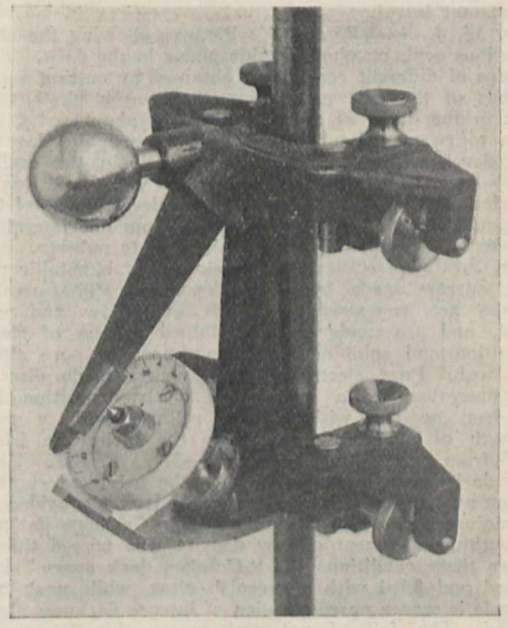


FIG. 2.—Cambridge patent extensometer.

Mr. J. W. Gordon and Mr. H. Fletcher Moulton: A

new object-glass for high-power magnification. The objective exhibited, used with an ordinary eye-piece, constitutes a high-power ocular capable, in combination with an ordinary high-power objective glass, of yielding a perfect image up to magnifications of eight or ten thousand diameters. Being self-contained, that is to say, independent of external influences, it can be used in any position, and is therefore as well adapted to use with the telescope as with the microscope.

Mr. J. E. Barnard: Mercury vapour lamps for microscopic illumination. Mercury vapour lamps have considerable advantages as illuminants for microscopic work, as their visible spectrum consists chiefly of three bright lines, one each in the orange, green, and blue-violet. It is therefore possible, by using suitable absorbent colour screens, to transmit only one bright line of the required colour, the remaining ones being absorbed. The source of light then becomes truly monochromatic, and is practically of one wave-length.—*Mr. Conrad Beck:* (1) Diffraction patterns (antipoints) of point source of light viewed under the microscope with apertures of different shapes illustrating the influence of the aperture shape on microscopic resolution; (2) living bacteria, shown on a dark ground with 1/12 oil immersion lens visible by their own reflected light.

Prof. T. Turner: Transparent films of silver and other metals. Gold leaf supported on a glass plate and heated to about 550° C. loses its green colour and transmits white light. Silver leaf heated in air or oxygen to 400° C. becomes remarkably transparent, transmitting white light. The action begins at about 250° C. Copper leaf remains opaque if heated in a reducing atmosphere to 500° C. When heated in air for about an hour to 250°, or for a much shorter time to higher temperatures, the copper becomes transparent and transmits a brilliant green light. This colour continuously darkens with further heating. Aluminium leaf does not become transparent either in an oxidising or reducing atmosphere. Dutch metal skeletonises, but remains opaque.—*Mr. S. D. Chalmers:* Models illustrating refraction at plane and spherical surfaces. These models illustrate the influence of reduced velocity in glass on the form or direction of waves. The curvatures of the incident and refracted waves are indicated by flexible rods; the paths from a point on the incident to the corresponding point on the refracted wave are indicated by cords of constant length.

Dr. W. J. Russell, F.R.S.: Pictures showing the action of various coals on photographic plates in the dark. These pictures of different coals were obtained by cutting vertical sections of the coal and laying them on a photographic plate in the dark, at a temperature of about 50° C., for seven to twenty-four hours. The photographic plate was then developed, and the picture printed in the ordinary way.—*Prof. J. Symington, F.R.S., and Dr. J. C. Rankin:* A series of skiagrams illustrating the development of teeth in man. The skiagrams were taken from one lateral half of a series of skulls aged from birth up to puberty.

Mr. S. Cowper-Coles: (1) Specimens of bimetallic parabolic mirrors made by electro-deposition. The parabolic mirrors are composed of bands of yellow and white metal, and are made by a combined process of electro-deposition and spinning. (2) Specimens of pure electrolytic iron. Pure electrolytic iron sheets made direct in one operation by a process of electro-deposition from pig iron or ore without any rolling, with a tensile strength of about thirty tons to the inch; the iron is free from crystalline structure.—*Mr. F. W. Aston:* New dark space in helium. The tube exhibited contained helium at a pressure of about 3 mm. It was provided with aluminium electrodes, the kathode being a large flat plate. A continuous current of low density was passed through. Under these conditions the "Crookes dark space" is ill-defined and filled with a greenish glow, while next to the kathode is seen a narrow region of intense darkness sharply defined. The fall of potential across this "new dark space" appears to be invariably about 30 volts.—*Dr. J. A. Fleming, F.R.S.:* (1) Apparatus for exhibiting photo-electric effects with potassium-sodium alloy. The alloy was enclosed with an insulated platinum plate in an exhausted tube. When the plate and alloy were connected to a galvanometer and the surface of the alloy illuminated by an arc lamp, an E.M.F. of about 0·8 volt was created, and a current produced in the circuit by the light. (2) Oscillation valves or glow-lamp electric-wave detectors used for receivers in long-distance wireless telegraphy. It was shown by the exhibitor in 1904 that a carbon filament glow-lamp, having in its bulb a metal cylinder surrounding the filament carried on an insulated terminal, could be used in combination with a galvanometer or telephone as a wave detector in wireless telegraphy, owing to the emission of negative electricity from the incandescent carbon. Such a device was named by him oscillation valve, and is a very sensitive long-distance receiver. Glow-lamp detectors of the type exhibited have been used as receivers in Transatlantic wireless telegraphy, and are also of use as receivers for wireless or radiotelephony. (3) A recent form of cymometer or instrument for measuring the length of the waves radiated by, and the damping of the oscillations in radiotelegraphic antennæ.—*Mr. L. H. Walter:* (1) Tantalum wave-detector for wireless telephony or telegraphy. A tantalum wire point dipping into mercury is spontaneously restoring. At 450 miles, using less than 2 kilowatts, the results equal those of the electrolytic detector. The sound is louder than with the electrolytic when the signals are not too weak. (2) New electrolytic signalling key. A water-cooled signalling key for higher powers (2 kilowatts upwards). A local key circuit actuates two valve electrodes, normally separated, and having the whole primary voltage across them, so that the cell is short-circuited beneath the electrolyte. (3) Model of an experimental form of the exhibitor's magnetic detector of 1906.

The National Physical Laboratory. Mr. A. Campbell: (1) Moving-coil vibration galvanometer. This instrument belongs to the class of tuned galvanometers first introduced by Prof. M. Wien. Its novelty consists in the use of the moving-coil system. (2) Variable mutual inductance standard. Designed for the measurement of small inductances and capacities. (3) Standard of mutual inductance calculable from the dimensions. A small model of the large mutual inductance (10 millihenries) recently completed at the National Physical Laboratory. (4) Secondary standard of mutual inductance (subdivided). *Mr. W. Rosenhain:* (5) Quenching apparatus for metallographic specimens, for quenching small specimens of metal *in vacuo* without removing them from the furnace. *Mr. W. Rosenhain, Mr. F. C. A. H. Lantsberry, and Mr. P. A. Tucker:* (6) Composite photomicrographs representing relatively large areas of steel. *Mr. W. Rosenhain:* (7) Tensile fracture of steel under the Zeiss stereoscopic microscope.—*Rev. F. J. Jervis-Smith, F.R.S.:* Apparatus for generating a luminous glow in an exhausted vessel, moving in an electrostatic field, and exhibiting the action of a magnetic field on the glow so produced (see p. 70).—*Mr. J. T. Irwin:* Hot wire oscillograph.—*Mr. S. G. Brown:* Experiments with a high-frequency alternator.

Mr. R. Threlfall, F.R.S.: Laboratory apparatus for experiments under very high measured pressures and at very high temperatures—pressures up to 100 tons per square inch, temperatures up to 2000° C. Advantage is taken of the practically perfect fluidity of crystalline graphite at high pressures, and of the solidity of compressed magnesia, zirconia, &c., to construct an apparatus on the laboratory scale for such experiments as the possible transformations of carbon under high temperatures and pressures.—*Prof. T. B. Wood:* The factors which influence the baking value of wheat flour. The "strength" or baking value of wheat is determined by two main factors:—(1) high diastatic capacity, which continuously produces sugar in the dough, and thereby enables the yeast to keep up a continuous evolution of carbon dioxide; (2) suitable concentration of acid and salts in the flour, which affects the physical properties of the gluten, and hence the shape of the loaf.—*Dr. T. E. Thorpe, F.R.S.:* (1) Apparatus and specimens used in connection with the determination of the atomic weight of radium; (2) glass and quartz vessels coloured under the influence of radium.—*Sir William Crookes, F.R.S.:* Scandium, its salts, and its position in the scheme of the chemical elements. Scandium is an exceedingly rare terrestrial element, occurring in very few minerals and in very small amount—usually not more than 0·01 per cent. The one exception is the rare mineral wiikite, which contains scandium in considerable quantity. Astronomical

research has demonstrated the presence of scandium in comparative abundance in the sun and some of the brighter stars. To enable its spectrum lines to be identified with certainty, especially in some of the fainter celestial bodies, a thorough examination of its spectrum has been undertaken.—*Messrs. Johnson, Matthey and Co., Ltd.:* (1) Apparatus in transparent fused silica; (2) various vessels of pure iridium.

Miss Amy Barrington and Prof. Karl Pearson, F.R.S.: Specimens of the hair of chestnut horses. Samples of hair from the ribs, mane, and tail of chestnut horses to show:—(1) the wide range of chestnut coats; (2) that "chestnut" is not a simple unit character; and (3) that the mane and tail of chestnuts can be sensibly black.—*Marine Biological Association of the United Kingdom:* (1) Living representatives of the Plymouth marine fauna; (2) photographs illustrating methods of dredging and trawling (North Sea investigations).—*The Grouse Disease Commissioners:* Specimens illustrating certain aspects of the work of the Grouse Disease Committee, 1905–8. A committee of inquiry into the causes of disease in the red grouse (*Lagopus scoticus*) was constituted in 1904 at the suggestion and under the chairmanship of Lord Lovat; the work and results, of which the exhibit represented a part, will be published by the Zoological Society of London.—*Mr. C. Gordon Hewitt:* The large larch saw-fly (*Nematus erichsonii*, Hartig). The larch saw-fly has increased during the last few years to so great an extent in many of the large larch plantations in Cumberland as to become a serious pest. Many hundreds of acres of larches were completely defoliated in 1907. Except in the young plantations, it will be necessary to rely on natural means of control, of which birds and voles are at present the most important.—*Mr. F. Enock:* Living specimens of Mymaridæ-ovivorous parasites (new to Great Britain).

Prof. R. T. Hewlett and Mr. J. E. Barnard: A method of disintegrating bacterial and other cells. The machine consists of a phosphor-bronze vessel, revolving at a high speed, containing hardened steel balls, which are kept in position at the periphery of the vessel by a central steel cone. By retarding the revolution of the central cone, a drag is put on the balls, so that a grinding action takes place between them and the internal surface of the vessel. Rise of temperature is prevented by the use of liquid carbonic acid or other means.—*Dr. Ernest F. Bashford, for the Executive Committee, Imperial Cancer Research Fund:* Cancer as a manifestation of cell-life throughout the vertebrates, and the biological properties of cells which have become cancerous.—*Prof. W. B. Bottomley:* Bacterial treatment of non-leguminous plants. (1) Specimens showing effect of nitrogen-fixing organisms upon growth of oats, barley, turnips, radishes, tomatoes, &c.; (2) cultures and microscopical preparations of nitrogen-fixing bacteria (*Pseudomonas radicicola, Azotobacter beyerinckii*, &c.).

Prof. J. Milne, F.R.S.: Seismograms recorded by a Milne seismograph in the Isle of Wight. (1) These seismograms illustrate the difference in character of records obtained from the same instrument. The Mexican earthquake of March 26, 1908, was obtained on *quickly* running paper. The earthquakes of August 9, 1901, were obtained on *slowly* moving paper. In the former halation effects do not eclipse the first preliminary tremors, and an open diagram is obtained. (2) The three earthquakes which occurred on August 9, 1901, indicate the value of seismograms in correcting cablegrams. The interval of time between the preliminary tremors and the maximum motion shows that the origins of the first and third disturbances were 6000 miles distant, while the second was nearly 7000 miles distant. The first and last came from Japan, while the second came from the East Indies. In American and European newspapers it seems to have been universally stated that the origins were in Alaska.—*Dr. C. W. Andrews, F.R.S.:* Restored model of the skull and mandible of *Prozeuglodon atrox*. *Prozeuglodon atrox* is a primitive whale (Zeuglodont), and is one of the forms which unite the true Zeuglodonts with the early land-carnivores known as Creodonts.—*Mr. J. Y. Buchanan, F.R.S.:* Features of land-ice illustrated by photographs and stereoscopic slides in the taxiphote. These slides, taken last winter in the grotto of the Morteratsch glacier, illustrate the internal structure of the ice in winter.—*Mr. A. Hutchinson:* Protractors for constructing stereographic and gnomonic projections of the sphere. The protractors exhibited are intended for the use of students of crystallography, and are designed to facilitate the construction of great and small circles in the stereographic projection.

Mr. Henry Balfour: Stone implements of very early date from the Zambezi River and some of its tributaries. A large proportion of the implements of chalcedony, quartzite, &c., are of forms exactly similar to types characteristic of the river-drift period of western Europe and Great Britain. These were found associated with, and evidently forming part of, ancient terrace gravels deposited as drifts by the Zambezi at a remote period. Several implements were found by excavation in undisturbed gravel deposits at depths varying from 6 inches to 2 feet.—*Prof. W. M. Flinders Petrie, F.R.S.:* Drawings of ancient zodiacs.—*Prof. W. Gowland, F.R.S.:* Megalithic monuments in Japan (see NATURE, February 14, 1907, vol. lxxv., p. 382).—*Mr. Francis Fox:* The saving of Winchester Cathedral and other ancient buildings. (1) Specimens of the beechwood logs on which the cathedral stands; (2) block of the peat found beneath the walls, in some cases 8 feet in thickness; (3) sample of the gravel bed down to which the underpinning is carried by a diver; (4) old box-wood rule found during the operations.—*Mr. J. Gray:* An instrument for measuring the colour of the hair, eyes, and skin (NATURE, February 27, vol. lxxvii., p. 406).

Prof. Silvanus P. Thompson, F.R.S.: Drawings of early compass cards and windroses. The compass card was developed from windroses drawn on the Portulani, or sailing charts, at the points of intersection of the loxodromic lines. The drawings shown were from old Portulani or other early works dating from 1375 to 1584.—*Messrs. T. and R. Annan and Sons:* Photographs of Lord Kelvin.—*Mr. J. Stewart, Largs:* Photographs of Lord Kelvin, and relating to him.

Prof. A. H. Church, F.R.S.: Documents and specimens of historical interest referring to the Royal Society, including an unpublished letter of Captain James Cook, F.R.S., the circumnavigator, dated Rio de Janeiro, September 30, 1768, and seventeen portrait medals, struck at the Paris mint, of foreigners who were members of the Royal Society.

Messrs. B. J. Hall and Co., Ltd.: Ordoverax copying process. This process is one for rapidly and accurately producing facsimile copies of line drawings and tracings on any materials. The original is first copied on ferro-prussiate paper; the copy is placed before development, face downwards, on a plate of ordoverax composition previously prepared. The portions of the ferro-prussiate paper not affected by light act upon the ordoverax composition, causing it to take up printers' ink from a roller, whereas the parts of the plate not so acted upon do not take up any ink.—*Mr. Donald Cameron-Swan:* A new method of reproducing pencil and other drawings. This method (which is being employed for the Memoirs of the National Antarctic Expedition) differs from most photo-mechanical processes of reproduction in that the drawings are reproduced in exact facsimile, without any background of tone where none exists in the originals.

NOTES.

THE British associates and correspondants of the Institute of France will attend at St. James's Palace on Wednesday next, May 27, at 11 a.m., to present an address to the President of the French Republic on the occasion of his visit to this country.

THE Royal Society of London invites applications for two Mackinnon research studentships, each of the annual value of 150*l*. These studentships, which are restricted to British subjects, are offered for the purpose of researches in physical and biological sciences, one being awarded for research in the group of the physical sciences, including astronomy, chemistry, geology, mineralogy, and physics, the other for research in the group of the biological sciences, including anatomy, botany, palæontology, path-

ology, physiology, and zoology. Applications must be sent in to the Royal Society not later than June 10 on forms which can be obtained from the assistant secretary of the Royal Society, Burlington House, W.

ON July 1 the president and council of the Linnean Society will entertain the Darwin-Wallace medallists and foreign guests to dinner at Prince's Restaurant.

PROF. OTTO BÜTSCHLI, of Heidelberg, and Prof. A. G. Nathorst, of the Naturhistoriska Riksmuseum, Stockholm, have been elected foreign members of the Linnean Society.

THE annual visitation of the Royal Observatory, Greenwich, by the Board of Visitors will be held on Wednesday, June 3. The observatory will be open for inspection by guests at 3 p.m.

THIS year's meeting of the French Association for the Advancement of Science will be held at the beginning of August at Clermont-Ferrand. Sir William Ramsay, K.C.B., F.R.S., has accepted an invitation to lecture during the meeting on his researches. Full particulars of the proceedings at Clermont-Ferrand can be obtained from the offices of the French Association, 28 rue Serpente, Paris.

ON Tuesday next, May 26, Prof. W. Stirling will begin a course of two lectures at the Royal Institution on "Animal Heat and Allied Phenomena." The Friday evening discourse on May 29 will be delivered by Sir Ralph Payne-Gallwey on "Ancient and Mediæval Projectile Weapons other than Firearms," and on June 5 by Sir James Dewar on "The Nadir of Temperature and Allied Phenomena."

THE first International Congress of the Cold Storage Industries is to be held in Paris, at the Grand-Palais, at the end of September next. One of the sections, of which M. d'Arsonval is the president, will concern itself with questions relating to low temperatures and their general effects. We understand that Sir James Dewar, Sir William Ramsay, and MM. Van der Waals, Kamerlingh Onnes, Linde, Georges Claude, and Jean Becquerel will be among the contributors to this section.

THE Berlin correspondent of the *Times* states that a scientific expedition to the South Seas left Hamburg on May 16 on board the steamship *Peiho*, a vessel of 900 tons, which has been specially chartered for the cruise from the Hamburg-American Line. The expedition has been organised by the trustees of the scientific foundations of the city of Hamburg, and its mission is to complete the exploration more particularly of the German islands in the South Seas and to collect materials for the study of the natives and natural resources of those regions. Dr. F. G. H. H. Fülleborn, assistant at the Hamburg Institute for Tropical Diseases, is in charge of the expedition, and he is accompanied by a competent staff of assistants.

THE Home Secretary has appointed a committee on the use of lead in the manufacture of earthenware and china. The committee includes, with others, Mr. E. F. G. Hatch (chairman), Mr. A. Vernon Harcourt, F.R.S., Dr. George Reid, Mr. William Burton, and Mr. Bernard Moore. The committee is to consider the dangers attendant on the use of lead in pottery, and to report how far these can be obviated or lessened by improved appliances and methods in lead processes, by the limitation of the use of lead, by the substitution of harmless lead compounds for raw lead, by the substitution of other materials for lead, and by other means. The danger or injury to health arising from dust or other causes in the manufacture of pottery, and the special rules regulating the decoration of earthenware and china, are also to be considered.

A CORRESPONDENT writes:—"The Atlantic Ocean is in certain parts about four miles deep. Would a rock, if thrown into the ocean at its greatest depth, sink to the bottom?" The inquiry is a little indefinite, but Dr. C. Chree, F.R.S., has been good enough to send us a reply to it, in the course of which he points out that any solid of larger than microscopic dimensions will fall in a liquid with continuously increasing velocity so long as its density exceeds that of the liquid. Even at a depth of four miles the pressure of the water is only about four tons to the square inch, and such increase is quite insufficient to raise the density of water to that of ordinary rock. In the case of some exceptional form of rock, the density of which approaches closely to that of water when both are uncompressed, the result would depend on the relative compressibility of water and the material, combined with any slight effects due to change of temperature.

AT the instance of the late Secretary of State for the Colonies, and with the cooperation of the Government of the Sudan and the Royal Society, the Government has decided to establish in London a bureau for the collection and general distribution of information with regard to sleeping sickness. The Royal Society will find accommodation for the bureau at Burlington House, and one-fourth of the cost of upkeep will be borne by the Sudan Government. The bureau will be under the general control and direction of an honorary committee of management, appointed by and responsible to the Secretary of State for the Colonies. The committee will include the Right Hon. Sir J. West-Ridgeway, G.C.B. (chairman), Sir Patrick Manson, K.C.M.G., F.R.S., Sir Rubert Boyce, F.R.S., Dr. Rose Bradford, F.R.S., and Colonel D. Bruce, C.B., F.R.S. The main function of the bureau, which will be administered by a paid director, will be to collect from all sources information regarding sleeping sickness, to collate, condense, and, where necessary, translate this information, and to distribute it as widely and quickly as possible among those who are engaged in combating the disease. The publications of the bureau will be divided into two categories, viz. scientific publications intended for those who are engaged in research work or in carrying out medical administration in the infected districts, and publications of a less technical character for the use of Government officials, missionaries, and others, whose duties involve residence in those districts. One important piece of work will be the preparation of a map of the whole of tropical Africa, showing the distribution of the disease and of the different species of blood-sucking insects which are suspected of conveying it. The duties of the director of the bureau will for the present be undertaken by Dr. A. G. Bagshawe, of the Uganda Medical Staff, who has been seconded from the Protectorate service for the purpose.

A MEDUSA from Java, referable to the remarkable genus Chiropsalmus, previously known by one species from Brazil and Carolina and a second from the Rangoon coast, is described by Dr. R. Horst as new in Leyden Museum Notes (vol. xxix., No. 2) under the name of *Ch. buitendijki*. Unfortunately, the only known example of the Rangoon *Ch. quadrigatus* is in very bad condition, so that the distinctness of the Java form does not appear absolutely beyond doubt.

IN addition to a paper on fossil cetaceans by Mr. True, and one on the meteor-crater of Canyon Diablo by Mr. Merrill, which have been already mentioned in NATURE,

the fourth part of vol. iv. of the quarterly issue of Smithsonian Miscellaneous Collections contains an illustrated account, by Mr. R. Arnold, of the shells from the Tertiary oil-bearing strata of Santa Barbara, California.

STUDENTS of Coleoptera should be interested in a revision, by Mr. T. L. Casey, of the tenebrionid beetles of the subfamily Coniontinæ, published in the Proceedings of the Washington Academy of Sciences (vol. x., pp. 51–166), where several new generic groups are suggested and named, and also in descriptions, by Mr. W. D. Price, of new weevil-like species of the group Anthonomini, forming No. 1604 of the Proceedings of the U.S. National Museum.

A LARGE portion of part iii. of vol. lxxxix. of the *Zeitschrift für wissenschaftliche Zoologie* is occupied by a contribution from Mr. Valentin Dogiel, of St. Petersburg University, entitled "Catenata, eine neue Mesozoengruppe." The new group is established for the parasites of the genus Haplozoon, one of which was discovered by the author (as narrated in the *Zoologischer Anzeiger* for 1906) in the intestine of the polychæte worm *Travisia forbesi*, and the other in that of *Clymene lumbricalis*, a second member of the same group. The paper is illustrated by three plates (one partly in colour) showing the structure and development of these remarkable organisms.

IN the course of a paper on the nest of the ringed plover, published in the May number of *British Birds*, Mr. W. P. Pycraft argues that the commonly accepted theory as to the nesting of the earliest birds does not accord with the structure of Archæopteryx. Such birds, according to this theory, are believed to have nested in holes in trees, where they laid white eggs. But, urges the author, such a habit would be unsuited to a bird with a long body tail, which, in his opinion, is more likely to have made its nest in some such site as the crown of a tree-fern or a cycad. Is, however, it may be asked, the tail of Archæopteryx likely to have been much more in the way in a nesting-hole than are the tail-feathers of a hornbill?

NOW that Lamarck has received the recognition due to a pioneer of the evolution-doctrine, it is interesting to learn of the existence in Harvard University of a holograph manuscript from his pen. This MS., as we gather from a notice contributed by Prof. Bashford Dean to the *American Naturalist* for March, was written some time previous to 1820, and forms a series of essays and drafts of later work, comprising about ninety folios, of which fifty have writing on both sides. It was presented to Harvard by Prof. A. Agassiz, who appears to have obtained it in Paris in 1906. Prof. Dean gives a summary of its chief contents, together with reproductions of pen-and-ink sketches of micro-organisms and of a holothurian by Lamarck himself.

THE urgency of legislation for the protection of whales and turtles forms the subject of a forcible article by Dr. G. R. Wieland in the May issue of the *Popular Science Monthly*. The destruction, and in some cases practical extermination, which have resulted from the pursuit of the more valuable species of whales are familiar to all, but it is less well known how serious is the diminution in the number of turtles—edible and otherwise. It is, urges the author in conclusion, "neither Utopian nor impractical to attempt and speedily carry out the measures required for the preservation, not only of land animals, but of all our great animals of the sea. The only element of doubt is whether the volume of sentiment can soon enough make itself felt—in short, whether the race has reached the required culture stage in time."

IN the *Philippine Journal of Science* (iii., No. 1), Mr. Y. K. Ohno gives formulæ which express the laws governing agglutination phenomena as regards bacteria and agglutinating sera. The union of agglutinin and agglutinable substance he regards as a chemical reaction, and not as an absorption phenomenon.

IN the Scientific Memoirs of the Government of India (No. 31), Capt. Patton, I.M.S., details further observations on the tropical disease, kala azar, and its parasite, the Leishman-Donovan body, which, he finds, undergoes a cycle of development in a bed-bug (*rotundatus*), by the bite of which the disease is presumably communicated.

OPINION has of late been divided as to whether spirochætes belong to the bacteria or to the protozoa. In a paper on the *Spirochaeta pallida* of syphilis, Krzysztalowicz and Siedlecki definitely class these organisms as protozoa belonging to the Mastigophora, and propose to include them in a new family, the Spirilloflagellata (*Bull. Internat. de l'Acad. des Sciences de Cracovie*, No. 3, 1908).

TO meet the requirements of students and others with small incomes, Mr. C. Baker, of High Holborn, maintains a department for second-hand scientific instruments. The quarterly list recently issued contains as many as ten different sections. All kinds of microscopes and microscopic requisites, surveying and drawing instruments, also various pieces of optical and physical apparatus can be inspected and purchased under guarantee as to adjustment.

THE account of floral development and embryogeny in the wheat plant communicated by Mr. A. H. Dudley to the Liverpool Microscopical Society, and published in its thirty-ninth annual report, presents one or two special points of interest. The author obtains similar results to those recorded by Cannon for the megasporangium of Avena in so far that no parietal cell is cut off from the archesporium, and that numerous antipodal cells are produced in the embryo-sac; the limitation of the suspensor to the primary basal cell and the first divisions in the embryo appear to be similar.

TWO circulars referring to the International Botanical Congress that will be held in Brussels two years hence have been received. The first announces that, in place of the late Prof. Errera, Baron de Moreau, formerly Minister of Agriculture, has consented to become a president of the organising committee, sharing that position with Mr. Th. Durand, and that Dr. E. Wildeman will act as general secretary. The constitution of various local subcommittees is also indicated. The second circular gives the names of the two committees appointed for dealing with cryptogamic and palæobotanical nomenclature, and invites expressions of opinion with regard to rules additional to those formulated for phanerogamic plants and generic names that should be maintained in spite of priority rules.

AN editorial in the *Indian Forester* (March) referring to education and research in India cites the opinions expressed in NATURE of January 2 as to the wisdom of appointing professors and teachers who have shown their ability for prosecuting original research; in this connection, it is urged that the training of Indian foresters should be entrusted to men who have made a special study of forest problems in India. An instructive article on the private and communal forests in Japan is contributed by Sir Frederick Nicholson to contrast conditions with those found in the presidency of Madras. It is estimated that private forests cover 14 million acres, and the communal forests exceed 4 million acres, providing about an acre

and a half of woodland for every acre of arable land. Within recent years the necessity for re-planting has been recognised; *Cryptomeria japonica* and other conifers are generally selected, but camphor and chestnut trees are also largely planted; around the fields, mulberry, lacquer, and vegetable-wax trees are grown.

MR. C. F. STRAWSON has issued his ninth annual report on the destruction of charlock in corn crops during 1907 by spraying with a copper sulphate solution. Experiments extending over ten years have shown that young charlock can be destroyed in growing corn crops without injury to the latter by spraying with fifty gallons of 3 per cent. solution of copper sulphate (15 lb. to fifty gallons) per statute acre, and older charlock with a stronger solution. The corn crops are much improved, and give a better yield, where the charlock is destroyed, and young grass seeds and clover in the corn remain uninjured. The object of Mr. Strawson's annual reports is chiefly to induce those who cultivate charlock-seeded soils to adopt this new and easy method of restoring the land to its full crop-producing value.

IN a paper read before the Physiological Society on March 21, Dr. A. D. Waller, F.R.S., demonstrated that the contractility of animal and vegetal nerves observed by Prof. Bose (see NATURE, March 5, supplement, p. iii) may be obtained on fiddle-strings, or any other kind of strings, and is due to heating of the structures by the "fairly strong tetanisation" currents used by Prof. Bose. Dr. Waller calculates that the heat developed by the currents used, in the absence of evaporation, is sufficient to raise the temperature of a nerve 1°·35 per sec. Engelmann in 1895 showed that fiddle-strings in water contracted when heated. With weak tetanisation there is obtained elongation, with strong, shortening. The weight and the electrical conductivity of a fully contracted string are greatly diminished by loss of water.

ONE of the most important agricultural questions in Cape Colony, the deterioration of the veld, is discussed in the March number of the *Agricultural Journal of the Cape of Good Hope*. It seems to be established that the veld will no longer nourish cattle as well as formerly, and five causes are stated to have brought this about:—(1) overstocking and the kraaling of stock; (2) formation of sluits or dongas; (3) spread of noxious weeds; (4) burning of the veld; (5) destruction by drift sands. Overstocking, *i.e.* putting too many cattle on to a given area, is harmful, because the grasses or plants relished by the animals are so completely eaten off that they become exterminated, and their place is taken by plants which the animals have rejected, and which are, therefore, of no agricultural value. Some are positively noxious, *e.g.* the jointed cactus (*Opuntia pusilla*), which is likely to cause considerable trouble in future, the prickly pear, and the Mexican poppy. Kraaling, or herding the animals together at night to protect them from jackals, &c., has the effect of wearing down definite pathways, and thus starting the channels for the flow of water which finally develop into the sluits and dongas so characteristic of the veld. The burning of the veld is responsible for a good deal of damage, since the organic matter is largely destroyed, and there is considerable loss of nitrogen. Nevertheless, some means of removing old dead grass is necessary, for a good deal is apt to be left over from the previous season; sheep will not eat it, and it interferes with the new growth; there seems no option but to burn it. The whole problem is of vital importance, and can only be solved after careful scientific investigation.

THE American Government, in view of the rapid occupation of all the available land in the western States, has started a vast reclamation scheme. The most important is that for the irrigation of what are known as the Great Plains, the region extending from the Missouri River to the foot of the Rocky Mountains and from the Panhandle of Texas northward to the Canadian frontier. The projects now sanctioned in various parts of the country provide for the expenditure up to the year 1911 of about fourteen millions in the reclamation of some two millions of acres. The progress of this great experiment is described in the April number of the *National Geographical Magazine* by Mr. C. J. Blanchard, statistician to the U.S. Reclamation Service, under the title of "Home-making by the Government." The illustrations of fruit and other products grown under irrigation present a vivid picture of the possibilities of this important enterprise. The most remarkable of these projects is the Salt River scheme in Arizona, which involved the construction of the "most wonderful highway ever built by man," that on Fish Creek Hill, where a road has been cut along the banks of a stupendous canyon through the living rock for a distance of forty miles.

THE chain has hitherto received scant attention from investigators in the field of elasticity and strength of materials, and a welcome addition to the two or three scattered memoirs on the theory of the stresses in chain-links is made by a memoir on the strength of chain-links by Prof. G. A. Goodenough and Prof. L. E. Moore, forming Bulletin No. 18 of the University of Illinois Engineering Experiment Station. The investigation described deals with the development of the theory of the stresses induced in chain-links with given conditions as regards loading, with experimental tests of the validity of the theory employed, and with the assumptions made as to the distribution of pressure between adjacent links, and the deduction from theoretical considerations alone of rational formulæ for the loading of chains. Experiments made on steel rings were found to confirm the theoretical analysis employed in the calculation of stresses. Experiments on various chain-links further confirm this analysis. The introduction of a stud in the link equalises the stresses throughout the link, reduces the maximum tensile stresses about 20 per cent., and reduces the excessive compressive stress at the end of the link about 50 per cent. The following formulæ are applicable to chains of the usual form:—$P = 0{\cdot}4\ d^2S$ for open links, and $P = 0{\cdot}5\ d^2S$ for stud links, where P denotes the safe load, d the diameter of the stock, and S the maximum permissible tensile stress.

THE report of the Meteorological Service of Canada for the year 1905 has recently come to hand; it consists of xix+418 quarto pages, nearly all of which are taken up with monthly and annual summaries, including hourly or bi-hourly observations of air-pressure and temperature at some of the first-order stations. The careful preparation of these voluminous tables is of itself a stupendous undertaking; among the extreme shade temperatures we note 104°·5 at Spence's Bridge (British Columbia) in July, and −53°·0 at two stations in Alberta in February. The percentage of fulfilment of weather forecasts is very satisfactory, the average for all districts being 85·1; the greatest annual success is 86·9, in the Upper St. Lawrence district. In an interesting supplement Prof. W. J. Loudon discusses the effect of different winds on the "seiches" observed, and also gives the results of his researches in atmospheric electricity, at High Rock station, Georgian Bay.

IN the *Physikalische Zeitschrift* for May 1 Dr. L. Mandelstam considers the question whether the usual

method of representing dispersion on the electromagnetic theory, as due to the presence in the medium of electrical resonators, is capable also of explaining the gradual extinction found to take place as due to radiation from the resonators. He comes to the conclusion that it is not, and in this respect is in opposition to Prof. Planck, to whom the theory of dispersion owes so much.

THE concluding fascicule of the *Bulletin des Séances* of the Société française de Physique for the year 1907, which has just been issued, contains a valuable *résumé* of the communications made to the society during the past year. It occupies eighty pages, and is of the greatest service to those who have not the time to read the complete papers. A glance at the titles of the abstracts is sufficient to show that the Société française de Physique maintains its position as one of the most successful of the societies which receives and publishes original work done in the field of physics.

MANY geographical works, offered at greatly reduced prices, are included in a catalogue of publishers' remainders just issued by Mr. H. J. Glaisher, Wigmore Street, London, W.

AN admirable summary of the mineral resources of Western Australia is given by the Agent-General, the Hon. C. H. Rason, in the May number of the *Empire Review*. The twenty-three years' mining history of the colony proves it to be one of the richest mineral territories in the world.

AN illustrated itinerary of pleasure cruises to the Norwegian fiords by the yachting steamer *Midnight Sun* has been received from the Albion Steamship Co., Ltd., Newcastle-upon-Tyne. Each cruise extends over fourteen days, and the minimum fare is ten guineas. The sailings commence on June 6.

A USEFUL catalogue of electrical measuring instruments for technical and laboratory purposes has just been issued by Messrs. Isenthal and Co., Mortimer Street, London, W. Particulars and illustrations are given of electromagnetic, moving-coil, hot-wire, and switchboard instruments of special types, and also of aperiodic precision instruments on the dynamometer principle, and insulation testers. The catalogue makes the selection of a suitable instrument of any of these designs a simple matter.

MESSRS. MARION AND CO., LTD., of Soho Square, London, announce a prize competition in which money prizes are offered for photographic work done on their plates, films, and printing papers during the present season. Of the four classes into which the competition is divided, one is for photographs of scientific interest. Biological, geological, astronomical, and natural history photographs, spectroscopic work, and photomicrography serve to indicate the general character of this class, though other scientific subjects are eligible. The first, second, and third prizes in this class are, respectively, 10*l*., 5*l*., and 2*l*., and Mr. Chapman Jones will be the judge.

THE recent removal of Swedenborg's body from London to Stockholm, after it had reposed in the Swedish Lutheran Church in London for one hundred and thirty-six years, is a part of a larger movement for the recognition of the genius of Swedenborg in the domain of science. The movement began outside Sweden. Dr. Max Neuberger, of Vienna, in 1901 delivered an address before the assembly of German Naturalists and Physicians entitled "Swedenborg's References to the Physiology of the Brain." Following up this interest, Dr. Neuberger addressed a communication to the Academy of Sciences of Stockholm in which he expressed his regret that Swedenborg's extensive manuscript on the brain, which is preserved in the library of the Academy of Sciences, had not yet been published. This led to the appointment of a committee to investigate the matter. Prof. Gustaf Retzius, the chairman of the committee and president of the academy, made a study of the subject of Swedenborg's physiological treatises. He became so impressed with the value of these works that he proposed to the academy to issue an edition of Swedenborg's scientific and philosophical works, and offered to bear the expense of the first three volumes himself. Several volumes of these and other of Swedenborg's works have already been published. The examination of Swedenborg's manuscripts is leading to the conclusion that theories and facts in many branches of science usually assigned to much later dates and to other men of science are becoming recognised as largely the work of Swedenborg.

OUR ASTRONOMICAL COLUMN.

A BRILLIANT METEOR.—A meteor of extraordinary brightness was seen by several observers at 9.45 on Sunday evening, May 17. Mr. T. F. Connolly, of the Solar Physics Observatory, observed the object from Wimbledon Common. It apparently commenced its flight about half a degree east of Polaris, and, travelling slowly to the east of north, passed about half-way between δ and γ Cassiopeiæ. The brightness of the meteor exceeded that of Venus, which was above the horizon, and the head was pear-shaped. The duration of the flight was between three and four seconds; no trail was observed, and the meteor disappeared when at some twelve degrees above the horizon. This object was independently observed by Mr. H. E. Goodson, who states that it was one of the brightest he has ever seen. Mr. P. W. Copeland also writes to say that he observed the meteor at Belper, Derby, at the same time. He says:—"The meteor was of the slow-moving type, and I estimated its apparent diameter as from two to three times that of Venus at the present time. Just before the end of its path, a smaller portion, apparently at a lower temperature, separated and dropped in a more vertical direction. This observation has been confirmed by a friend who saw the meteor at Derby, eight miles from Belper."

CORRELATION OF STELLAR CHARACTERS.—A second paper by Miss Gibson and Prof. Karl Pearson on the correlation of stellar characters appears in the Monthly Notices (R.A.S.) for May (vol. lxviii., No. 5, p. 415). The characters of which the correlations have been examined in this paper are magnitude, colour, spectral class, proper motion, parallax, and position, all of which are of fundamental importance in any study of cosmical structure. As might be expected, there is found to be a marked relationship between the colours and the spectral classes of the stars considered, whilst the relation between magnitude and spectral class is but about half so marked; the latter is sensibly increased if the temperature classification of Sir Norman Lockyer be taken as the index of spectral class. The type of spectrum is also shown to be definitely associated with proper motion and parallax. It follows that, judging from the Yale parallax stars considered, there is a sensible correlation between chemical constitution and motion in space. Among the numerous other results obtained by Prof. Pearson we may mention that he confirms Prof. Newcomb's deduction that the mean parallax of an array of stars of given proper motion is one-fifteenth of that proper motion.

VARIABLE STAR WORK AT THE LAWS OBSERVATORY, MISSOURI.—Bulletin No. 13 of the Laws Observatory, University of Missouri, contains brief descriptions of the Zöllner-Müller photometer and the Gans-Crawford telescope recently acquired by the observatory for use in the series of photometric observations being carried out there. The results of numerous observations and revised elements and light-curves are also published for the variable stars X and V Lacertæ. Bulletin No. 14, from the same source,

discusses 160 observations of the peculiar variable RV Tauri (45, 1905). The light-curve of this object is of the β Lyræ type, and the maxima and secondary minima present variations in amplitude which appear to be irregular. Between November, 1904, and July, 1905, the character of the variation seems to have altered completely, while further observations made at the Laws Observatory during 1906 and 1907 indicate that the curve has again changed its form. This object then presents an unsolved problem similar to that presented in the cases of R Sagittæ and V Vulpeculæ.

PHOTOMETRIC OBSERVATIONS OF SHORT-PERIOD VARIABLE STARS.—No. 4247 of the *Astronomische Nachrichten* (p. 369, May 8) contains a series of results of the observations of twenty-nine variable stars of short period obtained by Herr H. v. Zeipel at the Upsala Observatory during 1907. For each star two comparison stars were employed, and their positions and magnitudes are given at the head of each table.

THE RELATIVE ACCURACY OF VARIOUS DOUBLE-STAR OBSERVERS.—A short paper by Herr V. Ehrenfeucht, appearing in No. 4247 of the *Astronomische Nachrichten* (p. 381, May 8), deals with the relative accuracy of the principal double-star observers. The resulting figures were obtained by comparing the measures of these observers with the ephemerides of fifty-two well-known doubles, and the probable errors in position-angle and distance are given for eleven observers. The errors in distance range from 0″·055, for Schiaparelli, to 0″·100, for Mädler, the mean value for all the observers considered being 0″·698.

ITALIAN OBSERVATIONS OF THE SUN DURING 1907.—The usual summary, by Prof. Riccò, of the observations of spots, faculæ, and prominences made at Catania during last year, appears in No. 3, vol. xxxvii., of the *Memorie della Società degli Spettroscopisti Italiani*.

The present paper deals especially with the second semestre of 1907, but the values for the whole year are given. For the period July to December the mean daily frequencies of spots, faculæ, and prominences were 5·7, 2·1, and 4·7 respectively, whilst for the whole year the corresponding values were 5·5, 3·4, and 4·3.

THE NATAL OBSERVATORY.—Mr. Nevill's report of the work done at the Natal Observatory during 1907 is, as usual, chiefly devoted to the meteorological results obtained at the various meteorological stations of the colony. The only astronomical note of general interest is that a series of observations of comet 1907*d* was made by Mr. A. E. Hodgson, and the results are to be communicated to the Royal Astronomical Society. The magnetic declination at Durban for January 1, 1908, is given as 22° 27′ W., with a yearly decrease of 12′, and the present value of the dip is 63°·2.

SOLAR PHENOMENA AND TERRESTRIAL TEMPERATURES.—In a paper published in the *Bulletin de la Société astronomique de France* for May, Dr. J. Loisel discusses the relationships between the activity of various solar phenomena and the amount of heat received at the earth's surface. The results are based on the observations made at Montpellier during the period 1883–1901, and are of such interest as to suggest the desirability of prosecuting this research in many more different localities. Plotting the actinometric results obtained at Montpellier, together with the frequency curves for sun-spots, faculæ, and prominences, Dr. Loisel shows that they are distinctly analogous, but the terrestrial variation is an inversion of the solar variations.

THE OKAPI MONOGRAPH.[1]

SHORTLY after the arrival in London of the first complete skin of the okapi, the administration of the Congo Free State at Brussels sent urgent orders to its officials on the Uganda border to procure other skins, and also skeletons, of the then newly discovered animal. In due course these orders were carried out, and a representative series of specimens received at the Museum of the Free State at Tervueren, a few miles out of Brussels, some of which were mounted for public exhibition, while others were reserved for study. With commendable promptitude, the administration thereupon took steps to arrange for a monograph of the okapi, the preparation of which was entrusted in 1902 to Dr. Forsyth Major, who had already made a special study of the giraffe group.

During the same year, that gentleman visited Belgium for the purpose of studying the Tervueren specimens, upon which he published several preliminary notes in *La Belgique Coloniale*. Coloured and other plates for the monograph were also prepared under his direction. Nevertheless, after something like two years' delay, no MS. was forthcoming, and the Secretary of the Free State felt himself compelled to seek another author. Accordingly, Prof. Julien Fraipont was approached, who, after some demur, eventually consented, at the close of 1905, to undertake the work, and to use, so far as practicable, the plates prepared under Dr. Major's direction.

The result of these negotiations is the present elaborate and richly illustrated monograph, which bears on every page testimony to the author's diligence and industry. In one respect the delay has been of very considerable advantage, since it has admitted of the examination and comparison of a much larger series of specimens than was available in 1902–3. Most of these, it should be mentioned, originally belonged to the authorities of the Free State, by whom examples have been presented to the museums of Stockholm, Lisbon, Paris, Madrid, and Antwerp. Altogether, the author had at his disposal no fewer than a dozen skins, seven skeletons, and eleven skulls. With such full material, the monograph could scarcely fail to be otherwise than in a great degree exhaustive.

Following the usual rule, the monograph opens with a historical sketch of the discovery of the okapi and the subsequent acquisition of fuller knowledge of its structure and affinities. In the course of this chapter the author discusses the identification of the okapi with "Set-Typhon" of the ancient Egyptian frescoes and sculptures—an identification which he refuses to admit. The idea is, however, by no means dead, a special work on the subject having been published in Paris last year.

The next chapter is devoted to the general external form and colouring of the creature, in the course of which the author expresses his opinion that, if we except the zebra-like pattern on the limbs and the general brilliance of tone (rather a large order, by the way), the coloration is not unlike that of many antelopes. Of great interest are a number of figures of the limbs of different individuals to display individual variation in the matter of colour-pattern. The skeleton forms the subject of the following chapter, in the course of which the author devotes particular attention to the nature of the horns of the giraffe and okapi, and their correspondence with those of other ruminants. The "vellericorn," or skin-covered, type presented by the former is evidently the most primitive, and there can be equally little doubt that the cap of bare bone at the tip of the okapi's horn represents the deer's antler. A further inference from the latter identification is that the shedding of the antlers in deer is an acquired character, and it is noteworthy that some Tertiary stags seem to have permanent antlers, while in several of the less specialised living species, such as the Indian sambar, the shedding does not take place annually. Front views of a male and a female skull are given, although little is said with regard to individual variation in skull-width, of which we believe there is a good deal. In mentioning the existence of a double bicipital groove to the humerus, the author scarcely gives sufficient emphasis to the fact that this feature is absolutely distinctive of the Giraffidæ.

With regard to the habits of the okapi, Prof. Fraipont has, of course, nothing new to relate, but the photographs he gives of the equatorial forest seem to confirm the suggestion that the striping of the limbs and hind-quarters serves the purpose of breaking up the outline of the creature in the comparatively clear basal zone of the forest. Copious extracts are given from the writings of those who have obtained more or less nearly accurate information with regard to the okapi's haunts and mode of life.

A casual survey of the four coloured plates included among the illustrations will probably lead to the belief

[1] "Contribution à la Faune du Congo." Vol. i., Okapia. By Julien Fraipont. Pp. 118; 38 plates. *Annales du Musée du Congo*. Zoologie, ser. 2. (Brussels, 1907.)

that the author recognises two species of okapi, as two of the plates are lettered *Okapia liebrechtsi*. This is due, however, to the fact that Prof. Fraipont had to use the plates prepared for Dr. Major, and from the descriptions of the plates we learn that the author recognises only a single species—the typical *O. johnstoni*. In this we think he is certainly right, and that some other factor than specific distinction will have to be sought to explain the differences between individual okapis in the matter both of colour-pattern and of skull-characters. If there be two kinds, the okapi certainly forms a strange exception to the law of "geminal species."

Both the author and the administration of the Congo Free State are to be congratulated on this handsome and exhaustive monograph. R. L.

IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute was held in London at the Institution of Civil Engineers on May 14 and 15, and was largely attended by members from the various iron-producing districts of this country and abroad. Sir Hugh Bell presided.

The report of the council, read by Mr. Bennett H. Brough, the secretary, showed that the institute had made considerable progress during the year 1907. The membership amounted to 2100, and the financial prosperity was a matter for congratulation. In presenting the accounts, Mr. W. H. Bleckly, hon. treasurer, announced that Mr. Andrew Carnegie, past-president, had presented to the research fund the further sum of eleven thousand dollars, bringing his total benefaction to one hundred thousand dollars. In moving the adoption of these reports, the president announced that the institute had secured larger premises in the same building as those previously occupied, and that the reading-room accommodation had been much improved.

The president then handed the Bessemer gold medal to Mr. B. Talbot, inventor of the continuous open-hearth steel process, who expressed his acknowledgments.

The first paper read described improvements in plate-rolling mills. In it Mr. A. Lamberton described a new form of plate-mill now successfully at work at the Glasgow Iron and Steel Works for rolling light plates. The paper, on the physical qualities of steel in relation to its mechanical treatment, contributed by Mr. James E. York (New York) contained suggestions for changes that might result in the production of more trustworthy rails and other similar sections than those now produced by ordinary methods. The heating of the ingots is a matter of great importance, and it is recommended that the finishing temperature should be as low as possible to get the best results, and that the initial temperature should not exceed 950° C. For solidifying ingots the author's method of transverse rolling may be applied.

Dr. T. E. Stanton, of the National Physical Laboratory, described a new fatigue test for iron and steel, in which a combination of rolling abrasion and alternate bending is used. The machine designed for the purpose was exhibited and described.

Prof. B. Igewsky (Kieff) submitted a paper describing a small electric furnace of novel design erected for experimental purposes at the Kieff Polytechnic Institute. It is a rotating cylindrical furnace, with its axis horizontal, built up of fire-brick blocks with contact pieces rubbing against the outside surface. Most of the heating is done by the passage of the current through the inner surfaces of the refractory material, which, when red hot, becomes a conductor. A continuous current of 250 volts and 50 amperes is employed. Experiments for the production of steel from cast iron by the ore process were successful.

The meeting was then adjourned until May 15, when the first paper was read by Mr. F. J. R. Carulla (Derby), who directed attention to the difficulty in finding cast iron suitable for use in the construction of chemical plant. For some purposes, as, for example, ammonia stills, cast iron seems everlasting, and even acid chemicals have sometimes little action on cast iron. Yet when hydrochloric acid is in question, cast iron succumbs like any weaker vessel.

It was announced that the council had awarded Carnegie research scholarships, each of the value of 100*l*., to T. Baker (South Wales), R. F. Böhler (New York), W. Giesen (Mexico), E. Preuss (Germany), and L. P. M. Révillon (France). The president then handed the Carnegie gold medal for research to Dr. Carl Benedicks, of Upsala University, and stated that the reports submitted by the eight holders of research scholarships were considered to be of sufficient merit to warrant their publication in the journal of the institute.

Mr. E. F. Law exhibited some striking lantern photographs illustrating the application of colour photography to metallography. With the aid of Lumière's autochrome plates it is possible to obtain a photograph in colour on a single plate and by a single exposure. In order to distinguish the constituents, the polished specimen of an alloy is heated until a film of oxide forms on the surface. Owing to the different rates at which the constituents oxidise, they assume different colours, and can be readily distinguished in the coloured photograph.

The utilisation of blast-furnace slag formed the subject of a paper read by Mr. C. de Schwarz (Liége), in which he reviewed recent processes for making slag bricks and cement. Blast-furnace works, especially those producing grey pig iron, have evidently still a large field for improvement by utilising their slag for such purposes.

Mr. Walter Rosenhain gave a detailed description of the metallurgical and chemical laboratories in the National Physical Laboratory, and Mr. Wesley Lambert gave an interesting account of the pyrometric installation in the gun section of the Royal Gun and Carriage Factories, Woolwich.

The eight reports on research work submitted by holders of Carnegie research scholarships showed that a large amount of very valuable work is resulting from the funds placed at the disposal of the institute by Mr. Carnegie. The investigation described by Mr. E. Hess (New York) was carried out at a plant at Monterrey, Mexico, its object being to ascertain the microscopical structures of steels the carbon content of which is above 0·9 per cent. at various temperatures above the critical point. The rusting of iron was dealt with by Mr. J. Newton Friend (Suffolk), whose results point to the fact that the rusting of iron is primarily the result of acid attack. The object of the research described by Mr. D. M. Levy (Birmingham) was to investigate the influence of sulphur, as it affected the relations of carbon and iron, and by a series of coordinated thermal, mechanical, chemical, and microscopic tests to determine how far this action could be traced to any combination or reaction between these three elements, or what explanation could be elicited for it.

No evidence was found to support the view that chemical union between iron, carbon, and sulphur is the cause of sulphur tending to retain carbon in the combined form in irons. The purely physical—or rather mechanical—effects of the sulphide observed in the research appear to offer a satisfactory explanation of its action, exercised even by very small proportions.

Mr. A. Hiorth (Christiania) gave the preliminary results of trials in refining iron and steel by means of vapours of metallic sodium. He finds that iron treated in this way is more fusible and will remain molten longer than other iron, and that such treatment will remove the oxygen. The research submitted by Mr. B. Saklatwalla (Charlottenburg) on the constitution of iron and phosphorus compounds was made with the view of supplementing Stead's chemical researches by a complete thermal and metallographic investigation of the subject. The function of chromium and tungsten in high-speed tool steel was investigated by Mr. C. A. Edwards (Manchester); and Mr. H. C. Boynton (New Jersey) submitted a continuation of his researches on the hardness of the constituents of iron and steel.

Lastly, Dr. Carl Benedicks (Upsala), in a memoir for which the Carnegie gold medal was awarded, gave the results of experimental researches on the cooling power of liquids, on quenching velocities, and on the constituents troostite and austenite. He finds that the essential condition for a quenching liquid to give effective cooling appears to be a high latent heat of vapour, and so low a temperature that the vapour bubbles formed at the surface of the metal may be easily condensed in the surrounding liquid. The rate of flow of the liquid has very little in-

fluence on the effectiveness of the cooling. The investigations of cooling velocities were made with an automatic quenching apparatus and temperature calibration device, with a string galvanometer, calibration of which instrument has been investigated. The cooling velocity is considerably lowered with increasing carbon content, and possibly silicon has a similar effect. Results are given confirming the theory that troostite is a solid colloid solution of cementite in iron, or, in other words, a pearlite having ultra-microscopic particles of cementite. The last section of the report is devoted to the study of austenite, for which a new etching medium, 5 per cent. alcoholic solution of metanitrobenzolsulphonic acid, was found to be of use. Austenite was observed to be more liable to rusting than martensite. The most important fact found concerning the preservation of austenite in carbon steel is that it requires a high mechanical pressure. Austenite never occurs in the outer layer of a hardened specimen, but it is entirely erroneous to ascribe this to oxidation; it has been shown to depend on the lack of the necessary pressure.

The annual dinner of the institute was held on May 14, with Sir Hugh Bell in the chair. Four hundred members and visitors were present, the principal speakers being Sir Edward Grey, Secretary of State for Foreign Affairs, Sir W. H. White, K.C.B., the Right Hon. J. L. Wharton, Sir Walter Runciman, Mr. R. A. Hadfield, Viscount Ridley, and General Baden-Powell.

SCIENTIFIC AID TO EGYPTIAN AGRICULTURE.[1]

FEW of the changes effected during the past decade in our management of the Crown colonies, India, and Egypt will be of more lasting benefit than the establishment in them of scientific, as distinct from the ordinary administrative, departments of agriculture. Although they have only been working a short time, some of them have already rendered very useful service, and give promise of even better things in the future; indeed, in this respect these countries are usually better off than the self-governing colonies—one might almost add than ourselves; in proof it is only necessary to refer to the admirable work accomplished in Jamaica and in the Transvaal, where, on the advent of self-government, it was decided to maintain the scientific department.

The volume before us contains an account of the work done by the scientific staff of the Khedivial Agricultural Society. More than half of it is devoted to cotton, the staple Egyptian crop.

Mr. Willcocks gives some notes on the Egyptian cotton-bug or cotton-stainer (*Oxycarenus hyalinipennis*), an insect which receives its name from the fact that it stains the fibre either with its excrements or with the juices of its body, but which in addition inflicts other damage by sucking the juices from the bolls and the seeds. Once the pest has invaded a cotton field there appears to be no way of getting rid of it, but various suggestions are given for keeping it down. Mr. Willcocks has worked out the life-history, and the stages in its development are shown in a beautiful coloured plate by Miss Connie Beard.

This is followed by a long paper, or rather a collection of papers, by Mr. Lawrence Balls, dealing mainly with heredity in cotton. The cotton plant follows Mendel's laws of gametic segregation in certain of its characters, but the practical problems involved are likely to prove difficult of solution. The history of cotton in Egypt has not yet been worked out; the crop is undoubtedly of great antiquity, and some indigenous culture still exists in the Soudan. But the modern crop is not indigenous; it is closely related to Sea Island cotton, from which, indeed, it has probably sprung, since Sea Island cotton was certainly imported into Egypt in 1822. It is not, however, a pure type. Mr. Balls shows that cross-fertilisation takes place to a certain extent under field conditions, and the accumulated effect of this has been to convert the crop into a mass of hybrids. This is no doubt of prime importance in studying two of the most pressing practical problems, the deterioration of the crop in yield and quality and the multiplication of a weed cotton in the fields. Much can be done by selection to get rid of the weed cotton, but selection alone cannot solve the problem, since there will always remain the splitting forms arising from natural crosses between the wild and cultivated varieties. The only permanent solution is to breed pure types, and though Mr. Balls is aware of the special difficulties involved (notably the fact that many of the characters of importance to the manufacturer and cultivator are dominant), he is quite hopeful of the result.

Cotton is not the only hope of the scientific staff. The Nile Valley is well adapted to wheat cultivation, and was in Roman times a great wheat-producing district. To-day wheat is actually imported, but it is pointed out that the crop might very well come into the rotation with cotton, so that Egypt could once again take a place among the wheat-producing countries of the world.

Mr. Hughes contributes some notes on Egyptian and Soudan soils. Generally speaking, the Nile soils do not contain much organic matter, and the "total" phosphoric acid is not high, but a large proportion is "available," so that Dyer's method may show 0·02 per cent. to 0·08 per cent. In spite of this, however, application of superphosphate has been found beneficial. We may expect some very interesting and important results when the manurial requirements of these soils, as ascertained by field trials, are compared with their chemical composition. It would also be desirable to get out the full mechanical composition of some of the typical soils of known history. Mr. Burns gives an interesting series of analyses of the solids dissolved in the Nile water, samples having been taken for this purpose every month during 1906. The results will be of great value to students of the Nile flood.

Altogether, the work is very satisfactory, and is full of promise for the welfare of Egypt. E. J. R.

[1] "Year-book of the Khedivial Agricultural Society, Cairo, 1906." Pp. 219. (Cairo: National Printing Department, 1907.)

THE PIGMENTATION SURVEY OF SCOTLAND.

THE last half-yearly number of the Journal of the Royal Anthropological Institute contains an important memoir, prepared by two enthusiastic Scotch anthropologists, Messrs. Gray and Tocher, on the pigmentation of hair and eyes among the school children of Scotland. In one respect the methods employed fail to secure that precision which is necessary to an investigation of this kind. Attempts were made to furnish the correspondents with standard colour cards produced by the three-colour lithographic process, but English manufacturers have up to the present been unable to provide them. There seems, however, to be a prospect of overcoming this difficulty by the adaptation of Lovibond's tintometer to anthropological work. The new instrument is described by Mr. Gray in the April number of *Man*.

Even with these imperfect methods the results are valuable. In the first place, the percentage (24·9) of Scotch boys with fair hair is unexpectedly low. The obvious inference is that the pure Norse or English element in the population is by no means predominant, and that there is a dark or brunette element at least equal, and probably greater. The highest density of fair hair is to be found in the great river valleys opening on the German Ocean and in the Western Isles. In the former case this probably points to invasions of a blonde race into those regions. Similarly, the higher percentage of fair hair in the Spey valley and in the Western Isles implies inroads of the Vikings or Norsemen. It is perhaps pushing the evidence too far when the writers suggest that the high percentage of fair-haired girls in the neighbourhood of Dunfermline is due to the train of blonde damsels who are supposed to have accompanied the Saxon princess Margaret, who about the time of the Norman Conquest became Queen of Malcolm Canmore.

The survey appears to corroborate the conclusions of Dr. Shrubsall in regard to London slum districts, that the percentage of fair-haired people in industrial towns is very low. For some reason as yet obscure, whether from alien invasion or the influence of environment, in towns like Glasgow and Dundee the conditions are specially unfavourable to the survival of blonde men, while the reverse is

the case with women. Another important conclusion seems fairly well established, that improvements in communication do not, as might naturally be expected, tend to homogeneity of type; on the contrary, owing to selection centres or to some obscure influence of environment, all improvements in transport apparently tend to make the race more heterogeneous.

The part of the country in which dark hair specially prevails is the extreme west. "If," write the authors of the memoir, "we assume for reasons given above that the pigmentation of girls represents more nearly the pre-Norse inhabitants, this native type has crowded into the Isle of Skye and the opposite coasts of the mainland. If the Dalriadic Scots, who invaded Argyllshire in the fifth century, were a dark race, and the invaders who settled there were men only, that would account for the darkest region in the boys' map being in Argyllshire. The Hebrides have been so much affected by the Viking and Norse invasions from Scandinavia which have passed round the coast of Scotland that they have a much smaller percentage of dark type than the islands and mainland lying further east. The Isle of Lewis has a higher percentage of dark girls than boys, indicating the presence of a pre-Norse dark native population. The south-west corner of Scotland in both the boys' and girls' map is darker than the average; and since, in historical times, the Picts inhabited this region, this evidence points to the conclusion that the Picts were a dark race."

Such wide-reaching conclusions, in the present state of our knowledge, are obviously premature, and too much stress is laid upon pigmentation as a test of race. But the results of this imperfect investigation are sufficiently instructive to justify the demand for a national anthropometrical survey, which was pressed on the late Prime Minister by an influential deputation, the proceedings being reported in the same number of the journal.

ACOUSTIC OSCILLOGRAPHS.

AN interesting addition to the phonograph or the gramophone has been designed and made by Mr. Bowron, of 57 Edgware Road. It is well known that the action of a gramophone depends on a spiral line cut in the record disc. When this line is examined with a magnifying glass, it is seen to consist of numerous small oscillatory curves; as the disc rotates the needle that follows these curves actuates a diaphragm, and thus the sounds are reproduced. In other words, the curve cut on the disc is a graph of the various sounds produced by the instrument. Several years ago Prof. Ewing studied the analysis of vowel sounds by examining the corresponding curves cut on a phonograph record. Mr. Bowron has undertaken the task of reproducing on a large scale the curves to be found on a gramophone record: he has accomplished this by means of a small mirror, which is mounted so that it oscillates with the diaphragm of the instrument; a beam of light is reflected from this oscillating mirror and from another mirror which rotates uniformly, with the result that a luminous curve of about three feet amplitude can be thrown on a white screen, and so made visible to a large audience. The variations in this luminous curve can be watched while the corresponding sounds are heard; thus the nature of the oscillations produced in the course of a song or the peformance of an orchestra can be most instructively studied.

It would, no doubt, be possible to obtain gramophone records of the various vowel sounds, and to study the corresponding oscillations in a similar manner. In teaching the elements of harmony, it would be interesting and instructive to project on a screen curves showing the characteristics of the various harmonious and dissonant intervals, while the corresponding sounds are rendered audible; and this also could be done by the aid of Mr. Bowron's invention.

Of course, for the curves to correspond exactly to the sounds, it is imperative that the oscillating mirror shall have a very small period of vibration—a period much smaller than that of any of the oscillations which it is necessary to reproduce. Hence the mirror and the mechanism by which it is actuated must be made as light as possible. Some difficulty has been found in obtaining an oscillating mirror large enough to reflect sufficient light to produce curves visible to a large audience, and at the same time light enough to have a period as small as is required; but the progress already made indicates that complete success may ultimately be obtained.

Mr. Bowron has also adapted a Koenig's manometric flame to indicate the acoustic oscillations produced by a gramophone; were it not for the fact that the variations in the shape of the flame must be interpreted before the precise character of the oscillations can be known, this method would be the preferable one. Mr. Bowron's inventions are certain to be appreciated, not only as an educational aid, but also as affording an interesting spectacular display for public entertainments. E. E.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

ST. ANDREWS.—In order to remove misapprehensions which have apparently arisen upon the subject, announcement is made that the University Court—the patrons of the Chandos chair of physiology in the United College, St. Andrews, now vacant—has resolved that the appointment should be open, and that the person to be elected should be the person deemed to be the best candidate, whatever may have been his previous sphere of work. The Court is not pledged to any one candidate, and the election is not a foregone conclusion.

CAMBRIDGE.—The election of a professor of biology will take place on Monday, June 8. Candidates are requested to communicate with the Vice-Chancellor on or before Saturday, May 30.

Mr. C. Shearer, of Trinity College, has been nominated to use the University table at Naples for five months from May 1, 1908.

The professor of botany gives notice that the botany school will be open for practical work during the long vacation. A practical course in elementary systematic botany (flowering plants) will be given in the elementary laboratory on Tuesdays and Saturdays at 9 a.m., beginning Tuesday, July 7. Fee, 1*l.* 1*s.* A series of botanical excursions will be arranged.

Prof. Larmor has been appointed a member of the board of electors to the professorship of chemistry until February 20, 1910, in succession to Lord Rayleigh, who has resigned his place on the board.

The general board of studies, acting on a memorandum received from the board of geographical studies, recommends a re-construction in the staff engaged in teaching geography in the University. It is proposed that the readership of geography, which becomes vacant in the Michaelmas term of this year, be suppressed, and to establish in its place three lectureships in geography. One of these lectureships will be on historic and economic geography, and will be in connection with the special board for history and archæology. The second will be in regional and physical geography, and it is proposed to connect this with the special board for biology and geology. The third will be a lectureship of surveying and cartography in connection with the special board for mathematics. The salary of each of the first two mentioned lectureships will be 150*l.* per annum, and that of the last 50*l.* per annum. The last two named will be known as the Royal Geographical Society lectureships in their respective subjects. The council of the Royal Geographical Society has offered to contribute 200*l.* a year for three years to the geographical education fund. This offer the board recommends should be gratefully accepted. The University will pay a like sum to the same fund.

THE second annual conference of the Association of Teachers in Technical Institutions will be held in London at Whitsuntide, on June 6, 8, 9, and 10. The delegates will meet on Saturday, June 6, and in the evening there will be a conversazione at St. Bride's Institute, E.C. On Monday, June 8, the president, Mr. C. Harrap, will deliver an address, and there will be papers on:—(*a*) Group courses and continuation schools; (*b*) homework and tutorial classes; (*c*) commercialism, the schools, and the decorative arts; (*d*) modern education—the technical phase. On

June 9 there will be a discussion on trade and technical schools, and on the evening of the same day the annual dinner of the association will be held at Anderton's Hotel, Fleet Street, E.C. All interested in technical education are cordially invited to attend the meetings and discussions.

WE learn from the *Pioneer Mail* that the Government of the Maharaja of Mysore is about to award four scholarships—of which two will be for mining and metallurgy, including electrometallurgy—of the value of 200*l*. each per annum, for the year 1908, for study in some British or other recognised university or approved technical institution. These scholarships will be open to all Indians who have taken with credit a degree in arts, medicine, or engineering in an Indian or other recognised university, provided that when qualifications are otherwise equal preference shall be given to candidates who are natives of Mysore or who have taken a degree from a Mysore college. The selection of candidates will be made in August. From the same source we notice that, of 157 students selected in the past three years by the Association for the Advancement of Scientific and Industrial Education of Indians to proceed to foreign countries, 100 have availed themselves of the opportunity, while the fifteen returned students have all found suitable employment.

THE second volume of the report of the U.S. Commissioner of Education for the year ending June 30, 1906, is now available. It gives a very prominent place to statistical information, designed to show the progress which continues to be made in American secondary education. School education in the States is divided according to a well-devised scheme of studies into twelve grades, and the first eight constitute what, in this country, would be called elementary education, and the grades from nine to twelve inclusive correspond to our secondary schools. The number of American secondary-school pupils in both public and private institutions in 1890 was 367,000, or about 5900 to the million of population; in 1895 the number had increased to 539,700, or 7900 to the million; in 1900 the number was 719,200, or 9500 to the million; while for the year 1906 the number aggregated 924,400, or about 11,000 to the million of population, or more than 1 per cent. The growth of public, as compared with private, secondary schools has been remarkable. The number of public schools, which in 1890 was 2526, had in 1906 grown to 8031, and they educated 87·66 per cent. of the total number of secondary-school pupils. On the other hand, the number of private secondary schools, which increased up to 1895, has since that time steadily decreased. In 1906 the number of private schools was 1529. Of the public secondary schools of the country, there were forty for boys only and twenty-nine for girls only, all the others being co-educational. Of the private schools, 304 were for boys only, 500 for girls only, and 725 co-educational.

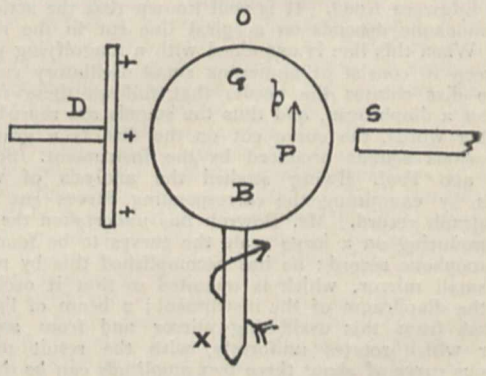
THE annual report of the superintendent of education of the public schools of Nova Scotia for the year ended July 31, 1907, contains, with much other useful information, reports on technical education by the director, Prof. F. H. Sexton, and on the Nova Scotia College of Agriculture by its principal, Mr. Melville Cumming. On April 25, 1907, an Act relating to technical education passed the Nova Scotia Legislature, and led to Prof. Sexton's appointment as director of technical education, with charge of all the schools established under the Act. The schools provided for are:—(i.) a technical college in the capital city of Halifax, to provide professional training in mining, in civil, electrical, metallurgical, and mechanical engineering, and in industrial scientific research generally; (ii.) local technical schools to be established in various industrial centres; (iii.) coal-mining and engineering schools in colliery centres. The college is to be supported by the Government solely, and by private benefactions if such become available. The expenses of the coal-mining and engineering schools are at present defrayed altogether by the provincial treasury, and the local technical schools are supported jointly by the locality and the central government. The first step in organisation was to obtain information regarding the status of existing mining and engineering schools, and the attitude of workmen, employers, and local authorities towards the proposed local technical schools. The engineering schools seem to have been conducted in such a manner that they fulfilled most of the demands on them, and up to the end of the period with which the report deals it was not considered necessary to engage instructors to devote their whole time to teaching. In respect of the local technical schools, the greatest interest was found exhibited everywhere by wage-earners, employers, and the general public. Trades unions were found to be definitely opposed to pure trade schools; the unions fear that such schools will give an imperfect knowledge of the trades, produce a surplus of "hot-house mechanics," as they designate them, who will tend to decrease the demand and wages of skilled labour. It was finally decided that the first schools to be established should be evening technical schools to educate the men already employed in the scientific principles underlying their trades. The report on the College of Agriculture shows that the number of students in 1907 reached 132, and that it is expected the total will reach 200 during the present year.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 30.—"On the Generation of a Luminous Glow in an Exhausted Receiver moving in an Electrostatic Field, and the Action of a Magnetic Field on the Glow so Produced." By F. J. **Jervis-Smith**, F.R.S.

A glass bulb, exhausted as a Röntgen tube, was rotated in an electrostatic field and also in a magnetic field. The conditions of the experiment were varied in six ways. The static charge was either positive or negative. The direction of rotation was reversible. The pole maintaining the magnetic field was either S. or N. The relationship existing between the different conditions will be best understood by reference to the diagram, in which D is a charged disc, B the glow-bulb, S the magnet pole. The axis XO of rotation of the glow-bulb B, the axis of the electromagnet, and the stem of the inductor disc D, are situated in the same plane, when the glow-bulb B



rotates about the axis XO in a clock-hands' sense to an eye looking along XO. The metal inductor D being charged positively, it is filled with a luminous glow of a bluish-green colour, but when the S. pole is placed near the bulb the glow matter is deflected in the direction Pp, and a bright patch of light is produced at G. The charge on D can be reversed, also the direction of rotation and the magnet pole. If while any two of these conditions are kept the same the third is reversed, the direction of deflection of the glow is reversed. The glow-bulbs were exhausted to the same degree of exhaustion as the Röntgen tube by a leading maker of such tubes. The rays emitted have a definite effect on a sensitive photographic plate, giving shadow pictures. The glow-bulb was rotated about twenty times per second; it was found that the intensity of the glow increased as the rotation increased. The distance between the charged inductor and the glow-bulb was varied from 1 cm. to 13 cm. The glow was apparent at 13 cm. In most of the experiments the inductor was charged to about 1200 volts. The diameter of the glow-bulbs varied from 1·5 cm. to 5·0 cm.

February 20.—"Effects of Self-induction in an Iron Cylinder when traversed by Alternating Currents." By Prof. E. **Wilson.** Communicated by Sir William Preece, F.R.S.

Alternating currents up to about 2000 amperes at frequencies varying from 1/45 to 1/360 were supplied to an iron cylinder 10 inches in diameter, and the change of magnetic induction at different depths was obtained from readings taken with three dead-beat galvanometers connected to coils threaded through holes in the cylinder. The total current in the cylinder was observed on an amperemeter in the circuit. The curves of E.M.F. in the exploring coils were plotted, and by integration the magnetic induction at different depths was obtained. The results show that the effect due to internal self-induction, commonly called "skin effect," is greater the greater the average permeability, and it is shown how it depends upon change of current and frequency. The phase displacement of the E.M.F. curves reckoned from zero of current diminishes with increase of current for a given frequency, and increases with increase of frequency for a given current. From the hysteresis loops of the material the total currents interior to the respective radii were found and plotted against radius as distribution curves, from which the C^2R loss was calculated. The hysteresis watts were also found, and both compared with the watts which would occur if the distribution under continuous current were assumed to persist. For a given frequency, the ratio of the C^2R loss with alternating to those with continuous currents is greater the higher the average permeability. For a given current, the C^2R loss increases with frequency, and the hysteresis loss tends to increase with frequency, but to diminish owing to increased skin effect. The results hold for a cylinder of n times the diameter if the current is varied as n, and the frequency inversely as n^2. The paper contains tables of figures and curves.

"On the Refractive Indices of Gaseous Nitric Oxide, Sulphur Dioxide, and Sulphur Trioxide." By C. **Cuthbertson** and E. Parr **Metcalfe.** Communicated by Prof. F. T. Trouton, F.R.S.

The refractive index of nitric oxide, purified by fractionation at low temperatures, was found to be 1·0002939 for sodium light. This is about 1 per cent. less than the value found by Mascart.

The index of sulphur dioxide was re-determined in view of the discrepancies between the numbers published by previous observers. The value now obtained, 1·0006609, is in agreement with the results of Ketteler and G. W. Walker, when these are corrected for the density of the gas at 0° C. and 760 mm. The index of sulphur trioxide is, approximately, 1·000737. Both this and the index of sulphur dioxide are considerably below the additive values.

Faraday Society, April 28.—Prof. A. K. Huntington, vice-president, in the chair.—The planimetric analysis of alloys, and the structure of phosphor-copper: A. K. **Huntington** and C. H. **Deach.** The conditions under which it is possible to estimate the relative proportions of the constituent metals in an alloy by means of the planimetric measurement of the areas of the solid phases exposed in a polished and etched micro-section is discussed. Details of the method are given, and its accuracy is shown by a series of measurements of analysed alloys. The method has been most fully studied in the case of phosphor-copper, of which a number of photomicrographs are shown. In the case of alloys containing less than the eutectic proportion of phosphorus, however, the area of copper crystals is found to be considerably greater than that calculated from the composition determined by analysis. The origin of the discrepancies was traced to the segregation of the eutectic, the copper crystals which separate at first drawing to themselves a portion of the copper of the surrounding eutectic. The crystals are therefore surrounded by a belt of copper phosphide. By measuring the area of this belt, and thence calculating the amount of segregated copper, a correction may be applied to the area of the crystals, and a very satisfactory agreement with the analytical results is thus obtained.—The interaction of aluminium powder and carbon: F. E. **Weston** and H. R. **Ellis.** Very little work has been done on the combination of aluminium and carbon at temperatures lower than that of the electric furnace. The authors now show that aluminium powder and carbon can be made to react at temperatures much below that of the electric furnace. Mixtures of aluminium powder and carbon, wood charcoal, sugar carbon, and graphite have been prepared, in which reaction takes place by starting with a fuse of magnesium powder and barium peroxide, as in Goldschmidt's reaction; other mixtures have been made which only react when heated at temperatures varying from 400° C. to 1000° C. In all cases the products of reaction were found to be aluminium carbide (9·12 per cent. to 65·91 per cent.), aluminium nitride (3·67 per cent. to 42·16 per cent.), alumina (11·07 per cent. to 55·4 per cent.), aluminium, and carbon. The carbide produced is most probably that described by Moissan as aluminium carbide, C_3Al_4, since the gas obtained on treating the product of reaction with either water or hydrochloric acid was found to consist of CH_4 and H, the latter coming from (1) the action of HCl in unaltered aluminium; (2) action of NH_3 on aluminium, the NH_3 being formed by the action of water on aluminium nitride.

Mathematical Society, May 14.—Prof. W. Burnside, president, in the chair.—The invariants of the general linear homographic transformation in two variables: Major P. A. **MacMahon.**—The order of the group of isomorphisms of an Abelian group: H. **Hilton.**—The calculation of the normal modes and frequencies of vibrating systems (preliminary note): Prof. A. E. H. **Love.**—A question in probability: Prof. J. E. A. **Steggall.**

PARIS.

Academy of Sciences, May 11.—M. H. Becquerel in the chair.—The president announced the death of M. Albert de Lapparent.—A planimeter permitting of the integration of the Abelian equation $yy' = Ay^2 + By + C$: Col. **Jacob.** This form of equation occurs in the study of ballistics.—The application of the laws of similitude to the propagation of detonations: MM. **Crussard** and **Jouguet.**—Wireless telegraphy with directed waves: MM. **Bellini** and **Tosi.** The direction of the waves is obtained by the use of aërial conductors formed of closed oscillating circuits disposed in vertical planes without connection with the earth. The transmitter was installed at Dieppe, and two receiving posts were constructed, one at Havre and the other at Harfleur. The signals could be transmitted to either receiving station, and were received only by the station to which they were directed. The signals neither interfere with nor are interfered with by other systems of wireless messages.—The range of the α rays: William **Duane.** It has been shown by various observers that the photographic, phosphorescent, and ionising action of the α rays cease abruptly when the rays have traversed a few centimetres in air, and in the present paper experiments are described which were made with the object of deciding whether the other actions of these rays cease at the same distance. From the form of the curves obtained it is very difficult to decide the exact point at which the range of the α rays ceases, but it was found that the charge of the α particles and their ionisation ceases at the same point.—The electric dispersion of water: F. **Beaulard.** By extending the range of the method previously described to other wave-lengths, there would appear to be some anomalous electric dispersion for the order of magnitude of the electric field studied.—The spectrum of iron observed in the flame of the oxyhydrogen blow-pipe: G. A. **Hemsalech** and C. **de Watteville.** Using the method previously described, the gases feeding the flame were supplied with finely divided particles of the metal torn from electrodes by the electric spark. A table of the wave-lengths and intensities of the observed lines is given, and the results compared with the arc spectrum of iron.—Contribution to the study of the photographic grating: H. **Calmels** and L. P. **Clerc.**—Molecular agitation and the Brownian movement: Jean **Perrin.** An attempt to prove that molecular agitation is the cause of the Brownian motion. It results from the proof given that the number of molecules per gram of liquid is of the order $6{\cdot}7 \times 10^{23}$.—An electro-optic phenomenon in air containing dust in suspension: Eugène **Bloch.**—The commensurability of the atomic weights: M. **Hinrichs.**—

Thorium fluoride and oxyfluoride: Ed. **Chauvenet.** When hydrated thorium fluoride is heated to about 800° in a current of pure dry HF, thorium oxyfluoride, $ThOF_2$, remains. The fluoride, ThF_4, can be obtained by the action of anhydrous gaseous hydrofluoric acid on thorium bromide.—The combinations of silver selenide and the selenides of arsenic, antimony, and bismuth: H. **Pélabon.** The existence of compounds of these selenides is deduced from a study of the fusibility curves of their mixtures.—The origin of atmospheric ozone and the causes of the variation of carbonic acid in the air: H. **Henriet** and M. **Bonyssy.** Ozone is produced by the ultra-violet rays of the sun in the upper atmosphere, and the amount near the earth increases when air currents set in from these upper regions. The reduction in carbon dioxide found to accompany an increase in ozone is an indirect effect, due to simple dilution of the lower air with the purer air of the higher atmosphere.—The properties of starch in relation to its colloidal form: E. **Fouard.** A study of starch solutions after filtering through collodion films of different permeabilities.—The properties of the metallic thiosulphocarbamates: Marcel **Delépine.**—Contribution to the study of the amido-derivatives of *o*-dibenzoylbenzene: A. **Guyot** and P. **Pignet.**—A new method of tanning: Louis **Meunier** and Alphonse **Seyewetz.** Skin can be tanned with quinone or quinhydrone. Skins thus tanned present great affinity for both acid and basic colouring matters.—The thermal effects of high-frequency currents on the organism: A. **Zimmern** and S. **Turchini.** Experiments made in dogs and men show that a rise of the body temperature of between 0°·1 and 0°·4 is caused by high-frequency currents. As a method of thermotherapy, the authors regard this method as much preferable to the external methods in current use (hot baths, sun baths, &c.). The application to certain circulatory troubles is indicated.—Researches on the distribution of the antivirulent substance in the humours of vaccinated animals: L. **Camus.**—A new Oospora (*Oospora lingualis*) associated with *Cryptococcus linguae-pilosae* in black tongue: Fernand **Guéguen.**—The formation and disappearance of acetaldehyde under the influence of alcoholic yeasts: A. **Trillat** and M. **Sauton.** Experiments are cited showing the formation of aldehyde under the action of yeast; the reverse action also takes place, since when aldehyde is gradually added to an alcoholic liquid containing fresh yeast in suspension, the aldehyde disappears.—The nutritive value of some peptones for different microbial species: H. **Dunschmann.** Comparisons were made of the nutritive action of Dufresne, Martin, and vegetable peptone on cultures of typhoid, *Bacterium coli*, anthrax, and diphtheria.

DIARY OF SOCIETIES.

THURSDAY, MAY 21.

ROYAL SOCIETY, at 4.30.—On Some Features in the Hereditary Transmission of the Albino Character and the Black Piebald Coat in Rats. II.: G. P. Mudge.—A Further Note on the Nutrition of the Early Embryo, with Special Reference to the Chick: E. Emrys-Roberts.—The Antagonistic Action of Calcium upon the Inhibitory Effect of Magnesium: S. J. Meltzer and J. Auer.

ROYAL INSTITUTION, at 3.—The Chemistry of Photography: Dr. Alexander Scott, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—The United Provinces of Agra and Oudh: Sir J. J. D. La Touche, K.C.S.I.

CHEMICAL SOCIETY, at 8.30.—Hydroaromatic Ketones, Preliminary Note: A. W. Crossley and C. Gilling.—Titani-dihydroxymaleic Acid, and the Detection of Titanium: H. J. H. Fenton.—Some Experiments on Carbon at High Temperatures and Pressures, and Apparatus Therefor: R. Threlfall.—The Sulphides and Oxy-sulphides of Silicon: I. G. Rankin and S. M. Revington.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Recent Progress in Tungsten Metallic Filament Lamps: H. Hirst.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Electrical Equipment of Gold Mines (*continued discussion*): H. J. S. Heather.—The Behaviour of Tellurium in Assaying: S. W. Smith.—The Average Rate of Accumulation and Absorption of Gold Amalgam by Copper Plates: E. Halse.—The Absorption and Accumulation of Gold on Copper Plates: W. F. A. Thomae.—A Journey to Central Asia: A. Adiassewich.

FRIDAY, MAY 22.

ROYAL INSTITUTION, at 9.—Recent Researches in the Structure of the Universe: Prof. J. C. Kapteyn.

PHYSICAL SOCIETY, at 5.—On the Spectrum Top: G. P. Sexton.—On the Coefficient of Diffusion: B. W. Clack.—On the Production of Small Alternating Currents of Variable Frequency suitable for Telephonic and other Measurements: B. S. Cohen.

MONDAY, MAY 25.

LINNEAN SOCIETY, at 8.—Anniversary meeting.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary meeting.

TUESDAY, MAY 26.

ROYAL INSTITUTION, at 3.—Animal Heat and Allied Phenomena: Prof. William Stirling.

ZOOLOGICAL SOCIETY, at 8.30.—The Rudd Exploration of South Africa. X. List of Mammals collected by Mr. Grant near Tette, Zambesia: Oldfield Thomas, F.R.S., and R. C. Wroughton.—Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–5. Report on the Isopoda Terrestria: Rev. T. R. R. Stebbing, F.R.S.—On the Anatomy of Antechinomys and some other Marsupials, with Especial Reference to the Intestinal Tract and Mesenteries of These and other Mammals: F. E. Beddard, F.R.S.—The Armour of the Extinct Reptiles of the Genus Pareiasaurus: Prof. H. G. Seeley, F.R.S.—New Siphonaptera: Hon. N. Charles Rothschild.

FARADAY SOCIETY, at 8.—Presidential Address: Some Aspects of the Work of Lord Kelvin: Sir Oliver Lodge, F.R.S.

WEDNESDAY, MAY 27.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, MAY 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Theory of Capillarity: Prof. E. T. Whittaker, F.R.S.—Effect of a Cross Wind on Rifled Projectiles: A. Mallock, F.R.S.—Transparent Silver and other Metallic Films: Prof. T. Turner.

ROYAL INSTITUTION, at 3.—The Chemistry of Photography: Dr. Alexander Scott, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, MAY 29.

ROYAL INSTITUTION, at 9.—Ancient and Mediæval Projectile Weapons other than Firearms: Sir Ralph Payne-Gallwey, Bart.

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