THURSDAY, JUNE 9, 1904.

AN AMERICAN TREATISE ON NAVAL ARCHITECTURE.

Naval Architecture. By Prof. C. H. Peabody. Pp. v+616. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 31*s.* 6*d.* net.

SINCE the revival of shipbuilding in the United States and the construction of the "New Navy," courses of instruction in naval architecture have been arranged at several of the universities and technical institutes. The Massachusetts Institute of Technology has taken a leading position in this matter, and has provided classes for those intending to enter the profession of shipbuilding, as well as a post-graduate course in naval architecture especially arranged for assistant constructors whose preliminary training is at the Naval College, Annapolis. For many years the Navy Department of the United States had to send their assistant constructors to Europe for instruction. The first students who so came were entered at the Royal Naval College at Greenwich; in later years many young American naval architects have been students at Glasgow University. Others have been sent to the French School of Naval Architecture. For the future, it would appear that the United States intend to supply their own educational wants in this as in other branches.

The author of the book under review is the professor of naval architecture and marine engineering in the Massachusetts Institute of Technology, and it is obvious that the book has grown largely out of his professorial work. It is also apparent that Prof. Peabody has considerable sympathy with French methods. Indeed, he adopts several French technical terms instead of their usual English equivalents, and in certain sections of the book he gives prominence to French methods as distinguished from English. While this comprehensive treatment is praiseworthy, no sufficient reason is seen for departure from the accepted terminology of English treatises on the subject.

The book is intended "to give, in a consistent and connected form, the commonly accepted theory of Naval Architecture," and it is added, "while this work is intended primarily for students, it is hoped that it may be found useful by Naval Architects and Shipbuilders in general." It is probable that this hope will be realised, so far as those sections of the book are concerned which deal with ordinary ship calculations for displacement and stability, or those illustrating many practical operations connected with the addition, removal, or transfer of weights carried by ships. Herein Prof. Peabody bases his treatment upon the frank adoption, in practice, of mechanical aids to calculation which have been introduced during the last twenty-five years, chiefly by Amsler. Naval architects owe much to that great instrument maker, and can effect with his integrators an enormous economy of labour and a great increase of speed in obtaining important results. The planimeter for many years stood alone, but when Amsler learned that, in addition to the determination of areas, it was important in the designing of ships to obtain also *moments*, and *moments of inertia*, of areas about assigned axes, he speedily produced ingenious machines which could be used by ordinary draughtsmen. These instruments were first adopted in this country, and are now generally employed.

Prof. Peabody gives a clear account of the principles and methods of use of integrators. Moreover, he furnishes an excellent summary of the latest modes of arranging the actual details of work for ships' calculations. In this department very considerable advances have been made during the last thirty years since calculations for the stability of ships became general. But while, from the draughtsman's point of view, the book is, for the most part, admirable, it does not treat with equal fulness some calculations of considerable importance, particularly those relating to weight and strength. For these his treatment can hardly be described as "up to date," or as giving full and complete information to students or calculators. There is, in fact, a want of due proportion in the space and attention devoted to the various sections. Prof. Peabody, while aiming at giving a consistent and connected account of the whole accepted theory of naval architecture, devotes particular attention to certain portions of the subject, and unduly compresses his treatment of others. Some of his longest chapters, while they are undoubtedly interesting and valuable as compilations of existing treatises on special branches of the science of shipbuilding, have not, as a matter of fact, great practical value. The theory of waves, for example, including an outline of the stream-line theory of resistance, occupies nearly one-eighth of the book, and is treated in some portions with a mathematical detail that appears inappropriate in this work, where the principal conclusions might have been given and reference made to the original authorities for the mathematical proofs.

Again, in dealing with the propulsion of ships, much space is devoted to the practical reproduction of parts of well known books dealing with the design and efficiency of screw-propellers, such as that published in England by Mr. Sidney Barnaby, and that first issued in the United States by Naval Constructor Taylor, who was a graduate of our Royal Naval College. Both these gentlemen based their work chiefly on experiments made, or on methods suggested, by the late Mr. William Froude and Mr. R. E. Froude, and furnished valuable rules for guidance in practice; but as their books are accessible, they need not have been so largely drawn upon. Having done this, Prof. Peabody was practically compelled to abridge very greatly his treatment of other sections of great importance in the current work of ship designing, wherein students might have been greatly assisted if more extended descriptions and investigations had been given.

Another feature in which the volume is not entirely satisfactory is in some of its illustrations of actual practice, and in its allusion to broad general rules

followed by naval architects in endeavouring to secure good qualities in ships. For instance, Prof. Peabody, when dealing with the question of "metacentric heights," which are the measures of the "stiffness" of ships, their power to resist inclination under the action of external forces, states that, in practice, this height "is seldom less than 1½ feet and seldom more than 5 feet unless it be in special forms," and then remarks that "it appears that the metacentric height for steamships is somewhere near the same for all steamships whatever their size," which is obviously incorrect on his own showing, and might easily lead students to conclude that little importance attaches to the value of the metacentric height within a very wide range; whereas it is absolutely certain, and is elsewhere recognised by Prof. Peabody, that the more moderate the metacentric height the greater is the probability of steadiness in a seaway. He also states that "metacentric height may be controlled by varying the proportion of beam to length," and does not specifically direct attention to the much greater influence of variation in the proportion of beam to draught.

In another passage he refers to the characteristic features in the curves of stability of sailing ships and steamships, and makes the generalisation that this is chiefly due to the greater metacentric height and greater freeboard of sailing ships; whereas it is perfectly well known that other considerations have larger practical effect on the curve of stability. Many sailing ships having great range of stability have only very moderate metacentric heights and moderate freeboard. Few allusions are made to the details of practical shipbuilding, and some of these indicate that the author can have had but little experience in the conduct of actual work.

These criticisms are not intended to indicate any general disapproval of the scope or character of the book. It is no doubt intended to be used as an auxiliary to class-teaching by competent professors, and for this purpose it will be extremely useful. It also compiles and brings together much information appearing in the *Transactions* of the English Institution of Naval Architects or of similar societies in other countries, and practically reproduces the essential parts of standard treatises by other authors on particular branches of the subject. Prof. Peabody makes no claim to originality, and states frankly that free use has been made of numerous works on naval architecture, as well as of original articles and memoirs. His readers have to thank him for the labour he has bestowed upon this task, and, as a compilation, the book will be useful for reference to naval architects generally. But it does not profess to be—nor, indeed, within its compass could it possibly be made—a complete treatise on the modern theory of naval architecture. Such a treatise has yet to be written, and the advances made in recent years in both the theory and practice of ship construction have been so considerable that the work of preparing it would be very heavy. It is wanted, however, and no doubt will eventually be produced. W. H. WHITE.

NEW ELECTRICAL TEXT-BOOKS.

A Text-book of Static Electricity. By H. Mason. Pp. vi+155. (New York: McGraw Publishing Co., 1904.) Price 2 dollars.

Dynamo, Motor, and Switchboard Circuits. By W. R. Bowker. Pp. xi+120. (London: Crosby Lockwood and Son, 1904.) Price 6*s.* net.

Testing of Electromagnetic Machinery and Other Apparatus. By B. V. Swenson and B. Frankenfield. Pp. xxiii+420. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1904.) Price 12*s.* 6*d.* net.

The Alternating Current Transformer. By F. G. Baum. Pp. vii+195. (New York: McGraw Publishing Co., 1903.) Price 1.50 dollars.

The Induction Motor. By H. B. de la Tour. Translated by C. O. Mailloux. Pp. xxvii+200. (New York: McGraw Publishing Co., 1903.) Price 2.50 dollars.

THE subject of electrostatics is not *per se* one of very great importance either to the electrical engineer or the student of electricity, and it is open to question whether a text-book devoted to the elementary principles of the subject is much needed. Still, there is something to be said for having collected together between one pair of covers all the information which is usually only to be found scattered somewhat irregularly throughout the pages of a more comprehensive manual. Mr. Mason opens with a discussion of the general principles of electrostatics, and proceeds to consider in more detail capacity, electrostatic instruments, and static generators. The fact that there is not very much to say and plenty of space in which to say it has enabled the author to make his descriptions very complete and clear, and the further advantages of large type and numerous illustrations should help to make the book a very useful work of reference.

Mr. Bowker's book consists chiefly of diagrams of connections, with short explanatory notes: the number of different cases considered is very large—there are over a hundred diagrams—and these cover practically all the more important circuits with which an electrician is likely to have to deal, whether in direct current, single phase, or polyphase work. We do not doubt that the book will prove useful to those who are concerned rather with connecting up machinery than with electrical engineering, but we should hardly have thought that the matter was of sufficient importance to warrant its treatment as a separate study.

The work on the testing of electromagnetic machinery by Messrs. Swenson and Frankenfield is the first of two volumes, and deals only with direct-current machinery. It is a book which can be thoroughly recommended to all students of electrical engineering who are interested in the design, manufacture, or use of dynamos and motors. After a brief introduction, which contains, incidentally, some excellent advice on the writing of reports (which advice, by the way, the authors themselves transgress in the specimen report which they print), the authors give a series of nearly a hundred tests, which are well chosen and

clearly explained. A distinct and valuable feature of the book is the list of references at the beginning of each test to the principal text-books and papers dealing with the subject of the test. The book is well illustrated, and there is a useful chapter at the end on commercial shop tests.

The two books by Mr. Baum and M. de la Tour cover, in a satisfactory manner, two very important branches of alternating-current work on which not very much has yet been written in the way of text-books. This is especially the case with M. de la Tour's treatise on the induction motor, which is very comprehensive and certainly the best book as yet written on this subject. Mr. Baum's book is not so full, but it contains an excellent discussion of the theory and construction of transformers, which should prove very useful to students. It is difficult to understand why chapter ii. has been included at all, since the method given in it is not only unsatisfactory but, even in the author's own opinion, "always produces confusion in the mind of the student." There is a good final chapter on commercial transformers. M. de la Tour also leavens his theory with a little practical application of it, the last chapter but one being devoted to the design in very careful detail of three different induction motors. A word of praise is also deserved by the translator for the excellent way in which he has performed his task of presenting M. de la Tour's book to the English public.

M. S.

FROM BUFFON TO DARWIN.

Controverses Transformistes. By Alfred Giard. Pp. viii + 178. (Paris: C. Naud, 1904.) Price 7 francs.

THIS is an interesting book, written, like nearly all French scientific books, in transparently clear style. It assumes, however, that the reader has a fair knowledge of zoology, so that it hardly appeals to the reading world in general. It is intended rather for those who have made some study of comparative anatomy, and who wish for light on the various theories of evolution. In France Darwinism has not had the triumphant progress that it has had in England and, still more, in Germany. Even evolution, quite apart from the specially Darwinian interpretation of it, has been very slowly accepted, so that the earlier part of M. Giard's book deals with controversies that for us have long been buried. The second chapter, which originally appeared as an article in the *Revue scientifique* in 1874, discusses at length the question whether the ascidians are really near allies of the vertebrates. A figure of the larva of a typical ascidian is given, but it would have been well to give also a figure of Appendicularia, in which the notochord persists in the adult. Throughout, the book would have gained by being more amply illustrated. The chapter on ascidians combats von Baer's now exploded theory of them, perhaps at rather unnecessary length. But the author has deliberately adopted the plan of reprinting his essays written during the last quarter of the nineteenth century so that the reader may appreciate the difficulties against which the evolutionist has had to contend.

Chapter iii. deals with systems of classification that have had their day, systems which accepted each type of organism as an existing fact without attempting to account for it. M. Giard is heart and soul an embryologist. Kowalevsky is to him a far greater man than the greatest master of anatomy pure and simple who has had no grand hypothesis to guide him.

In chapter iv., on the factors of evolution, we enter on more controversial ground. M. Giard is a Lamarckian. He has a great reverence for Darwin, but Lamarck is put on a loftier pedestal. Lamarck, he holds, made known the great primary factor of evolution. Darwin introduced an important factor, but still a secondary one. In some cases M. Giard owns that the Lamarckian principle will not account for everything, *e.g.* for all the characters of a newborn mammal. Darwinism must then be called in. In chapter v. (1898) Weismann appears as a conspicuous figure on the stage. M. Giard will not allow Weismann to send Lamarckism to the limbo of worn out theories. He refers to the experiments of Brown-Séquard on guinea-pigs as proof that Lamarck was right. He accepts telegony as a fact telling strongly in Lamarck's favour, though men of science are coming to regard it as a breeder's superstition. Throughout his discussion of the question of acquired characteristics there is a certain confusion of thought. He draws a marked distinction between the characters that result from external conditions and those which spring from forces at work within the animal. Yet external influences can only stimulate the organism to show the stuff that it is made of. It responds to a stimulus. New characters become apparent, but are not, strictly speaking, acquired.

F. W. H.

OUR BOOK SHELF.

A Text-book of Quantitative Chemical Analysis. By Frank Julian. Pp. 604. (St. Paul, Minn.: The Ramsey Publishing Co., 1902.) Price 25*s.* net.

THE book is so excellent as far as it goes, except in the quality of the paper and the print, that it seems a pity it goes no farther. A little more elaboration would have converted it into a really serviceable manual. The reviewer has failed to discover any important omission among the special methods with which he happens to be familiar, but there is an absence of detail, which, it cannot be too often insisted on, deprives any treatise on analysis of much of its practical value. The chemist whose business it is to analyse cannot afford the time to elaborate methods for himself. The fact, of course, is not overlooked that the book is written for students, and no doubt the student is expected to supply any gaps which may occur. But apart from a chapter of typical exercises in analysis, it is difficult to see in what sense the book can be called a student's text-book, unless, indeed, the student is qualifying for the post of analyst.

And this raises the interesting question, into which there is no occasion to enter here, of how far analysis should be carried as a part of a general chemical training as distinguished from a specialised study. There can be little doubt that the kind of skill and knowledge which a public or works analyst requires must be met by a special training in a laboratory set apart for the purpose.

What a student of general chemistry needs, after

his preliminary qualitative study of the elements, is a knowledge of a few typical processes carefully selected to illustrate the principles of quantitative analysis.

It is for this reason that the exercises which form part ii. of this volume have much to recommend them. Those who are accustomed to the old system, which probably originated in Berzelius's laboratory, of analysing a few inorganic salts and then a series of minerals, will probably be startled at finding such an incongruous collection as lead carbonate, sodium chloride, coffee, cast iron, vinegar, &c., following one another. Yet when one considers how few students, after taking a substantial course in practical chemistry, could suggest a means for distinguishing between lard and vaseline, or benzene and petroleum, except by their smell, it must be admitted that a practical acquaintance with common materials in the form of analysis has many advantages.

Perhaps the best way of estimating the value of a book is to ask oneself whether one would care to possess it For those who are interested in any kind of general or technical analysis, this question may be safely answered in the affirmative. J. B. C.

Catalogue of the Mesozoic Plants in the Department of Geology, British Museum (Natural History). The Jurassic Flora. II. Liassic and Oolitic Floras of England (excluding the Inferior Oolite Plants of the Yorkshire Coast). By A. C. Seward, F.R.S. Pp. xv+192. Plates i–xiii. (London: Printed by Order of the Trustees of the British Museum, 1904.)

THE concluding part of Mr. Seward's catalogue of the Jurassic floras makes the catalogue a nearly complete treatise on the known fossil remains of plants from the Trias, Rhætic, Lias and Oolite of England. In the present volume are included plants from Jurassic rocks in various parts of England, together with a few from the Coralline Oolite and Liassic strata of East Yorkshire. A short account is also given of such Triassic and Rhætic plants as are represented in the British Museum.

Die Kathodenstrahlen. By G. C. Schmidt. Pp. vi+120. (Brunswick: Vieweg und Sohn, 1904.) Price 3 marks.

THIS book contains a concise and complete account of the properties of kathode rays, presented in an elementary way, together with as much information on the electric discharge and allied phenomena as is necessary for their comprehension.

The information is brought well up to date and references to the original papers are given. The book should prove of use to those wishing for a connected account of the subject in a readable form devoid of mathematical analysis. The fifth chapter contains a short but interesting account of the historical development of the theory of the electric discharge and kathode rays. H. A. W.

An Introduction to Metal Working. By C. J. Pearson. Pp. 106. (London: Murray, 1904.) Price 2*s*.

THIS little book is evidently intended to describe the ordinary tools used in the working of metals, although the author does not tell us so. These descriptions are of an elementary nature, and well suited for young students in the early stage. The book is fully illustrated with woodcuts, as well as with some very excellent photographs of operations, the latter being a distinct novelty in a technical book. The author uses simple language, he knows what he is writing about, and we feel sure that his little work will be much appreciated by junior students, apprentices and others, to whom we strongly recommend it.

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.]*

A Dynamical System illustrating the Spectrum Lines.

IN NATURE of March 10, which I received yesterday, Prof. Schott remarks that the dynamical system illustrating the spectrum lines, which I communicated to NATURE of February 25, is unstable. This evidently rests on a misunderstanding, because the system which I have discussed is not identical with that which was investigated by Prof. Schott. I believe that the statement, "such an ideal atom will not be contradictory to the results of recent experiments," led Prof. Schott to suppose that the system which I considered must be electrically neutral. Those who have read Maxwell's paper on the stability of Saturn's rings will admit, without Prof. Schott's comment, the futility of discussing an *electrically neutral* system with a central positive charge and a ring of negative electrons as satellites.

The system which I have investigated is not electrically neutral, but the central charge is supposed to be very large compared with the negative charges in the ring. Since q (using Prof. Schott's notation) is great compared with J or K, the ring is generally stable; the proof for stability can be given in a more general manner.

To prevent further misunderstanding, it will be necessary to explain how I was led to investigate such a system instead of an electrically neutral one. As the principal aim of the investigation was to discuss the small oscillations which will illustrate the regularity in line and band spectra, it was necessary to have a hypothetical atom, which will have some resemblance to an actual one, and the motion of which can be treated by means of simple mathematical analysis. Recent investigations show that a chemical atom is associated with numerous electrons, which in the lightest element amount to several hundred, while in heavy atoms the number may reach a hundred thousand. We have reason to believe that these electrons are not crowded together in spite of their large number. In making abstraction as to the hypothetical atom, we may conveniently assume the central positive charge to form a neutral system with all the negative electrons, but only a small fraction of the latter to be found in the ring the oscillation of which is the subject of investigation. The rest of the negative electrons may either describe their isolated orbits, or may form some other regular systems. These will evidently cause disturbances in the ring, which I have not calculated, inasmuch as it was necessary to introduce further assumptions as to the orbits or the arrangement of electrons. As a dynamical system illustrating the regularity in spectrum lines, I have assumed the ring and the central positive charge as an ideal atom, leaving the remaining electrons outside the domain of investigation.

Further evidence as to the validity of such an hypothesis is afforded by the fact that spectrum lines of most elements are not all subject to a regular law, but that there are a great many characteristic lines the position of which is not expressible by a simple mathematical formula. Moreover, the complexity in the structure of spectrum lines will probably find simple explanation by the perturbations due to stray electrons. These considerations point to the view that only a small part of the negative electrons accompanying an atom should be arranged in a ring, in order to approximate to the real state of a chemical atom.

There is no doubt that Prof. Schott will have good opportunity of applying the mathematical investigations of C. Neumann and Hicks in discussing the oscillations of three rings, just as Lindemann made use of Lamé's functions in studying the spectrum lines as due to the vibration of ellipsoidal atoms, but I am afraid that the result will be difficult of interpretation.

I take this opportunity of introducing a small omission in my former letter to NATURE for February 25 (p. 392, second column, line 31 from bottom); after "in opposite senses" add "in a magnetic field."

I may further add that the formula for band spectrum,

$$n' = \omega' + a'm'^2 + b'm'^3 + c'm'^4 + d'm'^5 + \ldots$$

which I have deduced as an extension of Deslandre's formula, is one of the empirical formulæ used by Kayser and Runge for cyanogen bands (*Abhandl. d. Berlin. Akad. d. Wissensch.*, 1889, formula I_a). From $m' = 0$ to $m' = 150$, the difference in wave-lengths between calculation and observation seldom exceeds $\pm 0{\cdot}03 \times 10^{-10}$ m., which is quite within errors of observation. H. NAGAOKA.

Physical Laboratory, Tokyo University, April 20.

Electromotive Force between Two Phases of the same Metal.

I WAS much interested in the letter of Mr. George Beilby in your issue of May 12. It may interest Mr. Beilby to know that I contributed a paper to the Institution of Civil Engineers on "The Effect of Stress on the Corrosion of Metals" (*Proc.* Inst. C.E., vol. cxviii., session 1893–4). On perusing this paper it will be seen that the results were somewhat analogous to the line of investigation Mr. Beilby is undertaking. The experiments were on an extensive scale, and were made on numerous samples of iron and steel. In each case a polished bar of the steel or other metal, of known chemical composition and physical properties, used was cut in two; one half was stressed, and the other remained in its normal state. Each pair of bars was immersed in sea water, as an electrolyte, forming the elements of a galvanic couple, with a delicate calibrated galvanometer in circuit, when a decidedly measurable E.M.F. was observed. It was invariably noticed that the alteration in the physical properties of the metals produced by the stress only in each stressed bar was sufficient to place that bar in the position of copper in a zinc copper cell, the normal unstressed bar answering to the zinc element in a galvanic couple.

A current is also set up between two polished bars of the same metal immersed in a suitable electrolyte, one being in its normal state and the other having had its micro-crystalline structure altered by annealing, in the manner illustrated in a recent paper to the Institution of Civil Engineers ("Effects of Annealing on Steel Rails," by Thomas Andrews and Charles Reginald Andrews, *Proc.* Inst. C.E., vol. clvi., session 1903–4, part ii.). When a metal is stressed a similar effect is produced. I have for some time past been working on a research on the E.M.F. between normal and annealed metals, using in one part of the investigation a complete series of specially prepared pure iron and steel bars of varied and known chemical composition, the object of the investigation being to show the E.M.F. produced between annealed and unannealed metals. I am much pleased to learn that Mr. Beilby is also working on this very interesting subject.

Mr. Beilby may also be interested in a research which I made some years ago showing the E.M.F. produced between polished bars of platinum or other metals, cut from the same bar, the E.M.F. being attributable to difference of molecular structure induced by heating one of the bars. The electrolytes employed for these experiments were fused salts at a high temperature (see "Electrochemical Reactions between Metals in Fused Salts," by Thomas Andrews, *Trans.* Royal Society, Edinburgh, session 1885–6). I venture to suggest that the following papers ("Observations on Variations of the Electromotive Force between Metals at High Temperatures in Fused Salts," *Trans.* Royal Society, London, 1885; "Electrochemical Effects on Magnetising Iron," parts i., ii., iii., iv., *Trans.* Royal Society, London, 1887, 1888, 1889, 1892), which I published some time ago, may perhaps be helpful to Mr. Beilby in the course of his researches, the results of which I am looking forward to with much interest and pleasure. THOS. ANDREWS.

Wortley, near Sheffield, June 3.

Graphic Methods in an Educational Course in Mechanics.

IN company, I think, with other correspondents, I have misunderstood Mr. Larden's use of the words "analytical methods." He alluded, it is true, to resolution and taking moments, but "analytical methods," especially when used in contradistinction to "graphical," have a much wider and more commonly received meaning. Dr. Murray's dictionary defines modern mathematical analysis as "the resolving of problems by reducing them to equations," and cites Hutton, "Course Math.," 1827, "Analysis or Analytical method is that which is commonly used in Algebra." Prof. Croom Robertson, in "Analysis" in the "Ency. Brit.," says:—"In modern times analysis has come to mean the employment of the algebraical and higher calculus, and synthesis any direct treatment of the properties of geometrical figures, in the manner of the ancients without the use of algebraical notation or transformations." "Analytical" is a hard-worked word, like potential and polarisation, and no doubt it may be used in Mr. Larden's sense. The word "analytical," in the sense of the employment of algebra and the higher calculus, is not self-explanatory, and "graphical" or "geometrical" are better for this reason than "synthetical," unless the philosophical aspect is under discussion.

There can be no question that for almost all mathematical calculation and research, algebraical methods are far more powerful than geometrical (but I make reservations), and teachers are perhaps for this reason apt to think that they are more useful and better suited for educational explanations of phenomena or of natural laws. If in mistaking Mr. Larden for an unusually pronounced teacher of this type I have protested too strongly, I apologise, but his parenthetical queries which I have provoked I deny.

That some persons have accurate musical "ears," and others "no ear for music," that some can draw excellently without having been taught, and others can never learn, may perhaps be explained by physiological psychology. Some are "good at languages," and others bad; some have a "good head for figures," and others not. Experts in pedagogy might be able to tell us whether this is due to some selective ability or inability. But that some persons use algebra and the calculus with facility, and are bored by geometry, while others have "no head for algebra," but have an aptitude for geometrical methods, seems to be a matter worthy of investigation by the mental philosopher.

Not only has Mr. Larden used "analytical" in a somewhat restricted sense, but in this discussion he limits "graphic methods" to "those methods that depend on accurate drawing only, there being no calculation. . . ." I will give one example of what I mean by a graphical method in an educational course. The fundamental idea of a differential coefficient is explained in the old text-books purely by symbols. Persons with "no head for algebra" find the greatest difficulty in grasping the idea. But draw a curve of speeds on the black-board, and explain that a tangent to it, or the slope at any point, gives the acceleration or rate of increase. You need no accurate drawing, no calculation, no algebra, but you give a perfectly clear idea of a differential coefficient.

It is rather hard that those who are called calculus dodgers cannot discuss the relative advantages of algebraical and geometrical methods without being accused of writing against mathematics or deprecatingly of mathematicians.

Westminster, June 6. A. P. TROTTER.

Association of Economic Biologists.

FOR some time past workers engaged upon various problems connected with economic biology have felt the need of some organisation whereby they could meet from time to time to discuss these different problems with fellow-workers so as to bring out suggestions and to prevent unnecessary duplication of work, and generally to promote and advance the economic side of biological science.

With a view to the formation of such an association of economic biologists, I have briefly discussed the matter with a few fellow-workers, and I shall be pleased to receive an expression of opinion or suggestions from any others.

The idea at present in my mind is an association somewhat on the lines of the American one, which would include and welcome all investigators and teachers in economic biology in its widest sense.

Mr. Fred. V. Theobald (Wye) writes:—"Your suggestion for an Association of Economic Biologists is most excellent.

. . . I will certainly do all I can to promote any such idea."

Mr. Robert Newstead (Chester) writes:—"You would have my heartiest support in the matter, as I feel that such an institution would be of material benefit to the Agriculturists and Horticulturists of this country."

Mr. A. E. Shipley (Cambridge) writes:—"I should welcome the founding of an Association of Economic Biologists if you think we are really strong enough. . . . If the Association is formed I hope it will be a really working one."

Mr. Cecil Warburton (Cambridge) writes:—"I heartily approve of your suggestion with regard to the formation of an Association of Economic Biologists in this country."

Similar letters or expressions of opinion have been received from Dr. A. H. R. Buller, Mr. Herbert Stone, and others. WALTER E. COLLINGE.

The University, Birmingham, May 30.

THE RELATION OF HUMAN TO BOVINE TUBERCULOSIS.

THE Royal Commission appointed to inquire into the relation of human and animal tuberculosis has presented an interim report published on June 1. The Commission was appointed in August, 1901, soon after Prof. Koch's address had been delivered at the British Congress on Tuberculosis held in London in July, 1901, in which he stated that as the result of experiments on animals, cattle, pigs, asses, sheep, and goats, he "felt justified in maintaining that human tuberculosis differs from bovine tuberculosis, and cannot be transmitted to cattle," and he also stated that "though the important question whether man is susceptible to bovine tuberculosis at all is not yet absolutely decided, and will not admit of absolute decision to-day or to-morrow, one is, nevertheless, at liberty to say that, if such a susceptibility really exists, the infection of human beings is but of very rare occurrence. I should estimate the extent of the infection by the milk and flesh of tuberculous cattle and the butter made of their milk as hardly greater than that of hereditary transmission, and I, therefore, do not deem it advisable to take any measures against it." According to Koch the chief danger of infection is from human tuberculous sputum. He suggested as the most important means of combating the disease the improvement of general hygienic conditions, provision of suitable hospitals and sanatoria for consumptives, and inspection and disinfection.

Lord Lister, at the conclusion of Prof. Koch's address, struck a note of warning. He pointed out "how serious and grievous a thing it would be if the rules now in force for securing purity of milk supply should be relaxed, and it should turn out after all that the conclusion was erroneous." This attitude was taken up by a number of other leading pathologists. Since Koch's statement a number of workers have published the results of experiments on the subject, and the bulk of the evidence has been opposed to Koch's view.

The most striking and interesting pronouncement on the subject has been from one of Koch's most distinguished pupils, von Behring, who on this subject places himself in a position entirely opposed to that of his old master. To many minds von Behring's view appears to be as extreme as Koch's. He holds that "the main source to which phthisis must be traced is the milk diet of infants." He found that in young animals such as guinea pigs, owing to the incomplete continuity of the epithelium, numerous bacilli, and among them the tubercle bacillus, could pass through the wall of the alimentary canal, giving rise to a tuberculosis of the cervical glands of the type of scrofula in the human subject, and that at a later period these animals not infrequently developed a type of tuberculosis which has been regarded as indicative of inhalation tuberculosis. The freedom with which milk-bacilli find their way through the walls of the alimentary tract into the circulation owing to the incomplete continuity of the epithelium and absence of active ferment secretion in young animals makes "the disposition to tuberculous infection entirely physiological and normal." At a later period in life a similar susceptible state may be induced by the exanthemata such as scarlet fever and measles. Von Behring, along with Römer, has also shown that immunity may be conferred on bovines by injection of tubercle bacilli of human origin, a striking argument in favour of the specific relationship of the two types of bacilli. These views, which have appeared since the appointment of the Commission, have only emphasised the need of further investigation.

The commissioners state that they felt it their duty to publish this interim report because the experimental results obtained by them are so striking.

The Commission was to inquire and report with respect to tuberculosis:—

(1) Whether the disease in animals and man is one and the same.

(2) Whether animals and man can be reciprocally infected with it.

(3) Under what conditions, if at all, the transmission of the disease from animals to man takes place, and what are the circumstances, favourable or unfavourable, to such transmission.

The first line of inquiry upon which the Commission entered was to ascertain the effects produced by introducing into the body of the bovine animal, either through the alimentary canal as food or directly into the tissues by subcutaneous or other injection, tuberculous material of human origin, that is, material containing living tubercle bacilli obtained from various cases of tuberculous disease in human beings, and how far these effects resembled or differed from the effects produced by introducing into the bovine animal under conditions as similar as possible tuberculous material of bovine origin, that is, material containing living tubercle bacilli obtained from cases of tuberculous disease in the cow, calf, or ox. More than twenty strains of tubercle bacilli have been employed, that is to say, the material taken from more than twenty cases of tuberculous disease in human beings. The effects produced were compared with those resulting from the injection of different strains of tuberculous material of bovine origin. In the case of seven of the above strains of human origin the injection of the human tuberculous material into cattle gave rise at once to acute tuberculosis, with the development of widespread disease in various organs of the body. In some instances the disease was of remarkable severity. In the case of the remaining strains the effects were less marked. The tuberculous disease was either limited to the spot where the material was introduced (this occurred, however, in two instances only, and these at the very beginning of their inquiry), or spread to a variable extent from the site of inoculation along the lymphatic glands with, at most, the appearance of a very small amount of tubercle in such organs as the lungs and spleen. Material, however, taken from the bovine animal thus affected and introduced into other bovine animals has, up to the present, in the case of at least five of these remaining strains, ultimately given rise in the bovine animal to general tuberculosis of an intense character. The disease thus set up in the bovine animal by material of human origin has been compared with that set up

in the bovine animal by material of bovine origin, and so far, both in broad, general features, and finer histological details, the two conditions have been found to be identical. The commission has, so far, failed to discover any character by which the one could be distinguished from the other, and the records contain accounts of the *post mortem* examination of bovine animals infected with tuberculous material of human origin, which might be used as typical descriptions of ordinary bovine tuberculosis.

There is no doubt that this interim report will be useful in strengthening the hands of local authorities, medical officers of health, and others, who have been struggling in difficult circumstances to obtain for the people a purer milk supply and food free from tuberculous contamination. As stated by the commissioners, the results obtained seem "to show quite clearly that it would be most unwise to frame or modify legislative measures in accordance with the view that human and bovine tubercle bacilli are specifically different from each other, and that the disease caused by the one is a wholly different thing from the disease caused by the other." G. D.

THE INTERNATIONAL ASSOCIATION OF ACADEMIES.

A COPY of the official record of the proceedings of the International Association of Academies at its plenary meeting on May 25, and of the proceedings of the section of science on the following day, has now been received from the Royal Society. The complete protocol of the meeting cannot yet be made up, because no report has yet been received of the proceedings of the section of letters; but we are informed that the proceedings on the last day of the general assembly in their plenary meeting consisted mainly of receiving the resolutions of the sections of science and of letters, and of certain complimentary resolutions with regard to the president of the meeting and to the Royal Society.

In the subjoined summary the foreign translations of the resolutions and details of the discussions have been omitted.

Wednesday, May 25.—After a few words of welcome from the president of the council (Sir M. Foster), Prof. Darboux (Secrétaire perpétuel de l'Académie des Sciences) proposed Sir Michael Foster as president of the general assembly. The proposal was carried by acclamation.

The president opened the proceedings with an address, in the course of which he said:—

I accept with pleasure, though not without anxiety, the duties of the honourable though arduous post in which you have placed me, and trust that such short-comings as I may disclose may prove as little hindrance as possible to the success of our meeting. When we met in Paris our association was an infant of some fifteen months; it had just begun its dentition. It is now a lusty child of four years and more; it has cut all of its first set of teeth. I feel sure that you will join with me in the hope that its teeth will be used, never for secondary purposes, as aggressive weapons, but always for primary purposes, for carrying out the first stages of the digestion and assimilation of scientific knowledge and scientific thought into living active scientific flesh and blood. When I say "scientific" I use the word in the broad sense used by my illustrious predecessor in this chair, in his opening address at Paris, as meaning all knowledge which is exact and which can be verified. Though we call the two sections into which we divide ourselves, the one "scientific," the other "literary," we are none of us, I venture to say, satisfied with our nomenclature. We wish, all of us, that we could use names which should free us from the mere suspicion that there is even the taint of antagonism between the kinds of knowledge with which we have to deal.

The association began as a brotherhood of existing academies, but it has already advanced from brotherhood to parentage. At a meeting at Paris, the Royal Society of London excited much sympathy by its lone condition; while the delegates of most other countries represented the whole round of knowledge with which the association deals, those of England could speak of one part only. That sympathy provoked action, and led to the establishment of the British Academy for the Promotion of Historical, Philosophical and Philological Studies; and it has been one of the pleasant duties of my three years' term of office to bring about the admission of that academy into our fold.

One of the matters brought before the council of the association last year, concerning the relations of the association to proposals for international investigations requiring State aid, is placed on the agenda for the present meeting. The subject is one which demands our most anxious attention; may we be able to come to a decision which, while assuring the future usefulness of the association, may not tend to hamper scientific activity outside ourselves. On another matter, namely, the question whether the association should hold property, the council came to the conclusion that it was undesirable to attempt at present a definitive decision; and there the matter at present stands. The question does not come up for consideration at the present meeting, but it is one on which a decision must, sooner or later, be taken.

On the motion of Prof. Diels, Lord Reay was nominated vice-president.

Secretaries for the meeting were nominated as follows:—German, Dr. K. Krumbacher, Munich; French, M. A. de Lapparent, Paris; English, Dr. A. D. Waller, London.

The president proposed the following delegates as *Présidents d'honneur*:—Dr. Diels, Prof. Darboux, Count Balzani, Dr. Bakhuyzen.

Prof. Gomperz proposed that section ix. (4), (5), of the statutes be amended to read as follows:—Section ix. (4). The president (of the council) shall be appointed by the directing academy. Section ix. (5). The vice-president, who shall belong to the other section, shall be appointed in the same way. In the event, however, of the directing academy having only one section, the association shall entrust the appointment of the vice-president to another academy. The proposal was carried.

Prof. Darboux moved "That the initiation of any new international organisation, to be maintained by subventions from different States, demands careful previous examination into the value and objects of such organisation, and that it is desirable that proposals to establish such organisations should be considered by the International Association of Academies before definite action is taken." The resolution was carried.

Prof. Armstrong presented the draft report of the executive committee of the International Catalogue of Scientific Literature. Prof. Credner moved "That this meeting recognises the great value of the International Catalogue of Scientific Literature, and the importance of aiding the work by making its existence known, as well as of contributing to its efficiency and completeness by endeavouring to secure the indexing of scientific publications at the time of issue, in accordance with the plan adopted by the Royal Society." The resolution was carried unanimously.

Mr. Bryce announced that the British Academy was taking steps to publish a similar catalogue for philology, and the other branches of learning not included among the sciences of nature.

M. Boutroux gave a brief account of the work completed and contemplated in connection with the preparation of a complete edition of the works of Leibniz, and moved "That the association be requested to renew the commission to the three academies above named to prepare an edition of the works of Leibniz committed to them by the resolution of the association of April 18, 1901, and to request them to bring about, between now and the general assembly of the association in 1907, the publication of a critical catalogue, for which they have already collected the materials, of the Leibniz manuscripts." The resolution was carried.

The president proposed Vienna as the place of meeting of the next general assembly in 1907. The proposal was adopted unanimously.

Thursday, May 26.—Section of science. Secretaries were appointed as follows:—German, Dr. A. Riecke; French, M. A. de Lapparent; English, Dr. A. D. Waller.

Prof. Waldeyer presented, on behalf of the commission for investigating the anatomy of the brain, the report of the sitting of the committee of May 24.

Prof. Waldeyer moved the following resolution:—

"The several academies and societies represented in the association are recommended to bring before their respective Governments, or other appropriate authorities, in the name of the association, a proposal to establish a special institution or department of institutions for the investigation of the central nervous system, where such organisations are not already in existence, or cannot be created otherwise." The resolution was carried.

The following resolution, giving the committee power of cooption, was also carried:—

"That the Brain Commission have the power of cooption, as recommended in the report just received."

Prof. von Bezold moved "That a committee be appointed to consider the best means of bringing existing organisations into accord with the views of the International Association of Academies." This resolution was carried.

Sir A. Geikie, on behalf of the International Geological Congress, moved the following resolution:—"The International Association having received and considered a reference made to it by the International Geological Congress held at Vienna, 1903, resolves to ask the International Geodetic Association to take into consideration whether, and (or) in what way, it can undertake or promote international cooperation in the investigation of the following subjects:—

"Precise determination of levels in mountain chains subject to earthquakes, with the view of ascertaining whether such chains are stable or are undergoing movements of elevation or depression.

"Measurements of the value of gravity, with the object, so far as geological questions are concerned, of throwing light on the internal distribution of masses in the earth, and on the rigidity or isostasy of the terrestrial crust." The motion was carried unanimously.

Prof. Credner proposed that the committee on seismological investigations, appointed on the proposition of Prof. von Bezold, consist of the following members:—Prof. Schuster (chairman), Prof. Helmert, Prof. de Lapparent, Prof. Mojsisovics, Prof. Agamennone, Prof. A. P. Karpinski, Prof. W. C. Mendenhall. That the committee have power to coopt further members without votes. If a vacancy arise among the members of the committee, it shall have the power to fill up such vacancy subject to confirmation by the International Association.

Prof. Riecke moved the following resolution of the Academies of Göttingen, Leipzig, Munich, and Vienna:—

"That the International Association be requested to place the investigation of atmospheric electrical phenomena upon the list of its undertakings, and to arrange for carrying out observations upon atmospheric electricity for the period of two years at a large number of stations suitably distributed over the surface of the earth."

Prof. Schuster considered the matter to be in an experimental stage and hardly ready to be taken up by the association otherwise than as an experimental undertaking suitable for consideration by a committee, and proposed the following resolution, which was accepted by Prof. Riecke:—

"That a committee be nominated to prepare a plan for cooperation in investigations of atmospheric electricity, and to organise, if possible, such international cooperation for a period of two years."

Prof. von Bezold introduced the propositions of the Berlin Academy of Sciences relating to terrestrial magnetism, and moved "That the association nominate a special committee to consider as to the best methods of making accurate magnetic observations at sea with a view to carrying out a magnetic survey around a parallel of latitude." The motion was carried unanimously.

Sir David Gill presented the report of the Royal Society upon the undertaking for the measurement of the African arc of the 30th meridian, and moved "That the report of the Royal Society be adopted, with the following amendments, viz.:—

"That after the concluding words there be added:—

"(1) That the association notes with much satisfaction the sympathetic communication of the Imperial Academy of Sciences, St. Petersburg, on the subject of the arc of meridian, and recommends that diplomatic action be taken with a view to the extension of Struve's arc to Egypt.

"(2) The association expresses the hope that steps will be taken by the German Government under the advice of the Berlin Academy of Sciences to extend the arc along Lake Tanganyika, either by triangles extending across the lake or along its eastern coast as may be found the more desirable." The report was adopted with the additions proposed.

Prof. Fredericq presented the report of the late Prof. Marey on the work of the Institut Marey, and moved the following resolution:—

"The International Association of Academies approves the nomination of MM. Lippmann, Amagat, Charles Richet, Blix, Einthoven, Grützner, Langendorff, Schenck, Athanasiu as new members of the 'Association Internationale de l'Institut Marey.'"

"After having considered the report of the late Prof. Marey, dated May 5, 1904, on the work of the institute, the association congratulates the committee of the Marey Institute in having obtained in France recognition as being of public utility, and thus secured the permanence of this international scientific organisation. The association expresses its best wishes for the success of the scientific work undertaken at the institute." The resolution was adopted unanimously.

Other standing committees were appointed as follows:—For the investigation of terrestrial magnetism, Prof. von Bezold (chairman), Prof. Mascart, Prof. Palazzo, Sir Arthur Rücker, Lord Kelvin, Dr. Bauer, Prof. Liznar, General Rykacev, Prof. Wieckert, Dr. Paulsen.

For the investigation of atmospheric electricity, Prof. Exner (chairman), Prof. Arrhenius, Prof. Mascart, Prof. Schuster, Prof. Righi, Prof. Ebert, Prof. Riecke.

For both these committees resolutions were passed giving powers of cooption and for filling vacancies, similar to that passed in the case of the committee on seismology.

PROF. ADOLFO CANCANI.

AMONG the various sciences, the one which during the last few years has lost the greatest proportion of its workers is probably seismology. Von Rebeur-Paschwitz, M. S. di Rossi, Ehlert, Pacher, and Contarini have followed each other in quick succession, and to this death roll, with feelings of sorrow, we are called upon to add the name of the distinguished investigator Adolfo Cancani. Although connected with the University of Modena, Prof. Cancani's work was chiefly carried out while working with di Rossi at the observatory of Rocca di Papa, and later whilst engaged as an assistant at the Central Meteorological Observatory in Rome. At the former institution he introduced into seismometry the use of large and heavy horizontal pendulums the movements of which were recorded mechanically.

The first of these, which are probably the largest in the world, were 17 feet in height. The booms, made of T iron, were 10 feet in length, which at their outer ends carried in one case a block of marble and in the other a piece of pig iron. Beyond these heavy masses glass fibres recorded movements on a surface rotating at the rate of 60 cm. per hour. With this apparatus, all of which was home made, and cost but a few pounds sterling, Cancani obtained some striking seismograms.

In addition to taking this new step in seismometry, Cancani devised a photo-chronograph, various seismoscopes, and other instruments.

Although his investigations extended to several departments of earth physics, his chief works are those relating to seismology.

In July, 1903, at the Seismological Conference in

Strassburg, at which with his chief, Dr. Luigi Palazzo, he acted as a delegate for Italy, he brought forward a scale for seismic intensities which he followed by a paper on the possible relationship between small changes in latitude and the occurrence of large earthquakes. His last published paper relates to the advantages to be obtained from continuously moving high speed record receiving surfaces.

Seismologists throughout the world know Cancani's work, but those who were privileged to know him personally have stored up remembrances of an enthusiastic worker, gentle and persuasive in his speech, and with a kindliness of disposition of rare occurrence. He leaves behind a gap difficult to fill, a loss to a family, to a department, and to a new science. J. M.

NOTES.

PROF. GEORGE DARWIN, F.R.S., has been elected president of the British Association for the meeting to be held in South Africa next year.

AT the monthly meeting of the Royal Institution on Monday, the thanks of the members were returned to Dr. Andrew Carnegie for his donation of 1200*l.* to enable Prof. Dewar and Mr. R. A. Hadfield to prosecute their joint investigation on the physical properties of steel and other alloys at low temperatures; and to Dr. Frank McClean for his donation of 100*l.* to the research fund of the institution.

PROF. C. S. SHERRINGTON, F.R.S., has been elected a member of the Imperial Academy of Medicine, Vienna.

IT is reported that the University of Göttingen has awarded its Otto Wahlbruch prize, of the value of 600*l.*, to Prof. Wilhelm Pfeffer, professor of botany at Leipzig. The prize is awarded for the most important contribution to science during the past two years.

AT the annual meeting of the Association of German Chemists, held at Mannheim on May 25, the Liebig gold medal for distinguished services in applied chemistry was presented to Dr. Rudolf Knietsch, of the Badische Anilin- und Soda-Fabrik, the discoverer of the so-called contact process of sulphuric acid manufacture.

ON the recommendation of the Rumford committee, the American Academy of Arts and Sciences has awarded the Rumford medal to Prof. E. F. Nichols, of Columbia University, for his researches on radiation, particularly on the pressure due to radiation, the heat of the stars, and the infra-red spectrum.

Science announces the death of Mr. Frederick A. Walpole, botanical artist of the U.S. Department of Agriculture. He was considered the best plant artist in the United States, his drawings having been used to illustrate various reports published by the Department of Agriculture and the Smithsonian Institution, as well as the narrative of the Harriman Alaska Expedition.

A REUTER telegram from Frankfort-on-Main says that at the forty-fifth general meeting of the German Engineers' Association the Grashof medal, instituted in honour of the founder of the association, was unanimously conferred on the two pioneers of steam turbine propulsion, the Hon. C. A. Parsons, of Newcastle-on-Tyne, and M. de Laval, of Stockholm.

THROUGH the efforts of an organisation known as the Edison Medal Association, a fund has been created to establish a medal to be known as the "Edison Medal," and the responsibility of annually awarding it has been entrusted to the American Institute of Electrical Engineers. A medal will be awarded this year by a committee soon to be selected from among the members of the institute.

REUTER'S Agency learns that the expedition which left England in February under Lieut. Boyd Alexander for the forest region between the west coast and Lake Chad arrived in canoes at Ibi, 250 miles up the Binue River, in April. The explorers had already made some collections on the Binue, and intended landing at Ibi with the view of pushing north into Bauchi.

AN official communication issued at Simla on May 17, and published in the *Pioneer Mail* of May 20, contains the following remarks:—"It has recently been stated in certain newspapers that the Government of India have rejected the offer made by Mr. Tata of a donation for aiding the foundation of an Institute of Science. This assertion is absolutely without foundation. So far from having rejected Mr. Tata's offer, the Government of India have promised a large subsidy to the scheme, and they have throughout the negotiations done everything within their power to facilitate its progress and aid the realisation of a project which has their fullest sympathy."

DR. FRIEDRICH SIEMENS, who died in Dresden a few days ago, was born in 1826 at Menzendorf, near Lübeck, and received his education in that town. In 1848, says the *Electrician*, he came to England to introduce his brother's, Dr. Werner Siemens, telegraphic apparatus. Afterwards he worked with his other brother, the late Sir William Siemens, and succeeded in applying the latter's regenerative principle to furnaces in combination with gaseous fuel, thereby making possible the production of open-hearth steel and the melting of glass by the continuous process in tanks. He also invented the regenerative gas burner and stove, and brought out numerous inventions connected with the glass industry.

A REUTER message from Queenstown states that Mr. Marconi is among the passengers on board the outward bound Cunard Steamer *Campania*. The daily newspaper which the Cunard Company have arranged to publish on board their four largest boats will be produced under Mr. Marconi's personal supervision. There will be a regular editor and printing staff on board each liner. The news received from shore will be supplied through Reuter's Agency. Mr. Marconi stated that he would have the *Campania* in communication with America on Monday through Cape Breton station, and would keep in communication with the Cornwall station until Wednesday night or Thursday morning.

MR. J. DONOVAN, 1 Anstey Road, Denmark Hill, S.E., would be glad if psychologists or other investigators could send him information or references bearing upon the following points:—(1) A fairly representative list of animals, invertebrate and vertebrate, that make sounds in extreme pain or distress, although such sounds never serve to induce their fellows to help or relieve them, or even attempt to do so. (2) (*a*) Have any observations or experiments been made to show whether the sound or cry of pain or shock has any influence toward hindering or checking the oncoming of catalepsy or swoon in the animal producing the sound? (*b*) Are animals that do not possess means of sound production more subject to catalepsy from pain or shock than those which possess means of sound production?

DR. LUIGI MAGRI contributes to the *Atti dei Lincei*, xiii. (1), 9, some observations on the relation of the index of

refraction of air to the density. It appears that the index of refraction increases more rapidly under pressure than is consistent with the law $(n-1)/d=$constant, whereas the value of $(n^2-1)/(n^2+1)d$ is practically constant except at low pressures, where the observations could not be made with a great degree of accuracy.

DR. STÉPHANE LEDUC, of Nantes, has communicated to the French Physical Society a note on crystal formation, advancing the hypothesis that the phenomenon of crystallisation depends not only on the arrangement of the molecules in geometric forms, but also on the movement of these molecules through the liquid in certain regular and geometric directions. This hypothesis is based on the author's observations on crystallisation in liquids thickened by colloids.

IT is well known that two triangles in the same plane may be homologous in 1, 2, 3, 4 or 6 different ways at the same time, and that two tetrahedra may be homologous in 1, 2 or 4 different ways, it being assumed in either case that there are no common vertices. Prof. Luigi Berzolari contributes a note to the *Atti dei Lincei*, xiii. (1), 9, in which it is shown that in space of more than three dimensions two pyramidoids cannot have more than one centre of homology unless they possess common vertices or corners.

THE results of meteorological and magnetical observations made at Stonyhurst College Observatory during 1903 have been published in the usual concise form, with the exception of the valuable appendix containing the Malta meteorological returns. Father Sidgreaves states that the year will be known as the wet year, the rainfall being 11·8 inches above the annual average. Notwithstanding the unfavourable weather, the solar surface was observed on 207 days, and 141 plates have been added to the collection of stellar photographic spectra.

WE have received from the Deutsche Seewarte part xii. of *Ueberseeische meteorologische Beobachtungen*, containing carefully made observations, three times a day, at the following remote localities:—Marshall Islands (two stations), Nauru (lat. 26° S., long. 167° E.), Apia (Samoa), Tsingtau (lat. 36° N., long. 120° E.), and Rarotonga (Cook's Islands). With the exception of the latter station, all the observations were taken at the German colonies in the Pacific Ocean. It is worthy of note that the preparation of this very valuable work has been financially supported by the Colonial Department of the German Foreign Office.

CAPTAIN D. WILSON BARKER, in his presidential address to the Royal Meteorological Society, reviewed the past and present condition of ocean meteorology. The importance of this branch of science led to the international conference on meteorological observations at sea at Brussels in 1853, and to the establishment of the Meteorological Department of the Board of Trade by Mr. Cardwell in the following year, under the superintendence of Captain (afterwards Vice-Admiral) FitzRoy. He and Captain Maury in the United States (more especially the latter) are recognised as the most successful pioneers of ocean meteorology. Maury constructed wind and current charts for all oceans, copies of which were supplied gratuitously for the use of navigators in this country, and FitzRoy and his small staff at once set to work on them, and converted the pilot charts (which showed the wind directions numerically under each principal point of the compass) into graphical "wind-stars," and subsequently (about 1859) FitzRoy commenced the publication of a new series of monthly (instead of quarterly) charts, including wind-force and other data obtained from log-books collected by the Board of Trade Department. Other countries, especially France, Germany, and Holland, also pursued the subject vigorously; the Deutsche Seewarte published, among numerous other valuable works, an atlas of thirty-six charts of the Atlantic Ocean. In 1874 another international maritime conference was held in London, and was attended by representatives of all the principal nations. In this country the Meteorological Council, with the cooperation of the Hydrographic Office of the Admiralty, continues to devote untiring attention to this important subject. Captain Barker's able summary is contained in the *Quarterly Journal* of the Royal Meteorological Society for April last, and is illustrated by maps drawn on Flamsteed's projection, showing very clearly the principal meteorological elements, five or six maps being devoted to each of the great oceans.

WE have to acknowledge the receipt from the Field Columbian Museum, Chicago, of copies of three papers on mammals by Dr. D. G. Elliot, published last year.

WE regret to find that in the notice of Mr. Regan's paper on the classification of fishes in our issue of June 2 (p. 109), the Teleostei are stated to be derived from the Chondropterygii instead of from the Chondrostei.

ACCORDING to a well illustrated article in the March number of the *American Naturalist* by Prof. E. A. Andrews, the assumption that the breeding habits of the American crayfish are identical with those of its European relative proves to be incorrect, and it turns out that there are considerable differences in this respect between the two species. The second article in the same issue, by Mr. W. M. Smallwood, is devoted to the natural history of the bulla-like mollusc known as *Haminea solitaria*.

ALL recent experiments on keeping animals in menageries in the open air seem to point to the superiority over the old plan of confining them in close and narrow cages. In the report of the Zoological Society of Philadelphia for 1903, for instance, it is stated that the raccoons in the society's menagerie were recently placed in an open enclosure containing a tall tree with a cavity at the base, and a hollow log. With these natural retreats at hand, it is noteworthy that the raccoons preferred to pass their time in winter, even during most inclement weather, high up in the tree, some 40 or 50 feet above the ground. In the same report the importance of pathological investigations into the causes of death of animals dying in menageries is urged.

THE Australian Ornithologists' Union is to be congratulated on the completion of the third volume of its official organ, the *Emu*. Efforts are to be made in the immediate future to render this valuable journal more strictly scientific. The part before us contains a coloured plate of two species of honey-eater, which, although described many years ago, have never previously been figured.

ACCORDING to the report for 1903, there is a satisfactory and continuous increase in the amount of gate-money taken at the Giza Zoological Gardens, the receipts for that year being £1213 (Egyptian), against £1037 in 1902. An extremely interesting feature in the report is the notes on the habits of the numerous species of Nile fishes kept in the aquarium. From these it appears that the proboscis-fish (*Mormyrus kannume*) is chiefly nocturnal, and employs its long snout in probing about among stones for animal food.

Very remarkable is the statement that in the case of *Hydrocyon forskali* it was found advisable to keep a light burning near the tank in order to prevent the fish from injuring themselves by swimming violently against the glass walls.

AN official publication issued at Colombo by the Government printer contains a summary of Prof. Herdman's report on the pearl oyster fisheries of the Gulf of Manaar, which may be considered as supplementary to the report on the same subject published by the Royal Society in November last, and already noticed in our columns. After referring to the condition and extent of the oyster-banks, the present report briefly points out the chief sources of injury to the molluscs, after which reference is made to the mode of formation of pearls, and the best methods of pearl-fishing. The report concludes with a series of recommendations, among which are comprised the substitution of dredging (in many instances) for diving, and the advisability of the appointment of a permanent naturalist.

AN apparent instance of mimicry of a most remarkable type is recorded by Dr. A. Willey in *Spolia Zeylanica* for April (vol. ii., part v.).. The attention of Dr. Willey had been directed by a correspondent to the striking resemblance presented by one of the Cingalese fishes commonly known as sea-bats (*Platax vespertilio*) to a decayed leaf, and soon after he had the opportunity of verifying this statement for himself. "I was walking," he writes, "along the reef in the company of a fisherman carrying a net when he espied a small fish, which he attempted to catch for me. I could not see what it was at first, but noticed that the man failed to bag it after several ineffectual attempts. The fish did not swim far away from the spot, but dodged about, baffling its pursuer. I approached and seized the net, whereupon I saw a yellow jak-leaf gently and inertly sinking to the bottom. This is no unusual sight, and I was about to turn away, when the leaf righted itself and darted off. Efforts were redoubled and the fish secured and sketched. . . . When a fish has a leaf-shaped and leaf-coloured body, and in addition the unique habit of toppling over and feigning death when pursued, it seems natural to conclude that it is a genuine example of protective resemblance."

MANY of the visitors to Kew Gardens who take a special interest in the orchid houses will be interested to know that a revised edition of the "Kew Hand-list of Orchids" has been published, with the usual interleaved blank pages to facilitate the jotting down of notes. The increase in the number of genera, at any rate in the plants shown in the houses, has been very evident, and the catalogue gives a total of 220 for the collection.

THE large proportion of economic questions which occupies the attention of the botanical departments in our colonies is well shown in the *Bulletins* (January, April) of the Botanical Department in Trinidad. A striking analysis of samples of sugar canes grown in Florida is quoted in an extract, in which no reducing sugar was found. The proportion of the sugars in canes is not only important from a commercial point of view, but as a purely scientific question is well worth investigating. The recommendation of carbon bisulphide as an insecticide affords evidence of the spread of scientific knowledge amongst planters. Other useful articles refer to prussic acid in cassava, rubber analyses, and treatment of "black pod" on cacao estates.

PROF. ERIKSSON returns to his mycoplasm theory, which asserts that rust fungi can hibernate in a protoplasmic form in the leaf-cells of the host, in a paper which appears in the *Transactions* of the Royal Swedish Academy of Sciences, vol. xxxvii., part vi., January. The investigations which were carried out by Dr. Eriksson and Dr. Tischler consisted in collecting the leaves of varieties of wheat which are liable to rust, and examining them both in late autumn and the following early summer, when no fungal mycelium could be observed, but in certain cells the authors distinguished a special dense accumulation of protoplasm, the mycoplasm. Later in July, intercellular fungal tubes were found which gradually developed into the ordinary hyphæ. The change from the mycoplasmic to the intercellular condition which is assumed still requires confirmation.

MR. C. FOX-STRANGWAYS has prepared a second edition of his memoir on the Oolitic and Cretaceous rocks south of Scarborough (Geological Survey, price 4*s*. 6*d*.). More than twenty years have elapsed since the first edition was published, and opportunity has been taken of adding a series of pictorial views illustrating the fine cliff-sections, while the subject-matter is amplified throughout. The results of recent researches on the Speeton Clay are incorporated, and the author has dealt more fully with the interesting topics of scenery and denudation.

IN an article on recent changes in the elevation of land and sea in the vicinity of New York City, and from a study of tidal observations on both sides of the Atlantic, Mr. G. W. Tuttle (*Amer. Journ. Sci.*, May) comes to the conclusion that the mean sea-level oscillates in an irregular manner, having an average period of about eight years. These oscillations appear to be largely due to changes in atmospheric pressure, and the resulting changes in wind velocities. In addition to the above movements, Mr. Tuttle finds that some ports show a more or less continuous rising of the sea relatively to the adjacent land, others a lowering of the sea-level in its relation to the land, and still others maintain a constant relation between the two. These last make it clear that, except for the periodic changes noted above, the sea does not change its level, and that the relative changes are due to land movements. Observations at New York City show that since 1875 the land has been subsiding at about 1·45 foot per century.

MESSRS. PHILIP HARRIS AND CO. have sent us a pamphlet giving a descriptive account of some new models and apparatus to be used in teaching the measurement of volumes, designed by Mr. S. Irwin Crookes.

MESSRS. WATTS AND CO. have published for the Rationalist Press Association, Ltd., a pamphlet entitled "What to Read: Suggestions for the better Utilisation of Public Libraries," which contains the substance of an address delivered by Mr. John M. Robertson. Many useful hints to parents and librarians who wish to develop in children a love of reading and a regard for good books may be gathered from the address. The price of the pamphlet is fourpence.

WITH the growth of the Stassfurt industries and the increasing application of potassium salts in agriculture, a rapid method of estimating potassium has become a question of some importance. In the May number of the *Gazzetta*, N. Tarugi describes a volumetric method of estimating the element which depends on its precipitation in the form of the sparingly soluble persulphate. The method is accurate,

and can be carried out with great rapidity. Incidentally, the existence in aqueous solution at temperatures between 0° and 40° of four hydrates of potassium persulphate is established.

SOME experiments by Mr. K. E. Guthe, published in the April number of the *Physical Review*, show that fused steatite or soapstone can be used as a substitute for fused quartz in the production of fibres of very small elastic fatigue suitable for suspensions. The soapstone can be melted in a gas-oxygen jet, and very fine fibres are easily drawn out from the clear bead thus obtained. The elastic fatigue and tensile strength of these fused steatite fibres have approximately the same value as fused quartz fibres of the same dimensions. In the same journal Mr. J. H. Hart describes a continuous method of steam calorimetry which, with simple apparatus, gives results which compare very favourably with the best results obtained by the admittedly excellent continuous electrical method.

AN exhaustive account of investigations with the respiration calorimeter, by Messrs. Armsby and Fries, on the available energy of timothy hay has been issued as *Bulletin* No. 51 of the Bureau of Animal Industry of the U.S. Department of Agriculture. According to well known experiments of Rubner, different nutrient materials—proteids, fats, and carbohydrates—can replace each other in the animal metabolism, and "isodynamic values" can be deduced for the various nutrients. The authors question the applicability of Rubner's generalisation to herbivorous animals, and their experiments indicate that the digested matter of hay is not isodynamic with body tissue when the food supply is below the maintenance ration. It was found that only 63 per cent. of the metabolisable energy served to prevent loss of tissue, while 37 per cent. simply increased the heat production of the animal.

A VERY interesting paper dealing with the constitution of the ammonium compounds is contributed by Dr. J. C. Cain to the current volume of the *Memoirs and Proceedings* of the Manchester Literary and Philosophical Society (vol. xlviii., No. 14). To take examples, the author's suggested formulæ for ammonium chloride and ammonium hydrate are $H_3N{=}ClH$ and $H_3N{=}OH_2$, in which the chlorine and oxygen are respectively trivalent and tetravalent. The conception involved in this new formulation explains a large number of well known facts in a very satisfactory manner. It accounts for the difference between solutions of ammonia and of the alkaline hydroxides, and for the existence of isomeric quaternary ammonium salts. By means of it the formation of metal-ammonia compounds and of diazonium salts, the reduction of diazonium derivatives to hydrazine, and the process of diazotisation are all capable of simple representation.

OUR ASTRONOMICAL COLUMN.

SPECTRUM AND ORBIT OF δ ORIONIS.—Some very interesting results have been obtained by Dr. Hartmann in a research carried out at Potsdam on the spectrum and orbit of δ Orionis. The variability of the velocity in the line of sight—or, as Dr. Hartmann prefers to designate it, the "oscillation"—of this star was first discovered by Prof. Deslandres at Meudon, who determined the period as 1·92 days, and the orbit as very eccentric. Dr. Hartmann's results, however, do not confirm these conclusions, for he finds the period and the eccentricity to be

5d. 17h. 34m. 48s. ± 17s.

and 0·10334 respectively.

A striking feature on the spectrograms obtained is that the calcium line at λ 3934 ("K") is always sharp, whilst the other lines are characteristically hazy, and it *does not share in the periodic displacements of the lines caused by the orbital motion of the star.* Seeking an explanation of this anomalous behaviour, Dr. Hartmann has arrived at the conclusion that the absorption producing K does not take place in either of the components of the δ Orionis system, but in a separate "cloud" of calcium vapour situated somewhere between that system and our own. The distance of this cloud cannot be determined, but Dr. Hartmann suggests that its extent, perpendicular to the line of sight, might be approximately determined by the observation of the K line in stars situated in the same region and having "oscillations" similar to those of δ Orionis (*Astrophysical Journal*, No. 4, vol. xix.).

ANOMALOUS DISPERSION AND SOLAR PHENOMENA.—A further exposition of anomalous dispersion, and its action relative to solar phenomena, by Prof. W. H. Julius, appears in No. 10 (May 30) of the *Revue générale des Sciences*. After reviewing the current theories as to the sun's physical constitution, Prof. Julius proceeds to demonstrate that the "apparent" excessive speed of prominence variations, the abnormal solar spectrum photographed by Prof. Hale in 1894, the periodical variation of the solar radiation, the eleven-year period of solar activity, the connection between allied terrestrial and solar phenomena, and several other phenomena, may all be explained by considering the relative geometrical positions of the sun and earth, and the consequently variable distorted paths of the solar radiations. For example, he states:—"The eleven-year period may be the combined consequence of a progressive variation (not necessarily periodic) of the system of the surfaces of discontinuity and the periodic displacement of the Earth in regard to the rotating mass of the Sun."

PRIMITIVE CONDITIONS OF THE SOLAR NEBULA.—An interesting mathematical study of the conditions which probably obtained in the primitive solar nebula has been communicated to the Academy of Science of St. Louis by Mr. Francis E. Nipher, and is published in No. 4, vol. xiv., of the academy's *Transactions*. According to the equations developed by the author, it seems impossible that at the time when the planets were separating from the parent mass the nebula was wholly gaseous. The idea that the planets were formed from condensing swarms of meteorites is the only reasonable one which conforms with the numerical results obtained. It also appears that at the times when the moon separated from the earth, and Mercury from the sun, the respective parent masses must have been in the solid state, the sun having fused and become vaporised since the separation of Mercury. Further, it seems unnecessary, and even improbable, that the earth should ever have been in a state of fusion. By substituting the proper conditions in one of his general equations, Mr. Nipher finds that the isothermal 7000° C. is probably the one existing at the sun's surface at the present time.

INVARIABILITY OF SPARK AND ARC WAVE-LENGTHS.—In a paper communicated to No. 4, vol. xix., of the *Astrophysical Journal*, Messrs. Eder and Valenta describe the results they have obtained from a series of experiments performed in order to test the various theories as to the variability of wave-lengths, in arc and spark spectra, with the amount of vapour present or with the nature of the electric stimulus used.

As the result of his experiments, Prof. Haschek proposed, in a paper published in February, 1902, a system of *quantitative* analysis based on the measurement of the amount of "shift" a line experienced when varying quantities of the material under analysis were used. Taking most stringent precautions to eliminate subjective photographic effects, Messrs. Eder and Valenta have shown that these "shifts" do not really exist, and they state their conclusions in the following words:—(1) That at ordinary atmospheric pressure there exist no relative shifts between the arc and spark spectra as were said by Exner and Haschek to occur; (2) that there also exist no shifts in the spark spectrum which could be attributed to a reduced quantity of the element present in the vapour.

THE PROGRESS OF MARINE BIOLOGY.[1]

OR some few years past the advances made by oceanography have been very marked, thanks to the rivalry which has grown up between different peoples. The English, the Americans, the Germans, the Belgians, the Scandinavians, and the Russians have made great efforts in this direction, while France, Italy, Austria and Portugal have not remained outside of the movement. Consequently this science in its principal features is already pretty well known.

But oceanography touches many departments of science, and amongst them marine biology is for the moment the least advanced, because it requires researches of a particularly difficult kind. It is to it that I have more particularly devoted my attention, and it is of it that I propose to speak this evening.

From the reports of many important expeditions, you are already well aware how universally distributed life is, even in the greatest depths of the sea; nevertheless, the means employed in this kind of investigation have been, as a rule, too primitive to furnish very complete results. In my own personal oceanographical work I have, for long, employed new means and methods, which attract different groups of marine animals, each according to its own characteristic instincts, and I have been able in this way to add to our knowledge of zoology.

It is not, however, enough to collect. We must also endeavour to penetrate the mystery of the laws which regulate life in the medium of the sea, so different in almost all respects from that of the air. For this the oceanographer requires the collaboration of the biologist and the physiologist.

Not unfrequently unexpected circumstances open to the observer new horizons, to be afterwards explored by science. It is thus that, finding myself among the islands of the Azores, to which my oceanographical researches have frequently conducted me, I assisted at the capture of a *cachalot*, or sperm whale, by the whalers of the country; simple peasants, who launch their well appointed whale boats the moment that the appearance of a fish is signalled by the look-out man, who is continually stationed on a little hill in their neighbourhood, and I have seen how these mammals go to the intermediate depths of the ocean in search of the great cephalopods which form their exclusive nourishment. When the *cachalot* in question came to endure the convulsions of death, its stomach rejected enormous fragments of the prey which it had captured during its last sounding.

It is in this way that I have recognised the existence of a fauna remarkable for the size and the number of its components, relegated to the large space which separates the surface from the great depths, but the organisation of which prevents its rising to the regions illuminated by the light of the sun, and probably also its descending to the bottom, when this lies beyond a certain depth.

What other groups of living animals inhabit these regions? We know nothing of them yet, but we may believe that they abound, because beings as powerful as these cephalopods require much nourishment.

So soon as I understood the importance of researches capable of throwing light on the life which exists in regions inaccessible to our ordinary means, I established on board of my ship all the equipments of a whaler, namely, three whale boats, each carrying a harpoon gun, several harpoons, a lance and a thousand metres of line, and I added to the complement of my ship an experienced Scottish whaler. The results of this organisation have left nothing to be desired. The cetaceans obtained already form an interesting collection, and their stomachs were abundantly furnished with these cephalopods.

In the Mediterranean, where previously the cetaceans had never been hunted, I have taken several individuals of the species *Grampus griseus, Orca gladiator, Globiceps melas*, and I lost a *Balenoptera musculus*. In the Atlantic Ocean I have taken several Globiceps and Grampus, as well as a very rare specimen of dolphin, *Steno rostratus*. I have also lost a cetacean of moderate size but of undetermined species.

[1] A Discourse delivered at the Royal Institution on Friday, May 27, by H.S.H. Albert I., Prince of Monaco.

The attack of cetaceans, especially when they are large, causes the harpooneering novice an emotion which diminishes his *adresse*; and even for a good shot the use of the harpoon gun is very difficult when there is the least motion of the sea. A school of animals has been sighted. Their presence has been revealed by their blowing, or by the regular reappearance of their backs at a greater or less distance from the ship, which is then steered towards them. If the animals are of the species already mentioned, the movement of the propeller does not trouble them; on the contrary, they may almost always be seen to come and take up station near the stern as if retained by curiosity. But some species, and among them the *cachalot*, seem to distrust this neighbourhood, and care must be taken that they do not hear even the too marked sound of oars; indeed, in such cases it is preferable to use paddles rather than oars.

The animals have found in the depth a favourable hunting ground, and they do not leave it. They sound to this depth during a time which varies from ten to forty-five minutes, according to the species, and come to the surface again to breathe during four or five minutes. These alternations repeat themselves, sometimes for several hours consecutively, almost on the same spot, with occasional pauses, which seem to be those of repose. It is when the cetaceans appear in this way at the surface that the nearest whale-

FIG. 1.—Breaking up a Sperm Whale.

boat should make every endeavour to come up with them before they again disappear, and so soon as one of them gives a sufficiently good presentation of the part of its body near the head, the harpooneer fires his shot. But this critical moment seldom arrives until after several hours of pursuit, even when the animals are full of confidence and allow the whalers to get well in amongst them. Most frequently, and in the most favourable circumstances, it happens that during the three or four seconds which the emergence of the animal at each of his eight or ten respirations lasts, the presentation is bad, or the movement of the sea has destroyed the aim; it is then necessary to wait until after the next sound.

If the animals sighted pursue a fixed route with any speed, it is useless to attempt the attack; it is impossible to come up with them because they are then on passage. Once I followed a large Balenoptera for six hours with my ship. He travelled about thirty miles in an absolutely straight line, which shows that the marine animals possess a sense of orientation more remarkable than that of the migratory birds, because these can always see the ground above which they travel.

At last, close to the boat, a powerful blow like a jet of

steam comes out of the water; the back of the animal emerges immediately afterwards; in the movement necessary to recover the horizontal position of its head, the dorsal fin appears and finally the lumbar region, which is much curved by the action of the tail, which determines the descent. It now proceeds for several lengths, hardly submerged, whilst the steersman, who can see the lighter-coloured portions of this immense body, and sometimes

FIG. 2.—Harpooning a Whale.

certain pools caused by the motion of the dorsal fin, steers the boat, driven by all the force of its crew, so as to cross the route of the cetacean. A fresh blow cuts the water, a black back presents itself at a distance of five or six metres, the shot is fired, and the eye can follow the harpoon with the attached line.

But at the first moment there is nothing to show that the animal has been touched. In a body of such size the arrival

FIG. 3.—Towed by a Grampus.

of sensation in the brain and the transmission of the will to the periphery require a sensible time. The success of the harpooneer is indicated by the rapid running out of the line, which very soon produces heat and a dense smoke in the bollard, round which a turn is taken in order to allow the harpooneer to regulate the run of the line according to the velocity of the cetacean and the direction which it follows. This is a very delicate moment for the safety of the whale-boat; nobody moves, and the turns of the line, carefully coiled in a receptacle, run out without a check. A second boat approaches in order to take the end of this line, when it is apparent that the thousand metres in the first boat will not be sufficient, and to add it to his own line. The running out is continued from this boat, and sometimes the three whale boats are rapidly cleared of their lines. But, with the friction which such a length of line offers, and to which the resistance of the boats towed has to be added, the cetacean reduces its speed very sensibly, so that there is no difficulty in maintaining it. Little by little the line is got back into the boats, and after various alternations the weakened animal advances more and more slowly, and close to the surface, where it is obliged to breathe more and more frequently.

Often many hours have passed before the favourable moment arrives for despatching the unfortunate victim and terminating the drama, and this is accompanied by the most serious circumstances of the whole enterprise. The exhausted animal stretches itself on the surface, almost motionless before the boat, where the harpooneer now holds a lance which has a considerable length, because it must pass through the whole thickness of the blubber and of the muscles before it reaches the vital organs. He approaches the animal by its side, so as not to be struck by the tail,

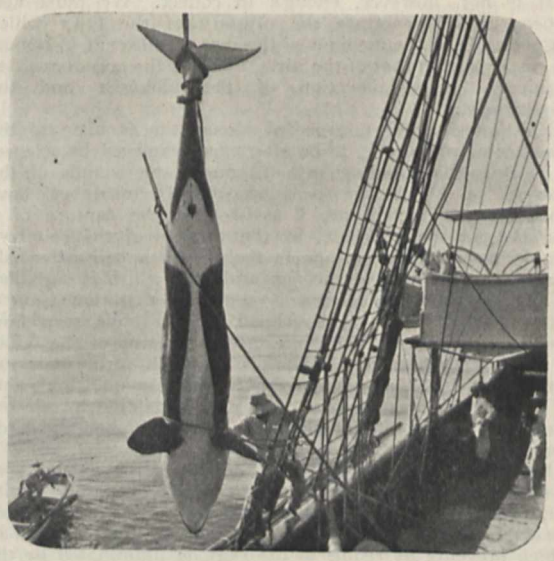


FIG. 4.—Hauling an Orca on board.

which may be thrown violently into the air so soon as the cetacean receives this new wound; but it is not always possible to avoid being struck by a fin, and especially in the case of large animals, this may wreck a boat. In spite of all the skill of the crew an accident of this kind may occur, and I could relate cases mentioned by various captains in which *cachalots*, old and solitary individuals, have seized and crushed between their jaws the boats which have attacked them. It has even been reported that two ships have been sunk by such animals in their fury, their enormous wedge-shaped head becoming in these circumstances a formidable ram.

When a cetacean of any size has been several times pierced, the red pool which spreads far over the sea gives the idea of great carnage. In fact the cetaceans contain a very large amount of blood, and before the last hour, when they lose it in torrents, they have already left behind them a red track of eight or ten miles in length over which they have towed the boats.

I have said that apart from the interest which each species of cetacean offers of itself (and it appears that some of them are hardly known at all), it is in the first place the contents of their stomachs which occupy us. The species which I have taken differ much in the nature of their prey, and their mouths are armed correspondingly. The *right whale*

is content to absorb the *plankton* composed of extremely small animals, which in some regions form a compact mass, a real cloud; and in order to keep out objects too large to pass down its very small throat, its jaws are furnished with the well known and valuable *whalebone*, which acts as a sieve.

The Grampus, the Globiceps, and the Cachalot penetrate to a depth probably much greater in search of cephalopods,

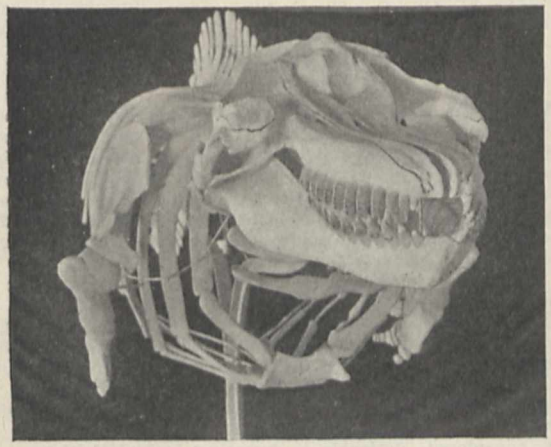


FIG. 5.—Skeleton of an Orca.

and they possess a dentition specially organised for seizing the gelatinous flesh of the cephalopods. The scars which they bear over the whole of their bodies are evidence of the energy with which their victims defend themselves with their suckers, often armed with formidable talons.

The Orca, provided with a more compact dentition, pursues the dolphins, of which it makes scarcely more than three or four mouthfuls, showing thus a remarkable power of digestion.

The dolphins themselves are more eclectic, and I have found in their stomachs several species of fish as well as cephalopods, but in both of them the characteristics special to great depths are wanting.

The principal object which I had in view in capturing the cetaceans, the knowledge of the beings living in the abysses, has been realised by the acquisition of a certain number of new and very rare cephalopods. Some of these are gigantic, and amongst them may be cited *Lepidoteuthis Grimaldii*, one of the most remarkable animals of the sea on account of its considerable size, and also because, though it is a cephalopod, it possesses scales like a fish.

The more we know of marine biology, and the more we

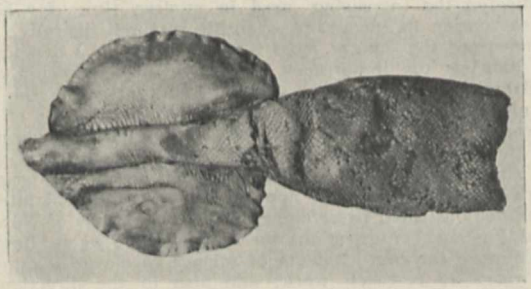


FIG. 6.—Part of the Fin of a Gigantic Cephalopod.

learn from it of the links which connect the creatures spread over our planet, of the interpenetration of types, such as that shown by Lepidoteuthis, as well as of the vital force, the great power of reproduction, the number of individuals in certain species, and the high antiquity of other forms, we seem to be justified in imagining that the sea may have been the cradle of organic life when the cooling of the atmosphere determined the precipitation of the waters.

THE ROYAL OBSERVATORY, GREENWICH.

THE report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, was read at the annual visitation of the observatory on Saturday last. Some of the results and observations described in the report are referred to in the subjoined abstract.

The progress made in the observation of the reference stars for the astrographic plates (for which more than 10,000 stars are to be observed, three times above and twice below pole) has been so satisfactory that it is expected that sufficient observations of all the stars will have been secured by the end of 1905, at which date it is proposed to terminate the observations. The catalogue of the astrographic reference stars will thus be completed in nine years, a year earlier than was originally proposed.

After consultation with Prof. Albrecht, it has been arranged to apply the correction for latitude deduced by him from the provisional discussion of the international series of observations to all observations of north polar distance year by year, commencing with 1902, Prof. Albrecht having arranged to communicate his results as soon as practicable after the end of the year. This correction has been applied to all the north polar distances for 1902 and to the planetary observations for 1903, and is now being applied in the star ledgers.

Provision having been made for the comparison between theory and the Greenwich meridian observations of the moon from 1750 to the present time, the discussion of the longitude of the moon 1750–1901, compared with revised tabular places, has been undertaken by Mr. Cowell on a plan devised by him, which enables the complex calculations to be done in a very economical manner, the lunar day being adopted as the unit of time. Mr. Cowell has published explanations of his methods of analysis of the moon's errors, together with some of the results obtained, in the *Monthly Notices* of the Royal Astronomical Society, November, 1903, to May, 1904.

The 28-inch refractor has been used throughout the year for micrometric measurements of double stars. The total number of double stars measured during the year is 512; of these, 178 have their components less than 1″·0 apart, and 85 less than 0″·5. The wider pairs consist of bright stars with faint companions, stars of special interest, and stars from Struve's catalogue which have not been measured within the last thirty years.

The occulting shutter has been used in the photography of Neptune and its satellite with the 26-inch refractor, and a good series of photographs has been obtained during the opposition of 1903–4. During the year the following photographs have been taken:—with the 26-inch refractor, 58 photographs of Neptune and satellite, 22 photographs of 10 double stars, 13 photographs for adjustments; with the 30-inch reflector, 117 photographs of 40 minor planets, 27 photographs on 27 nights of comet *c* 1903, 17 photographs on 12 nights of comet *a* 1904.

The photographs of comets have all been taken with short exposures, usually four on each plate, and are for the purpose of determining positions. Four exposures have also been given on each photograph of a minor planet, the object being to obtain accurate determinations of position on three or four nights for each planet during the opposition. In addition, the following photographs with long exposures have been obtained:—of comet *c* 1903, comet *a* 1904, the great nebula in Andromeda, and the Pleiades.

Considerable progress has been made with the measurement of the long series of photographs of Eros taken during the opposition of 1900–1. The measures have been made with the new micrometer described in a communication to the Royal Astronomical Society on May 13. With the magnification in use the probable error of the bisection of a perfectly defined speck is ±0″·020; the probable accidental error of a single measure of an image of Eros is found to be ±0″·067 on an astrographic plate, and ±0″·049 on a Thompson plate.

Owing to the error inherent in the star-images, the probable error of a position of Eros derived from a number of measures of four images on one plate is not nearly so small as the above measures suggest. Comparison of the positions of Eros for October 26 and 27 with the tabular places of M. Loewy's ephemeris gives a probable error of

$\pm 0''.082$ and $\pm 0''.045$ for photographs taken with the two instruments respectively. With the parallactic factor of October 26 and October 27, it results that two of the Thompson plates at the beginning of the evening compared with two at the end are sufficient to give the solar parallax with a probable accidental error of $\pm 0''.016$. We may therefore expect an adequate result for the somewhat arduous measurements and reductions involved.

No observations were made with the spectroscope during the year.

The solar activity increased considerably during the year ending May 10, the sun being free from spots on only 25 days, as against 190 in the previous year. The mean daily spotted area for 1903 is nearly six times as great as for 1902; still, as yet, the rate of increase is not so great as in the corresponding periods of the two preceding cycles. The greatest outburst of the year commenced on 1903 October 5, with the appearance at the east limb of the sun of a group of spots much larger than any seen since 1898 September. Several fine groups have appeared since.

The principal results for the magnetic elements for 1903 are as follows:—

Mean declination	16° 19′·1 West.
Mean horizontal force	4·0132 (in British units).
	1·8504 (in Metric units).
Mean dip (with 3-inch needles)	67° 0′ 51″.

The magnetic disturbances in 1903 have shown a marked increase in number and extent. There were five days of great magnetic disturbance and seven of lesser disturbance. Traces of the photographic curves for these days will be published in the annual volume. The calculation of diurnal inequalities from five typical quiet days in each month, selected in concert with M. Moureaux and Dr. Chree, has been continued.

The mean temperature for the year 1903 was 50°·2, or 0°·7 above the average for the fifty years 1841–90. During the twelve months ending 1904 April 30, the highest temperature in the shade was 87°·5 on July 14. The highest temperature in the Stevenson screen was 84°·2, and in the observatory grounds 85°·0, on the same day. The lowest temperature of the air recorded in the year was 23°·8 on January 1. During the winter there were forty-three days on which the temperature fell below 32°·0, being thirteen days below the average number.

The mean daily horizontal movement of the air in the year ending 1904 April 30 was 300 miles, which is 18 miles below the average of the preceding thirty-six years. The greatest recorded movement was 796 miles on February 13, and the least 69 miles on January 23. The greatest recorded pressure of the wind was 36 lb. on the square foot on September 10, and the greatest hourly velocity 43 miles on September 10 and 11.

During the year 1903, Osler's anemometer showed an excess of sixteen revolutions of the vane in the positive direction N., E., S., W., N., excluding the turnings which are evidently accidental.

The number of hours of bright sunshine recorded during the twelve months ending 1904 April 30, by the Campbell-Stokes instrument, was 1361 out of 4472 hours during which the sun was above the horizon, so that the mean proportion of sunshine for the year was 0·304, constant sunshine being represented by 1.

The rainfall for the year ending 1904 April 30 was 35·42 inches, being 10·88 inches greater than the average of the fifty years 1841–90. The number of rainy days was 182. The rainfall during 1903 was 35·54 inches, the heaviest ever recorded at Greenwich during the calendar year. The summer months in particular were very wet, more than 16 inches being recorded in June, July, and August, viz. 6·07 inches registered in June, 5·27 inches in July, and 4·82 inches in August. The greatest fall registered at Greenwich in a single day for many years past, viz. 2·46 inches, occurred on July 23. In 1904, January and February were wet months, so that the total fall from 1903 March 1 to 1904 February 29 was more than 37 inches.

The determination of the longitude of Potsdam by Prof. Albrecht and Dr. Wanach was completed in July. The result, which has been recently published by Prof. Albrecht, leads to an indirect determination of the longitude of Paris which is in close accordance with the results obtained by the Greenwich observers in 1902.

The revision of Groombridge's Catalogue for 1810, in connection with the Greenwich Second Ten Year Catalogue (1890), and the determination of the proper motions of about 4000 stars from Groombridge's observations, compared with recent Greenwich observations at an interval of about eighty years, have now been completed under Mr. Thackeray's supervision, and the results will be published without delay.

HIGHER SCIENTIFIC EDUCATION IN FRANCE.

AT one of a series of education conferences held recently at the École des Hautes Études Sociales in Paris, Prof. Appell, of the University of Paris, delivered an important address on the present facilities provided in France for higher instruction in the various branches of science, paying special attention to institutions established for this purpose in Paris. The address is published in the *Revue générale des Sciences* for March 30 last.

The address opened with a general historical account of the evolution of current estimates of the importance of scientific education of university standing and of the stages in the growth of French institutions in which such higher instruction is now given. Prof. Appell then recapitulated concisely the actual organisation of higher scientific teaching in existing schools and colleges in France, and supplemented his survey by indicating various improvements he considered desirable. Agreeing with British men of science, he urged that students must from the beginning of their work be led to avoid "une tendance fâcheuse à se contenter d'apprendre et de répéter la parole du maître," and that the object of all teaching should be to develop the scientific spirit and to encourage in the students a desire to apply to everything the methods of research.

The succeeding section of the discourse was concerned with scientific education in its relations to the practical applications of science to the needs of industry. A very liberal interpretation was given to the expression "technical" school, and the term was used to include such institutions as the schools of pharmacy, schools of mines, and agricultural colleges. Prof. Appell pleaded for a differentiation of the functions of the numerous establishments in which higher scientific education is being given, and in speaking of the work of all these technical schools, emphasised the great importance of insisting upon a good basis of general scientific knowledge on which to rest all instruction in technology. The absence of a due co-ordination of the work of existing scientific institutions in Paris was then pointed out, and a scheme outlined indicating the changes and developments desirable in order to realise "une union féconde entre la science et les applications."

The concluding subject of the address appeals in an especial manner to readers of NATURE. In it Prof. Appell indicated the increasing need in modern times for every great nation to encourage scientific research liberally. He condemned the danger most likely to exist in a democracy of judging the importance of a chair or lectureship at a university by the number of students it attracts; the test ought rather to be, it was pointed out, the number of discoveries which can be associated with a given laboratory or the amount of research work done in connection with it. The fallacy of disparaging new results in science because at the time they appear only of theoretical interest was demonstrated by reference to the researches of Newton and Pasteur. Suggestions were then made as to how to encourage the best students of science to devote a number of years to research work, and also in the direction of ensuring the most scientific and economical arrangement of buildings intended for research work in science. As an example, Prof. Appell referred to one of the needs of the University of Paris. This want was described as the creation on a large site, distinct from the Sorbonne, of an institute of chemistry, where laboratories for, and advanced instruction in, inorganic, organic, biological, and technical chemistry could all be found under the same roof, instead of being situated, as they actually are, in three distinct parts of Paris.

The concluding portion of the address is a powerful plea for the adequate endowment of research of all kinds. As Prof. Appell showed, it is in research laboratories that advances in industrial processes are really made, and it is a wise economy to encourage the foundation of such institutions. The discourse should have an immediate beneficial effect on the further supply of higher scientific education in France, and it is probable that the lessons drawn by Prof. Appell from Charlottenburg and from similar American technical institutes will serve to demonstrate to French statesmen the importance of the subject with which the address deals with such ability.

SOFT CHEESE-MAKING IN THE HOME COUNTIES.

IN the rapid increase of grass land during the last thirty years, farming in the Home Counties has seen a remarkable change. The exhaustion of land by the too frequent growth of cereals during the period of high prices, and the fall in the price of corn since, made corn, as the main product of farming, unprofitable to cultivate in part of this district. The land has been laid, or in too many cases has been allowed to lay itself, down to grass, and, instead of corn, milk has now become the principal agricultural product. This change is most noticeable within a circle having London for its centre and a radius of thirty or forty miles, for milk is both bulky and perishable, and railway charges and time in transit both desiderate its production near the great centre of consumption.

It must not be supposed that the greater part of this area is particularly well suited for grazing purposes. On the contrary, unlike the west country, or the polders of Holland, where second year's grass has all the appearance of an old pasture, it takes twenty years to produce a good pasture on the London-clay or Boulder-clay soils. It was one of the most mischievous effects of the high price of corn in the middle of the last century that the good old pastures, which formed perhaps one-third of most of the farms, were broken up. Besides, even when a good pasture has been produced, the climate is not humid enough in summer to produce an abundant growth; it is rare to get more than one cut of meadow-hay in a season, and the aftermath generally provides indifferent grazing. Per acre, the returns in milk are therefore not great. No doubt the output might be greatly increased by introducing the Danish system of dairy-farming, *i.e.* growing a succession of green tillage crops for feeding the cows instead of pasturing them, but the scarcity of cheap labour, which is the most serious drawback to intensive farming in the neighbourhood of London, prohibits the practice of this system.

The time of year when the milk production is greatest is the month of May. From observations made in Essex last year it was found that the yield of milk in May was about 20 per cent. greater than in the winter, while during the summer it fell off to an equal extent as the quality of the grazing deteriorated. The consumption of milk in London, on the other hand, fluctuates but little, and farmers must therefore limit their sale to their minimum output, and are unable to take advantage of the flush of milk in the spring to increase their returns.

It is clear that dairy-farmers require some outlet for this surplus milk. To give it to the calves and pigs is to utilise it for a purpose for which foods purchased at half the price per food unit would serve equally well. Taking everything into consideration, the use to which it could most profitably be put is in the making of soft cheese, for which there is a ready demand whenever placed on the London market. Soft cheese-making requires none of the expensive appliances and little of the storage that are necessary for hard cheese-making, and there is nothing to hinder its being carried out on any farm. But it needs knowledge and skill, and this is a subject of agricultural instruction, therefore, which the education committees in the Home Counties could most usefully provide.

Very opportunely, a little handbook on soft cheese-making has recently appeared,[1] for the preparation of which the authors, in virtue of their experience at Reading and Wye, are particularly qualified. First and foremost they lay stress on the need for cleanliness in the handling of milk, for, as they point out, taints are far more noticeable, because further developed, in soft cheese than in the milk from which it is made. But even in the production of milk for sale, reform in the matter of cleanliness is badly needed. Nowhere probably in the whole of Europe are cows kept in a filthier condition than in parts of England and Wales, and it is not unknown to find in milk a sediment of hair, dust and dung, which points to dirty cattle. In Holland and Hungary the cows are regularly groomed, and this is not only done to prevent contamination of the milk, but also because the cows, being made more comfortable, do better and give more milk. Besides dirtiness of the cows, contamination of milk is due to a variety of causes—dust blowing in an ill-kept, windy byre, neglect of the milkers to wash their hands before milking or to put on a clean overjacket, the use of impure water for washing pails and churns, &c., and it must be remembered that not only is such contamination an injury to the public, but it is sometimes the cause of loss to the farmers themselves when milk is returned to them as unsaleable. Short courses of instruction in the handling of milk for farmers and farm hands are badly needed. It may be doubted whether, without systematic science training, all the sources of bacterial contamination of milk can ever be guarded against, and it is to be urged that the county education committees should also provide for instruction in dairy bacteriology for those who, though a limited few, will, when distributed through the farming community, gradually spread the knowledge of the possible sources of bacterial contamination.

Once the principles of cleanliness have been mastered, the making of soft cheese is merely a matter of practice and attention to the details which are admirably set out in this little handbook. Of the sorts of cheese for making which directions are given, Bondon, Coulommier and Cambridge may be specially recommended, because they are milk cheeses and will consume the whole of the surplus milk on a farm, and because they need no ripening, and therefore require no storage accommodation. For the first-named especially there is known to be a good demand in London. They can all be made at any farm where a room capable of being kept at a uniform temperature is available, by the purchase of 5*l.* worth of appliances.

This is only one of the directions in which education committees in the Home Counties can directly aid the new style of farming, and in the neglect of which they will lose a splendid opportunity for usefulness. Greater productiveness of the land by more rational manuring, more economical feeding of dairy cattle, and improvement in the milk-producing qualities of dairy herds, are also needed to make the industry fairly profitable. In the writer's experience the majority of farmers feel their difficulties far too acutely to reject any means of improvement which are provided in a form of which they can make practical use.

T. S. D.

[1] "The Practice of Soft Cheese-making." By C. W. Walker-Tisdale, F.I.C., and T. R. Robinson, F.S.I. Pp. 51. (London: Office of the *Dairy World* and *British Dairy Farmer*, 1903.) Price 1*s*.

INHERITANCE OF PSYCHICAL AND PHYSICAL CHARACTERS IN MAN.[1]

IN his Huxley lecture, Prof. Karl Pearson gives the result of a prolonged investigation into the inheritance of the mental and moral characters in man (see NATURE, vol. lxviii. p. 607, October 22, 1903). His main conclusion is a remarkable one; it is that "the physical and psychical characters in man are inherited within broad lines in the same manner, and with the same intensity. . . . We inherit our parents' tempers, our parents' conscientiousness, shyness and ability, even as we inherit their stature, forearm and span."

Great as are the obstacles in the way of a precise determination of the power of heredity in the physical sphere, those in the psychical are far greater. This arises partly from the difficulty of obtaining trustworthy evidence in the

[1] "On the Inheritance of the Mental and Moral Characters in Man, and its Comparison with the Inheritance of the Physical Characters." The Huxley Lecture for 1903. By Prof. Karl Pearson, F.R.S. Pp. 179–237. (Published by the Anthropological Institute of Great Britain and Ireland, 3 Hanover Square, London, W.)

latter case, partly from the absence of any definite standard of measurement. Prof. Pearson, with characteristic ingenuity, has found means of overcoming both kinds of difficulty, and has succeeded in showing that for the inheritance of all observed traits, whether belonging to the "mental" or "bodily" category, the slope of the "regression" line closely approximates to the same value, viz. 0·5. Considering the extent to which the personal element must needs enter into any estimate, however careful, of comparative ability or character, the uniformity shown by the author's tables is far greater than might have been expected. Some, indeed, may incline to the opinion that he proves too much, for if the influence of heredity is supreme alike in the mental and moral, and in the physical domain, what room is left for the action of teaching, training, discipline, and the environment generally, influences which the common experience of mankind has held to be of importance? Prof. Pearson partly meets the difficulty by reminding us that "the average home environment, the average parental influence is in itself part of the heritage of the stock." This is true enough, but scarcely covers the whole ground, because a great deal of the average environment is not parental.

Still, however firmly we may be convinced of the power of education to foster desirable qualities of whatever kind, there can be little doubt of the significance of the author's figures with regard to the material on which education and experience have to work. From these considerations there emerges a practical conclusion of the highest importance. "Intelligence," says Prof. Pearson, "can be aided and be trained, but no training or education can *create* it." "The mentally better stock in the nation is not reproducing itself at the same rate as it did of old; the less able, and the less energetic, are more fertile than the better stocks. No scheme of wider or more thorough education will bring up in the scale of intelligence hereditary weakness to the level of hereditary strength. The only remedy, if one be possible at all, is to alter the relative fertility of the good and the bad stocks in the community." F. A. D.

ANTHROPOLOGICAL NOTES.

WE have frequently directed attention to the splendid work done by Mr. Clarence B. Moore in his archæological investigations in Florida. In the second series of the *Journal* of the Academy of Natural Sciences of Philadelphia, part iii. of vol. xii. is devoted to a memoir on certain aboriginal mounds of the Florida central west coast, and, like Mr. Moore's previous publications, it is sumptuously illustrated. Perhaps the most interesting find is a fish-spear of native copper; this is a unique record for Florida. There is little doubt that the ancient coppersmith had arrived at the knowledge that hammering the metal gave it stiffness. Numerous copper ornaments were found, such as pendants and ear-plugs, some of the latter being decorated with symbolic designs. None of the skulls from this district exhibited cranial flattening, though it was extensively practised on the north-west coast of Florida. In the latter district were found ceremonial vessels in which large holes had been made before the firing of the clay, but they do not occur along the central west coast. The mounds on the Apalachicola River yield forms of burial similar to those prevailing along the north-west coast of Florida. Ceremonial vessels, "killed" by a basal perforation and by holes throughout the body, made before the firing of the clay, were found in considerable numbers; the ware is most inferior in quality, as might be expected of vessels purposely made for interment with the dead.

There was a spirited discussion in the *American Anthropologist* during 1903 concerning the origin of the sheet copper found in the Florida mounds. Mr. J. D. McGuire contended that it owed its origin to European influences, but the whole weight of evidence and experience was against him.

There is immense variety in the basketry of the native tribes of America as regards form, technique, decoration and the materials employed, and our colleagues of the United States fully realise the importance of studying the designs with which so many baskets are ornamented while there is yet an opportunity of discovering their significance. We have several times referred to this subject; the latest publication of this kind is an admirably and copiously illustrated memoir, by G. T. Emmons, on the basketry of the Tlinget, in the *Memoirs* of the American Museum of Natural History (vol. iii. part ii.). The accuracy with which designs have been preserved and transmitted through so many generations is evidence of the conservatism of primitive peoples; most of the patterns of the past may be seen in the work of to-day, but the modern tendency to produce new figures is born of the rivalry in trade. The old characters are being combined to form attractive though meaningless figures, and so symbolism in design will gradually be lost. In existing circumstances the future of basketry is not difficult to foresee; the younger generation learns to read and write, but seldom learns to weave, and so the time is not far distant when Alaska must follow in the footsteps of all the basket producing countries. It is fortunate that, in the meantime, we have such an admirable piece of work as Mr. Emmons has produced, as he has saved from oblivion the meaning of many patterns and designs.

The following ingenious method of ethnological investigation adopted by Mr. E. Thurston, superintendent of the Government Museum, Madras, is worth rescuing from the oblivion of the report for the year 1902–1903. "In the inquiries concerning manners and customs, a novel and eminently effective method of arriving at the truth concerning tribal ceremonials was resorted to, marriage and death ceremonies being acted in the form of theatricals in which each performer at the real ceremony was represented by a member of the class concerned. In this way the interest was thoroughly sustained, and the fatigue, which soon supervenes among illiterate people when they are interviewed, was avoided. Moreover, apparently trivial but really important points of detail were clearly brought out in a manner which is impossible by mere oral examination. I have myself had to play the part of maternal uncle, and, as representing the *swami*, to receive the obeisance of the mock bride. The leading *rôle* of corpse at a funeral was played either by an elderly man or by a clay votive figure purchased from a local potter. The pupils of the eyes of these figures are not painted in till they are taken to the temple, where *puja* is done to them, as it is the painting of the eyes which endows them with life."

In the report on the administration of the Government Museum of Madras for the year 1902–1903, Mr. E. Thurston writes:—"Two tours were made in the course of the year. During the first of these the physical measurements of the jungle Uralis and Sholagas of the Coimbatore district were examined by myself, and their visual acuity, colour vision, &c., by Dr. W. H. R. Rivers, of Cambridge. It took many months before confidence was restored among these primitive folk, who, as a report records, 'could not understand why the measurements of the different organs of their bodies were taken; perhaps to reduce or increase the size of their bodies, to suit the different works which they were expected to do near London.' They believed, too, that the variously coloured wools, given to them for selection, were for tying them captive with. . . . A prolonged halt was subsequently made at Coimbatore, where the Kaikolans, Oddes, Okkiliyans, &c., were investigated. The Oddes, unfortunately, all have the title Boyan added to their names, and a fatal rumour was spread among them that the object of my visit was to transport the strongest among them to South Africa, to replace the Boers who had been killed in the war. My evil eye was cast on them, and they refused to fire a new kiln of bricks for house construction till my departure from their midst."

In appropriate yellow guise is published a new illustrated quarterly review called *Buddhism*, by the International Buddhist Society, at the Hanthawaddy Printing Works, Rangoon. The first article of the second number gives an account of the election and installation of the Taunggwin Sayadaw as Thathanabaing of Upper Burma. This functionary is the patriarch or ecclesiastic head, who is supreme in all matters connected with religion, and next to the king is the person most held in esteem. It is eight years since the last Thathanabaing died, and the people were as sheep without a shepherd, and feared that the Government would never exert its royal prerogative and elect a successor; but to their intense relief and satisfaction this was done in November, 1903. The review contains an

interesting paper on the Pali and Sanskrit texts by Prof. T. W. Rhys Davids. Judging from the other articles, this new journal should perform a useful service in clearly pointing out the true nature of Buddhism. In common with other religions, Buddhism has many extraneous local beliefs and practises grafted upon it from which it requires to be pruned. The foreigner too often does not distinguish between these two elements, and from this point of view alone the review will perform a useful task.

The brilliant work done by Prof. G. Elliot Smith on the mammalian brain is acknowledged by all anatomists, and they will eagerly look forward to the memoir (which is based on the examination of more than 400 human brains, and of an almost equally large series of simian cerebral hemispheres) that is shortly to be published as vol. ii. of the "Records of the Egyptian Government School of Medicine." A summary of the main conclusions is published in the *Anatomischen Anzeiger*, Band xxiv. p. 436. The most striking result of this investigation is the demonstration of the fact that the sulci called "calcarine" in most human and all simian brains respectively are not strictly homologous. The so-called "calcarine fissure" of the apes is a complete involution of the whole mesial part of the area striata, fossa striata occipitalis, whereas the similarly named furrow in the human brain consists in most cases of anterior and posterior parts which are genetically distinct, the anterior part being the anterior limiting sulcus of the mesial area striata, sulcus præstriatus, and the posterior part a mere depression in (not a complete infolding of) the mesial area striata, sulcus intrastriatus.

Those interested in human craniology are aware that Prof. Sergi, of Rome, has inveighed against the cephalic index, and has introduced a new nomenclature for describing skulls by inspection. Several English anthropologists recognise that the cephalic index has its uses and abuses, but there is an indefiniteness about Prof. Sergi's nomenclature, which besides is somewhat complicated, that prevents them from adopting the latter to the exclusion of the former method. As a matter of fact, they employ both systems, but only make use of the simpler terms introduced by the Italian anatomist. Dr. F. Frassetto has now applied Prof. Sergi's method to the anthropoid apes, and the following are his main conclusions. The skull of the adult chimpanzee is byrsoides rotundus, the less fully grown skull is byrsoides cuneatus; there is progressive reduction in the cephalic index, 88 to 70. The skull of the adult gorilla is byrsoides asciformis, while that of the young is ellipsoides cuneatus; there is a similar reduction in the cephalic index during growth, and the average breadth is less. On the whole the skull of the orang-utan is sphæroides and platycephalus; the cephalic index varies from 91 to 75. Thus the Asiatic anthropoid tends to preserve the primitive brachycephaly, while the African forms, especially the gorilla, become dolichocephalic. The author directs attention to the essential brachycephaly of Asiatic man and the dolichocephaly of African man. Pithecanthropus, however, which he describes as byrsoides asciformis, "is a fossil form of African anthropoid found in Asia." This short but suggestive paper will be found in the tenth anniversary volume of the *Atti della Società Romana di Anthropologia* (Rome, 1904). A. C. H.

INTERNATIONAL OCEANOGRAPHY.[1]

THIS first instalment of the observations of the international scheme of deep-sea investigation proves conclusively the unique value of the undertaking, launched amid many difficulties, both for the advancement of the purely scientific interests of marine zoology and meteorology, and for their practical applications to matters of fisheries and weather forecasting. It contains the numerical results of the observations made during August, 1903, by ships sent out specially by no less than ten countries—Belgium, Germany, Denmark, England, Finland, Holland, Norway, Russia, Sweden, and Scotland. The classification is that of the council, and we may ignore any question as to the international relations of Sweden and Norway, Finland and Russia, or England and Scotland, and congratulate ourselves on the fact that so many nationalities have been found to agree to meet on neutral territory and to engage in a uniform scheme of scientific research, as of happy omen.

The *Bulletin* is divided into four sections, A, B, C and D. Section A consists of a table of observations of the condition of the atmosphere as to its temperature and movement, and of the condition of the surface water as to its temperature and salinity. The distributions disclosed by the data are shown graphically on two maps, one on a scale of 1 : 18,000,000, which includes the whole area, the Baltic, the North Sea, the North Atlantic and the Arctic, and another, on a scale of 1 : 6,000,000, giving the North Sea, the English Channel, and the Baltic entrance, in more detail. The maps contain much that is of supreme interest, but it is greatly to be regretted that advantage has not been taken of the skill and enthusiasm of the commanders and officers of ships crossing the Atlantic in lower latitudes to extend the maps into the region in which the explanation of facts they show is to be looked for.

In Section B we find the observations of temperature and salinity at various depths. The salinities are determined by chlorine titration of water samples collected, and from these and the observed temperatures the specific gravities *in situ* have been computed. These tables profess a high degree of accuracy—temperatures to hundredths of a degree, salinities to two places of decimals, and specific gravities, in some cases, to six places—but it seems hardly necessary to inquire whether all the figures given are significant or not, or, if they are, whether it is worth while to trouble about the necessary refinements when observations taken from ships, the positions of which are scarcely known to within a mile or two, on any day during a month, are lumped together as if they were absolutely simultaneous. For in the end we obtain a series of sections which is absolutely invaluable. Discussion of these sections is impossible in the space available here, and in any case it will be better delayed until further bulletins provide material for comparison. We may, however, instance as of special interest the sections across the Færöe-Shetland Channel furnished by the Scottish Fishery Board, and the parallel section from Bergen to Iceland of the Danish and Norwegian observations. We are now in possession of a number of sections in this region for different years, and the constant change in the relation of the northward and southward moving streams is a phenomenon of ever-increasing interest.

Section C contains the results of gas analyses of a number of the samples collected by the German, Dutch, and Danish vessels. It is to be hoped that the other nationalities will join in this very important part of the work. The last section is devoted to tables showing the distribution of plankton.

It is worth noting that four of these bulletins will constitute one volume, for which the subscription is one pound.

H. N. D.

[1] "Conseil permanent international pour l'Exploration de la Mer." *Bulletin* des Résultats acquis pendant les Courses périodiques, No. 1, Août, 1903.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. Beck, master of Trinity Hall, has been elected Vice-Chancellor for the ensuing academical year.

Prof. Howard Marsh has been approved for the degree of Master of Surgery.

The Vice-Chancellor has published to the Senate a resolution unanimously passed by the Association of Chambers of Commerce of the United Kingdom supporting the recent communication from the council of the Royal Society, and urging that steps be taken to "ensure that a knowledge of science is recognised in schools and elsewhere as an essential part of general education."

The special syndicate appointed for the purpose report in favour of the university granting a diploma in mining engineering to members of the university who have completed six terms' residence, and have pursued an approved course of theoretical and practical study in the subject.

Prof. Ewing's Rede lecture, on the structure of metals, will be delivered in the anatomy and physiology lecture room on June 11 at 11.30 a.m.

Prof. W. H. Perkin, F.R.S., of Manchester, has been appointed an elector to the chair of chemistry and to the Jacksonian professorship.

Dr. L. Humphry, Dr. S. West, Dr. W. Hale White, and Dr. J. Rose Bradford, F.R.S., have been appointed examiners in medicine; Dr. Handfield-Jones and Dr. Herman, examiners in midwifery; Mr. Clinton Dent, Mr. Edmund Owen, Mr. Mansell Moullin, and Sir Hector Cameron, examiners in surgery for medical degrees.

Two portfolios of valuable drawings, illustrating ophthalmology and otology, have been presented to the university by Dr. Ole Bull, of Christiania. They will be exhibited at Oxford next month by Prof. Clifford Allbutt.

SIR WILLIAM H. WHITE, K.C.B., F.R.S., will open the new workshops, laboratories, &c., at the Merchant Venturers' Technical College, Bristol, on Wednesday, June 29.

AT a meeting of the council of University College, London, on Monday, June 6, Dr. Gregory Foster was appointed principal of the college as from September 1 next, in succession to Dr. Carey Foster, who had intimated his intention not to seek re-election on the expiration of his office at the end of August. Mr. Tansley was appointed lecturer in plant anatomy for a term of three years. Mr. E. C. C. Baly was re-appointed lecturer in spectroscopy for a term of three years.

IT is announced in *Science* that the Bill appropriating 50,000*l.* for the erection of a building for the College of Agriculture at Cornell University has been signed. From the same source we learn that Mr. Eugene N. Foss has given 10,000*l.* to the University of Vermont for the million dollar fund which the graduates of that college are trying to raise to mark the centenary of the institution; and that the will of the late Mr. Solomon Loeb, of New York City, has given 2000*l.* for the Chemical Laboratory of the New York University, 2000*l.* for the Hebrew Technical Institute, and 1000*l.* to the American Museum of Natural History.

IN a copy just received of the Johns Hopkins University *Circular*, we notice a feature that might well be copied by other institutions of a similar kind, viz. the publication of "Notes in Biology," edited by Prof. Brookes, and "Notes in Mathematics," edited by Prof. F. Morley. A very useful purpose is served by the publication of such "notes" in a university journal, which would hardly be a suitable medium for the detailed exposition of the results of lengthy researches. In the biology notes the body cavities and nephridia of the Actinotrocha are discussed by Dr. R. P. Cowles, while the mathematical notes deal with linear correspondences, the orthic cubic curve, and the construction of quadric polarity in space.

THE North of England Education Conference, which met for the first time in Manchester in January, 1903, and held its second meeting in Leeds in the early part of the present year, is to meet on the next occasion in Liverpool. The first meeting of the executive committee appointed to make arrangements for the next meeting of the conference was held at Liverpool on Friday, June 3, when Alderman W. Oulton, chairman of the Liverpool Education Committee, was appointed chairman of the executive committee, and Mr. E. M. Hance and Mr. W. Hewitt were appointed joint secretaries. It was decided that the conference should be held on Friday, January 6, and Saturday, January 7, of next year, and a general purposes subcommittee was appointed to make arrangements as to the subjects for papers and discussion.

A PUBLIC meeting of residents of the central part of Calcutta was held on May 4, the *Pioneer Mail* states, with the object of promoting the advancement of scientific and industrial education among Indians. In opening the meeting, Mr. Norendro Nath Sen remarked that a lakh of rupees was required annually, to be devoted to scholarships for deserving students to enable them to proceed to England, America and Japan for the study of the industries and arts of those countries. The marvellous progress of Japan, the speaker continued, is due entirely to education in this direction. The people of India cannot be too grateful to the Government of India for providing scholarships, but the Government should not be allowed to carry the burden alone. It is left to the residents to develop and complete the work begun by the Government, and it is for this purpose that the movement has been started. The formation of local associations such as this one in Calcutta should have an excellent effect on scientific and technical education in India.

IT has for some time past been a matter of comment that while American universities, and in several cases foreign ones—such as the University of Leyden—have frequently devoted considerable sums of money to the endowment, and in some instances to the separate publication, of scientific transactions, our English universities have not only been unable to subsidise the publication of researches, but have in most cases even failed to give their staffs sufficient leisure for the efficient prosecution of original work. The appearance of a paper by Prof. Karl Pearson on mathematical contributions to the theory of evolution, bearing on the title-page "Department of Applied Mathematics, University College, University of London—Drapers' Company Research Memoirs," is significant in more ways than one. It represents the fact that, probably for the first time, a City company has given an endowment of 1000*l.* to a university for the furtherance of research pure and simple, and further it indicates that mathematical research is at last beginning to receive public recognition. The present paper deals with the theory of contingency and its relation to association and normal correlation.

THE attention of the reader who is interested in the teaching and development of mechanics and mathematics is directed to an important address by Prof. A. Sommerfeld, of Aachen, on "The Scientific Results and Aims of Modern Applied Mechanics," of which an abridged translation, by Mr. R. M. Milne, has appeared in the *Mathematical Gazette*. The address is a powerful statement of the now prevalent view that in teaching mechanics the foundations must be securely laid by systematic experimental work on the part of the students themselves, for whom suitable facilities must be generously provided; it is also a plea for a closer attention on the part of mathematicians to the problems of practical mechanics. In this country these doctrines have long been associated with the name of Prof. Perry, F.R.S., and one of the latest phases in the movement is the reform of the teaching of elementary mathematics. Prof. Sommerfeld states that most of the German high schools now possess richly equipped laboratories for research and instruction in mechanics, and that the value of such work is generally recognised and greatly appreciated. He also describes the nature of some of the experiments and investigations that are carried out in these laboratories.

IT is satisfactory that there seems to have been a general agreement among the speakers at a recent meeting of the National Association of Manual Training Teachers—held to discuss the references to manual training in schools in the reports of the Mosely Educational Commission—as to the need in all schools for practical work conducted on scientific lines. Mr. Mosely said that the broad-minded way in which American engineers tackled the problems brought before them was what first excited his interest in the system of education in the United States. Mr. Mosely agrees with Prof. Armstrong that it is the fourth "R" which makes all the difference between the educational results in the United States and in this country. American teachers are right in giving more attention to the teaching of how to reason in a scientific manner than is common in English schools. Prof. Armstrong, who also spoke at the meeting, deprecated the erection of what he called "a magnificent metal workshop here and a magnificent wood workshop there," and said a large supply of costly machinery of one kind is unnecessary. A variety of occupations rendered possible to the boys is what is wanted, and the manual training thus provided should be related to local requirements.

SOCIETIES AND ACADEMIES.

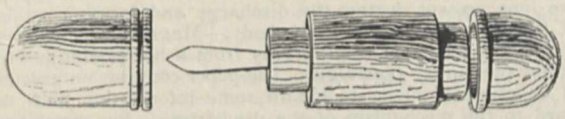
LONDON.

Royal Society, March 17.—"On the Effect of a Magnetic Field on the Rate of Subsidence of Torsional Oscillations in Wires of Nickel and Iron, and the Changes Produced by Drawing and Annealing." By Prof. Andrew **Gray,** F.R.S., and Alexander **Wood,** B.Sc.

May 5.—"Experiments on a Method of Preventing Death from Snake Bite, capable of Common and Easy Practical Application." By Sir Lauder **Brunton,** F.R.S., Sir Joseph **Fayrer,** Bart., F.R.S., and Dr. L. **Rogers.**

Although this paper is a joint one, the authors mention that each had a different share in its production. The whole research may be regarded as the natural outcome of the work begun in India nearly forty years ago by Fayrer; the instrument employed was designed by Brunton and the experimental work was carried out by Rogers.

Of late years a great deal of important and instructive work has been done by Fraser, Calmette and others in regard to the preparation of antivenins, the injection of which will preserve life in animals poisoned by snake venom. This method of treatment, however successful it may be, is open to the objection that its application is very limited, as it can only be employed in places where the antivenins can be stored ready for use. In order that any method of preventing death from the bites of snake poison should be of much practical utility, it must be one which can be constantly at hand when wanted and easy of application by unskilled persons, and as it is especially needed by very poor people, such as the natives of India, it must also be very cheap. In connection with this paper, an instrument which seems to promise good results was shown at the Royal Society. It consists simply of a small lancet about



half an inch long with a hollow wooden handle, in which crystals of permanganate of potash are contained. The way in which it is proposed to apply the permanganate is, that anyone bitten by a snake should at once tear a strip from a turban, shirt or any other article of clothing, and tie it as quickly as possible above the bite. A cut should then be made with the lancet over the site of the bite so as to convert the puncture made by the snake's tooth into a small wound. Into this the crystals of permanganate of potash, moistened with saliva if necessary, are to be rubbed. Permanganate of potash as an antidote to snake poison was first used by Fayrer in 1869; it was shown by Wynter Blyth in 1877 to be a complete chemical antidote to cobra venom when mixed *in vitro*, and his results were confirmed by Brunton and Fayrer in 1878. The anti-vivisection law prevented them from carrying these experiments further at the time, but their continuance in this country has now been rendered possible by Dr. Waller's invention of a method of giving chloroform continuously for forty-eight hours or more. By means of this instrument Captain Rogers has been able to test the effect of permanganate of potash applied in the manner already described on rabbits and cats. Five out of six animals experimented upon survived after the injection of cobra poison, and a similar number survived after the use of Daboia poison. These experiments, which were entirely carried out by Captain Rogers, are very satisfactory, inasmuch as they show that the utility of permanganate of potash is not confined to one class of venom, but that it acts equally well with the venom of all kinds of snakes. The results obtained five minutes after the injection of the poison were as good as half a minute after injection, so that although very rapid absorption occurs during the first few seconds, it seems probable that absorption soon becomes slow from local effusion, and that sufficient time would thus be afforded for the application of the proposed antidote. Further experiments will be carried on by Captain Rogers in India, and if they prove as successful as those which he made in this country, it is proposed that lancets,[1] with full directions for use, should be sold at a very cheap rate at all the post offices in India, in the same way as packets of quinine are sold at present. If the plan of treatment should prove efficacious, it will be a great pleasure to Sir Joseph Fayrer to see the fruition of the work which he began forty years ago.

Chemical Society, May 18.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The action of nitrosyl chloride on pinene: W. A. **Tilden.** It is shown that the yield of this compound by the usual processes is improved by using a mixture of equal quantities of *d*- and *l*-pinenes. For the regeneration of pinene from the nitrosochloride, methylaniline is recommended in place of aniline.—The electrolytic estimation of minute quantities of arsenic: H. J. S. **Sand** and J. E. **Hackford.** The authors recommend the use of lead electrodes for the estimation of minute quantities of arsenic, as their application permits of a simplification of previous methods.—The action of sodium methoxide and its homologues on benzophenone chloride and benzylidene chloride, part ii.: J. E. **Mackenzie** and A. F. **Joseph.**—The bromination of phenolic compounds: J. T. **Hewitt,** J. **Kenner** and H. **Silk.** It is shown that when one molecular proportion of bromine acts on phenol, the character and proportions of the products obtained vary with the conditions under which the reaction is carried out. Absence of water and presence of a strong mineral acid favour the formation of *p*-bromophenol, whilst sodium acetate in a glacial acetic acid solution diminishes the quantity of para-derivative formed.—The decomposition of the alkylureas. A preliminary note: C. E. **Fawsitt.** An investigation of the velocity of decomposition of the alkylureas with acids shows that the hydrolysis is indirect, and is effected as a secondary reaction of the acid with the alkylammonium cyanate first formed.—The formation of periodides in nitrobenzene solution, part ii., periodides of the alkali and alkaline earth metals: H. M. **Dawson** and Miss E. E. **Goodson.** In general, these iodides have properties similar to those of the potassium derivative already described, and the experimental data indicate that enneaiodides of the type $M'I_9$ or $M''I_{18}$ probably represent the highest limiting type of periodides.—The action of ozone on ethane. Preliminary note: W. A. **Bone** and J. **Drugman.** The authors have obtained ethyl alcohol by the interaction of ethane and ozone at 100°. The paper gives an account of the method and apparatus employed.—Caproylthiocarbimide: A. E. **Dixon.** A description of this substance and of a number of its derivatives is given.

Royal Meteorological Society, May 18.—Capt. D. Wilson Barker, president, in the chair.—The principal causes of rain: the Hon. F. A. Rollo **Russell.** The chief causes of rain are only four, but several of these are often in co-operation. These causes may be briefly described as follows:—(1) the forced ascent of moist air by the slopes of mountains; (2) a mass of air invading rather suddenly another mass moving from an opposite direction and maintaining its flow below the opposing current which it displaces; (3) the ascent of more or less moist air through heavier and colder air to a height where condensation of vapour takes place, increased radiation of heat towards space, and often electrical developments producing further condensation, increase of temperature, and renewed ascent with the same results; (4) the mixture of currents of air from different directions.—On the observations of rainfall at the Royal Observatory, Greenwich, in the years 1815 to 1903: W. C. **Nash.** The author has made a full inquiry into the circumstances relating to the early history of the register, and has drawn up an authoritative table of rainfall for the long period of eighty-nine years. The average annual rainfall is 24·36 inches, and the number of rainy days 157. The greatest fall was 35·54 inches in 1903, and the least fall 16·38 inches in 1858. During the five months January to May, no monthly fall exceeding 4·37 inches was recorded, but in the remaining seven months there were twenty-four falls exceeding 5 inches. Light falls of rain are spread principally through the nine months January to September, with a decided preponderance in spring.

[1] The lancets were made by Messrs. Arnold and Sons, West Smithfield.

Anthropological Institute, May 24.—Prof. W. Gowland in the chair.—Mr. E. F. **Martin** exhibited a large collection of native objects which he had obtained during his residence in northern Nigeria. The exhibit, which was of great interest, comprised specimens of musical instruments, weapons, leather and brass work and pottery, chiefly manufactured by the Hausas.—The Rev. C. T. **Collyer** delivered a lecture on Korea and its people, which he illustrated by numerous lantern slides. Mr. Collyer, during his twenty years' residence in the country, had unrivalled opportunities of observing the Koreans, and in his lecture he gave a valuable account of their manners, customs and architecture. His slides illustrated native types and buildings, and he also explained by diagrams the plan of the Korean house, with the theoretical arrangements for separation of the sexes, their system of counting and their alphabet, which is simplicity itself, consisting of only twenty-five letters, in marked contrast to the elaborate system of ideography in use amongst the Chinese and Japanese.

Linnean Society, May 24.—Prof. S. H. Vines, F.R.S., in the chair.—Anniversary meeting. The following officers were elected:—President, Prof. W. A. Herdman; treasurer, Mr. Frank Crisp; secretaries, Dr. D. H. Scott and the Rev. T. R. R. Stebbing. The president devoted the greater part of his address to considering the life-work of Linnæus and his claim to the gratitude of later workers. The president then presented the Linnean gold medal to Dr. A. Günther.

Physical Society, May 27.—Mr. J. Swinburne, vice-president, in the chair.—The law of action between magnets and its bearing on the determination of the horizontal component of the earth's magnetic field with unifilar magnetometers: Dr. C. **Chree.** Starting with the general formula for the action between two magnets perpendicular to one another, in Lamont's first position, the author discusses how observations should be combined when the higher terms usually neglected in magnetometer reductions are taken into account.—On the ascertained absence of effects of motion through the æther in relation to the constitution of matter on the FitzGerald-Lorentz hypothesis: Prof. J. **Larmor.** In consequence of recent misapprehensions (*cf.* D. B. Brace, *Phil. Mag.*, March), the argument on this subject, as given in "Æther and Matter" (1900), is briefly re-stated. The absence of effect of convection, to the first order, was demonstrated by Lorentz. Absence of effect to the second order of the ratio of the velocity of convection to that of radiation has now been experimentally established, as regards optical interference with long path, by Michelson; as regards mechanical action on a charged electric condenser, by Trouton; as regards double-refraction, by Lord Rayleigh and by Prof. Brace. This suggests strongly a complete correspondence in detail between the material system connected with the earth's motion and the same system at rest in the æther, so that their internal relations are indistinguishable. Theoretically such complete correspondence, up to the second order, exists, involving the FitzGerald-Lorentz shrinkage, provided a purely electrical constitution of matter (as regards its physical relations) is granted, but apparently not otherwise. Thus it is held that these phenomena point consistently in that direction.—On coherence and re-coherence: Dr. P. E. **Shaw** and C. A. B. **Garrett.** In a paper in the *Phil. Mag.* (March, 1901), Dr. Shaw described a method of investigating coherence by measuring the forces required to sunder the cohered surfaces. It was there shown that forces of the order of 1 dyne were required for a copper-copper contact of two single wires. Further, there seemed to be evidence of a change of state at the place of coherence, possibly orientation of the particles at the contact. In the present paper the authors follow the same method of investigation, adducing evidence that coherence can be explained, and only explained, by Lodge's original theory of fusion, and further establishing the after-effect, whether orientation or otherwise, mentioned in the former paper.

CAMBRIDGE.

Philosophical Society, May 16.—Dr. Baker, president, in the chair.—Note on the effect of a magnetic field on the vibrations of an atom containing six corpuscles placed at the corners of a regular octahedron: Prof. **Thomson.** The Zeeman effect for a single corpuscle vibrating about its position of equilibrium is to split up the spectral line corresponding to its free vibration into a triplet, the difference between the frequencies of the extreme lines of the triplet being He/m, in a field of strength H. Measurements of the magnetic separation of lines in the spectra of various elements show that different lines may experience different separations. The object of this note is to describe a model atom the vibrations of which would not all be affected in the same way by a magnetic field. It is shown that if six corpuscles are arranged at the corners of an octahedron their vibrations will under the magnetic field be split up into three triplets; in one of these the separation of the frequencies will be normal, *i.e.* He/m, while in the other two the separation will only amount to *half* the normal value.—The effect of screening on ionisation in closed vessels: A. **Wood.** Previous experimenters have shown that the so-called spontaneous ionisation in closed vessels is in part due to a radiation from the walls of the vessels. The experiments described go to show that this radiation consists of two kinds, (*a*) a secondary radiation excited by a penetrating radiation from without, and (*b*) an intrinsic radiation probably due to a true radio-activity of the material. The former predominates in vessels of iron, zinc and tin; the latter in vessels of lead and aluminium.—Quasi radio-activity produced by the point discharge: S. A. **Edmonds.** A metallic body becomes quasi radio-active when points are made to face it, and both points and body are connected to the terminals of a Wimshurst machine, and the discharge passed in dusty air. When caused to pass in the outside air, or in air freed from dust either by settling or by filtration through glass-wool, no effect is obtainable. All metals act equally well, while the points do not become at all active. This quasi activity is considered to be due to the dust particles in the air trapping the ions present during the discharge and forming a film of them on the surface of the body.—Magnetic deflexion of the negative current of electricity from a hot platinum wire at low pressures: G. **Owen.** The paper contains an account of experiments made to obtain some information with regard to the mechanism of the discharge at low pressures. The experiments lead to the conclusion that the carriers of the current are mainly corpuscles at all temperatures. When proper precautions are taken, about 90 per cent. of the carriers are deflected by a magnetic field corresponding to that required to deflect particles for which the ratio e/m is 10^7.—Some photoelectric effects: W. M. **Varley.**—Note on the atomic weight of bismuth: R. H. **Adie.** In this note the author gave his determinations of the atomic weight of bismuth, which confirm the results of Classen and fix the value at about 208·8.—Note on compounds containing an asymmetric nitrogen and an asymmetric carbon atom: H. O. **Jones.** The investigation of the formation of compounds containing an asymmetric nitrogen atom from an optically active tertiary amine was undertaken in the hope that the two possible isomerides would be formed in unequal quantities and separable by ordinary means. This expectation has been realised for the union of methyl-*l*-amyl-aniline with allyl and benzyl iodides.—The spatial configuration of trivalent nitrogen compounds: H. O. **Jones** and J. P. **Millington.** The paper describes the results of some experiments made with the view of obtaining evidence as to the configuration of trivalent nitrogen compounds, by attempting to resolve compounds in which the valency of the nitrogen should not change during the process. Methyl-ethyl-aniline-sulphonic acid was prepared and its brucine salt submitted to fractional crystallisation, but without effecting any resolution, and similarly with the dextro-camphor-sulphonate of benzyl-phenyl-hydrazine. It is therefore concluded that the three groups attached to the trivalent nitrogen atom are normally situated in the same plane with it.—Relations among perpetuants: A. **Young.**—On the proportion of the sexes among the Todas: R. C. **Punnett** and W. H. R. **Rivers.**

EDINBURGH.

Royal Society, May 2.—Prof. Geikie in the chair.—In a paper on the date of upheaval which caused the twenty-five-feet raised beaches in central Scotland, Dr. Robert **Munro** went carefully into the evidence, and gave

reasons for fixing the date of upheaval subsequent to the Bronze age and anterior to the Roman occupation.—Dr. R. H. **Traquair** exhibited a skull of the great extinct ox (*Bos taurus*, var. *primigenius*), and certain remains of reindeer, which had been found in the grounds of Dundas Castle, Dalmeny. The skull was very large, and indicated a great stretch of horns.—Prof. A. Crichton **Mitchell** gave certain preliminary results he had obtained on the rate of convective loss of heat from a surface exposed to a current of air. A thin strip of platinum foil formed the one branch of a Wheatstone bridge, which was constructed so as to be able to carry very powerful currents. The current through the strip was strong enough to raise it to the temperature of incandescence, and was measured accurately on a galvanometer placed suitably in the circuit. The strip was enclosed in a tube through which a blast of air was drawn by means of a large fan worked by a gas engine. The velocity of the air was measured directly in each case. The experiment consisted in finding the resistance of the strip, and therefore its temperature, for given values of heating current and velocity of air. It is evident that for moderate velocities of air current the strip will, for a particular value of electric current passing along it, be cooled more or less according as the air current is greater or smaller. The results so far obtained indicated that even in still air a large part of the cooling was due to convection. It was hoped that the experiments would lead to important information as to the relative amounts of convection and radiation when a surface was cooling in the air.

May 16.—Sir John Murray in the chair.—Dr. J. **Halm** read a paper on a cosmic theory of the diurnal and long-period changes of terrestrial magnetism and their possible connection with seismic phenomena and the displacement of the earth's axis of rotation. On the assumption that the atmosphere is a feeble electric conductor set in oscillation by the thermal and gravitational action of the sun and moon, an expression was obtained for the diurnal variation of magnetic potential. This contained as a factor the variation in height of a mass of air. But on the assumption that the air was in an average state of convective equilibrium, the principles of thermodynamics led to the result that this time variation in height was proportional to the time variation of the air temperature at the earth's surface. Hence was deduced the formula $V = a \sin 2\phi d\theta/d\lambda$, where V is the magnetic potential, ϕ is the latitude, λ the longitude, θ the temperature, and a a constant. The equipotential curves so obtained showed a remarkable resemblance to Schuster's curves deduced from magnetic observations, the main difference being a lag in longitude (equal to time) of the real curves as compared with those deduced from theory. The next step in the argument was to consider the possible strains which might result from this diurnal variation in magnetic distribution, and the conclusion was that such strains would cause a slight bulging on the side next the sun. This one-sided tide agreed with the indications of the horizontal pendulum as found by Ehlert, and with the recent measurements of change of direction of plumbline. It was easy to see that the change in declination of the sun would give rise to seasonal effects, and the periodicity indicated for various latitudes agreed in a suggestive manner with the seasonal curves of seismic activity in these latitudes. By an application of the same principle of convective equilibrium, Dr. Halm showed that the daily oscillation of the barometric pressure could be represented as the sum of two terms, of which one depended on the change of temperature from the mean and the other on the second differential coefficient of the temperature at the surface. The constant factor multiplying the latter term is the same along a latitude parallel, at least to a first approximation, but the multiplier of the former term depends on the character of the locality according as it is maritime, continental, or mountainous. The general theory advanced brought into connection not only meteorological and magnetic phenomena, but also seismic activity, change of latitude, and displacement of the earth's axis, and all as a result of solar radiation acting on the earth's atmosphere. It was natural to search for the eleven-year period in these variations. A careful tabulation of Omori's recent statistics of earthquakes in Japan from the earliest recorded cases showed an undoubted eleven-year period, and gave another argument in favour of the idea that seismic activity was influenced by magnetic changes. The paper touched upon several other astronomical and meteorological problems.

PARIS.

Academy of Sciences, May 30.—M. Mascart in the chair.—The chemical effects of light. The action of hydrochloric acid upon platinum and gold: M. **Berthelot.** Pure gold and platinum are slowly attacked by fuming hydrochloric acid in the presence of light; control experiments in which these metals were treated with hydrochloric acid and kept in the dark gave no metal in solution. In the presence of manganese chloride the amount dissolved was nearly doubled.—Study of the solubility of silicon in silver. On a variety of crystallised silicon soluble in hydrofluoric acid: H. **Moissan** and F. **Siemens.** Silicon is much more soluble in fused silver than in lead or zinc. The crystallised silicon found in the solidified metal contains a certain proportion of an allotropic variety of silicon which is soluble in hydrochloric acid. The experimental results are expressed in the form of a curve, showing the relation between the total silicon dissolved as a function of the temperature, and also of that portion which is soluble in hydrofluoric acid.—On the formation in nature of vanadium minerals: A. **Ditte.**—On the use of stereoscopical images in the construction of topographical plans: A. **Laussedat.**—The effects of small oscillations of external conditions on a dependent system of two variables: P. **Duhem.**—On a phenomenon analogous to phosphorescence produced by the *n*-rays: E. **Bichat.** A copper plate is exposed to the action of a bundle of *n*-rays of definite wave-length, obtained from a Nernst lamp after refraction through an aluminium prism. The secondary rays emitted by the plate are analysed by means of a slit and an aluminium prism, making use of a phosphorescent screen. It is found that, in accordance with Stokes's law, the secondary radiations are of greater wave-length than the primary radiations from which they are derived.—Magnetic observations at Tananarive: P. **Colin.** Tables of the absolute values of declination and inclination for the year ending April, 1904.—The synthesis of a series of tertiary alcohols, starting from cyclohexanol: Paul **Sabatier** and Alph. **Mailhe.** It has been recently shown that cyclohexanol can be readily obtained in quantity from phenol by the action of hydrogen and reduced nickel. By treating with alkyl-magnesium compounds, this substance yields a series of tertiary alcohols. The mode of preparation and the physical properties of a number of these alcohols are given, the reaction appearing to proceed equally well with both fatty and aromatic compounds.—The hydrographic study of the coasts of France, from 1902 to 1903: M. **Laporte.**—On the foundations of a systematic theory of spherical functions: Niels **Nielson.**—On the universal joint: L. **Lecornu.**—On the simultaneous emission of the *n*- and n_1-rays: Jean **Becquerel.** From the variation in the intensity of a feebly phosphorescent screen under the influence of the *n*-rays with the angle at which the screen is viewed, the conclusion is drawn that under the influence of the *n*-rays such a screen emits *n*-rays normally and n_1-rays tangentially. Experiments in support of this view are given.—The action of anæsthetics on the sources of the n_1-rays: Julien **Meyer.** Sources of n_1-rays, like those of the *n*-rays, are affected by anæsthetics.—On a new method of obtaining photographs in colours: Auguste and Louis **Lumière.** The method described in the present communication is based on the use of coloured particles arranged in a layer on a glass plate; this is covered with a suitable varnish, and finally with a layer of sensitive emulsion. The plate thus prepared is exposed through the back, developed, and the image thus prepared inverted, giving the colours of the original photograph on looking through it.—On a new regulator allowing of the control of the vacuum in a Crookes's tube: M. **Krouchkoll.** A side tube is blown on to the bulb containing some glass wool. After the tube has become hard through use, it is only necessary to warm the glass wool slightly, when sufficient air is given off to restore the tube to its original condition.—Acetylenic aldehydes. New method of preparation; the action of hydroxylamine: Ch. **Moureu** and R. **Delange.** The acetylene hydrocarbon is heated for twenty-

four hours with an alkyl-magnesium compound. Yields of acetal amounting to about 75 per cent. of the theoretical are obtained. These acetals are readily hydrolysed to the corresponding aldehydes by dilute sulphuric acid. These aldehydes, on treatment with hydroxylamine, do not give oximes, but isoxazols, several of which are described.—The differences of histological structure and secretion between the anterior and posterior kidney in male elasmobranchs: I. **Borcea.**—On the respective functions of the two parts of the adductor muscles in the lamellibranchs: F. **Marceau.**—On the adaptation of the plant to the intensity of light: M. **Wiesner.**—On the permeability of the tegument of certain dried seeds to the atmosphere: Paul **Becquerel.** If the tegument is carefully dried, it is absolutely impermeable to the gases of the atmosphere. In the presence of moisture, however, these gases pass through. Hence the complete suspension of all the phenomena of respiration of the seed is only realised in the absence of moisture.—On the spontaneous radiations of *Sterigmatocystis versicolor*: Paul **Vuillemin.**—A case of the emission of the *n*-rays after death: Augustin **Charpentier.**—The lipolytic property of the cytoplasma of the castor-oil seed is not due to a soluble ferment: Maurice **Nicloux.**—On an albumen extracted from the eggs of the frog: J. **Galimard.**—On the condition of the starch in stale bread: E. **Roux.**—The motive action of the pneumogastric nerve on the biliary vesicle: D. **Courtade** and J. F. **Guyon.**—On the toxicity of the chlorhydrate of amylene: L. **Launoy** and F. **Billon.**—Contribution to the study of Bence-Jones albumosuria: G. **Patein** and Ch. **Michel.**—The amount of albuminoid material necessary in human diet: H. **Labbè** and M. **Morchoisne.**—On ten cases of arterial hypertension treated by d'Arsonvalisation: A. **Moutier.** In all the cases the arterial pressure was reduced to the normal. At the same time, in some of the cases, the symptoms of arterio-sclerosis disappeared in great part.

DIARY OF SOCIETIES.

THURSDAY, JUNE 9.

ROYAL SOCIETY, at 4.30.—Notes on the Statolith Theory of Geotropism. (1) Experiments on the Effects of Centrifugal Force. (2) The Behaviour of Tertiary Roots: F. Darwin, For.Sec.R.S., and Miss D. F. M. Pertz.—The Fossil Flora of the Culm Measures of North-West Devon, and the Palæobotanical Evidence with Regard to the Age of the Beds: E. A. Newell Arber.—On the Structure and Affinities of Palæodiscus and Agelacrinus: W. K. Spencer.—On the Ossiferous Cave-Deposits of Cyprus, with Descriptions of the Remains of *Elephas cypriotes*: Miss D. M. A. Bate.—On the Physical Relation of Chloroform to Blood: Dr. A. D. Waller, F.R.S.—Contributions to the Study of the Action of Sea-Snake Venoms: Sir Thomas R. Fraser, F.R.S., and Major R. H. Elliot, I.M.S.—On the Action of the Venom of *Bungarus coeruleus* (the Common Krait): Major R. H. Elliot, I.M.S., W. C. Sillar, and G. S. Carmichael.—On the Combining Properties of Serum-Complements and on Complementoids: Prof. R. Muir and C. H. Browning.

MATHEMATICAL SOCIETY, at 5.30.—The Application of Poisson's Formula to Discontinuous Disturbances: Lord Rayleigh.—Some Expansions for the Periods of the Jacobian Elliptic Functions: H. Bateman.—Types of Covariants of any Degree in the Coefficients of Each of Any Number of Binary Quantics: P. W. Wood.

INSTITUTION OF ELECTRICAL ENGINEERS, at 5.—Annual General Meeting.

FARADAY SOCIETY, at 8.—The Hard and Soft States in Metals: G. T. Beilby.—The Electric Furnace; its Origin, Transformations, and Applications: Adolphe Minet.

FRIDAY, JUNE 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Rotation Period of Saturn: W. F. Denning.—Analyses of Errors of Moon's Longitude for Inequalities of Longer Periods; Methods and Results: P. H. Cowell.—Note on the Gyroscopic Collimator of Admiral Fleuriais: M. E. J. Gheury.—Variation in Latitude of the Greater Sun-Spot Disturbances, 1881–1903: Rev. A. L. Cortie.—The Mass of Jupiter, and Corrections to the Elements of the Orbits of the Satellites, from Heliometer Observations made at the Cape, 1901 and 1902: Bryan Cookson.—The Parallactic Inequality—a Reply: P. H. Cowell.—*Promised Papers*: Solar Parallax from Observations of Eros: A. R. Hinks.—Note on the Distribution of Sun-Spots in Heliographic Latitude: E. W. Maunder.—Micrometric Measures of Double Stars made with the 28-in. Refractor in 1903: Royal Observatory, Greenwich.—Sir David Gill will give an Account of the New Clock of the Cape Observatory.

PHYSICAL SOCIETY, at 8.—Projection of the Indicator Diagrams of a Petrol Motor: Prof. Callendar, F.R.S.—A Model Illustrating the Propagation of a Periodic Electric Current in a Telephone Cable, and the Simple Theory of its Operation: Prof. Fleming, F.R.S.—Exhibition of a Gyroscopic Collimator: M. E. J. Gheury.

MALACOLOGICAL SOCIETY, at 8.—On *Damayantia smithi*, Godwin-Austen and Collinge: Lt.-Col. H. H. Godwin-Austen.—Descriptions of Twenty-nine Species of Gastropoda from the Persian Gulf, Gulf of Oman, and Arabian Sea, dredged by Mr. F. W. Townsend, 1903–4: J. Cosmo Melvill.—*Conus Coromandelicus*, Sin, its Probable Affinities and Systematic place in the family Conidæ: J. Cosmo Melvill.—Descriptions of New Marine Shells from the Collection of the late Admiral Keppel: G. B. Sowerby.—Note on *Voluta brazieri*, Cox: E. A. Smith, I.S.O.—On *Doris planata* of Alder and Hancock: Sir C. Eliot, K.C.M.G.—Description of a Helicoid Land Shell from Central Australia: J. H. Ponsonby.—On Some Semi-fossil Land Shells found in the Hamakua District, Hawaii: C. F. Ancey.

MONDAY, JUNE 13.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Western Uganda: Rev. A. B. Fisher.

TUESDAY, JUNE 14.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—A New Principle in Photographic Lens Construction: Conrad Beck.

WEDNESDAY, JUNE 15.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A Direct Proof of Abbe's Theorems on the Microscopic Resolution of Gratings: Prof. J. D. Everett, F.R.S.—Report on the Recent Foraminifera of the Malay Archipelago, Part xvi: F. W. Millett.—Lecture on Nature's Protection of Insect Life, with Lantern Illustrations: F. Enock.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Effects of a Lightning Stroke at Earl's Fee, Bowers Gifford, Essex, April 13, 1904: Rev. C. F. Box.—An Instrument for Determining the True Direction and Velocity of the Wind at Sea: A. Lawrence Rotch.

CHEMICAL SOCIETY, at 5.30.—(1) The Mechanical Analysis of Soils, and the Composition of the Fractions resulting Therefrom; (2) The Effect of the Long-continued Use of Sodium Nitrate on the Constitution of the Soil: A. D. Hall.—(1) The Decomposition of Oxalates by Heat. (2) Some Alkyl Derivatives of Sulphur, Selenium, and Tellurium: A. Scott.—The Ultra-violet Absorption Spectra of certain Enol-keto-tautomerides. Part I.: Acetylacetone and Ethyl Acetoacetate: E. C. C. Baly and C. H. Desch.—The Action of Acetyl Chloride on the Sodium Salt of Diacetylacetone and the Constitution of Pyrone Compounds: I. N. Collie.—Our Present Knowledge of the Chemistry of Indigo: W. P. Bloxam.

THURSDAY, JUNE 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Decomposition of Ammonia by Heat: Dr. E. P. Perman and G. A. S. Atkinson.—On Flame Spectra: C. de Watteville.—On the Origin and Growth of Ripple-Marks: Mrs. H. Ayrton.—The Influence of Rainy Winds on Phthisis: Dr. W. Gordon.

LINNEAN SOCIETY, at 8.—Variations in the Arrangement of Hair in the Horse: Dr. Walter Kidd.—An Account of the Jamaican Species of Lepanthes: W. Fawcett and Dr. A. B. Rendle.—On the Blaze-currents of Vegetable Tissues: Dr. A. D. Waller, F.R.S.—British Freshwater Rhizopoda: James Cash.—Notes on the "Sudd" Formation of the Upper Nile: A. F. Brown.—The Place of Linnæus in the History of Botany: P. Olsson-Seffon.

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