THURSDAY, FEBRUARY 5, 1903.

INDIA-RUBBER.

The Chemistry of India-rubber. By Carl Otto Weber, Ph.D. Pp. x + 314. (London: Chas. Griffin and Co., Ltd.). Price 16*s.* net.

DURING the last few years the development of the india-rubber industry to meet cycling, motoring, and electrical requirements has produced quite a crop of descriptive handbooks, among which those of Brannt, Henriques, Seeligmann, Clouth and Warburg are the works which come most readily to mind. As a rule, however, these treatises have dealt more particularly with the manufacturing and commercial aspects of india-rubber production, and the scientific side of the subject occupies in them a relatively subordinate place as one matter among many. In the volume before us, the author has applied himself specifically to the chemistry of india-rubber, and incidentally to that of its various substitutes. Dealing, as he does, with only the scientific portion of the subject, he has naturally treated this branch far more exhaustively than previous writers have done. But pure science is even here tempered to the technologist, for almost throughout the book the point of view is that of the working—one had almost said of the works—chemist. Theoretical exposition and practical application jostle one another in every chapter; what to do, and the reason for doing it, rub shoulders together from cover to cover. It may be said at once that the result is an eminently useful contribution to the literature of india-rubber and its congeners.

The book contains nine chapters and an appendix. In the first chapter, which forms more than a third of the work and gives its title to the whole, Dr. Weber deals with the constituents of india-rubber, discusses their physical and chemical properties, and propounds in outline a theory of vulcanisation. The carbohydrates present in crude "unwashed" rubber are first referred to, and then follows a useful little table showing the proportions of resinous extract obtained from the various commercial brands of technically-pure rubber by treatment with acetone. It may be explained that the importance of these "resins" lies in the fact that they allow the chemist to discriminate between a high-quality rubber, such as Pará, and an inferior product like some of the African kinds.

Passing on to india-rubber proper, the author summarises the evidence which goes to prove that the pure rubber substance is a hydrocarbon of the terpene type. Oxygen, it is true, is always present in commercial specimens, but it is partly accounted for by atmospheric oxidation and partly by the presence of an "insoluble" compound having the empirical formula of a hydrated terpene. This last, the author suggests, may be an intermediate product between india-rubber itself and the carbohydrates from which, perhaps, the various terpenes are manufactured in the cells of the rubber plant.

Organic chemists have apparently found the chemistry of india-rubber somewhat unattractive. Gladstone and Hibbert's well-known paper, published some fifteen years ago, still remains the chief contribution to the subject. No doubt this is largely due to the intractable nature of the compound; for india-rubber, from this point of view, certainly possesses the defects of its qualities. It has few points of attack; there are none of the carbonyl-, carboxyl-, amido-, imido-, hydroxy- or methoxy-groups in which the organic manipulator delights; it cannot be readily dissolved; and *a fortiori*, being a colloid, it cannot be crystallised. Nevertheless, it has one vulnerable spot, and the Achilles' heel in this case is found in the existence of the "ethylene bonds" pointed out by Gladstone and Hibbert in the paper already referred to. The advances that have been made in the chemistry of this refractory substance have followed almost exclusively from the study of india-rubber as an "unsaturated" compound. From a consideration of its addition-products, our author concludes that the india-rubber molecule has probably an open-chain structure, and that its molecular weight corresponds, in all likelihood, to a high multiple of the empirical formula $C_{10}H_{16}$, with $C_{50}H_{80}$ or $C_{60}H_{96}$ as a possible minimum.

Much stress is laid upon the colloidal properties of rubber as being the clue to a proper understanding of its behaviour during manufacture. Graham's classical researches on colloids we are all supposed to know, at least in substance; but Dr. Weber appears to think—perhaps justly—that most of us are content to take them as read, since he remarks that they are, if not forgotten, certainly realised by very few present-day workers. For our sins in this respect we are treated to a twenty-five page disquisition on the colloidal state, leading up, however, to an interesting study of the phenomena of vulcanisation.

In the author's view—the experimental evidence for which is set out at some length—the vulcanisation of india-rubber by means of sulphur consists essentially in the direct addition of sulphur to the india-rubber hydrocarbon (polyprene), with the formation of various polyprene sulphides ranging between the limits $C_{100}H_{160}S$ and $C_{100}H_{160}S_{20}$. The particular sulphide produced depends upon the degree of vulcanisation, which itself is a function of the temperature, time, and proportion of sulphur present. Combating the theory that the action of the sulphur is one of substitution instead of addition, the author rightly points out that if the former were the case the vulcanisation of a ton of rubber would mean the production of about 18,000 litres of hydrogen sulphide—a daily amount which would make the vulcanising rooms fairly reek with the gas. In reality, only insignificant traces are found there. The cold process of vulcanising by means of sulphur chloride is also discussed in detail; alternative methods are mentioned, and the whole section, which is embellished by half-a-dozen photo-micrographs, forms a highly interesting and suggestive little monograph upon the inter-relations of sulphur and rubber.

In the succeeding chapter the technical examination and valuation of india-rubber and gutta-percha are dealt with. But in this industry, as in so many others, our manufacturers cling hard to rule-of-thumb methods; stocks are bought on the strength of a cursory empirical examination; and we read that, in consequence, different lots, supposed to be of identical quality, "often show the most absurd variations" when properly appraised by analysis. The following quotation speaks for itself:—

"Pig iron, caustic soda, wood pulp, and scores of similar articles, costing, comparatively speaking, a few shillings per ton, are bought and sold on the basis of strict analytical standards; but india-rubber, costing from 150*l.* to 500*l.* per ton, changes hands without either buyer or seller having more than a vague knowledge of its intrinsic value."

A full description is given of the various india-rubber substitutes now so frequently used, and which consist either of recovered rubber from cast-off articles or of the products obtained by the action of oxygen, sulphur or sulphur chloride upon such substances as linseed or colza oils. Inorganic compounding materials, vulcanising agents, solvents, colouring matters and textile fabrics each claim a chapter; and, as might be expected from a writer of Dr. Weber's experience and attainments, the treatment of all these subjects is eminently practical without in any degree lacking scientific precision.

Analysts and technical chemists who are called upon to examine india-rubber will be grateful for the chapter on the analysis of rubber articles, with which the volume proper closes. Information previously scattered in periodicals is here readily available, and the usefulness of the chapter is much enhanced by a section dealing with the interpretation of analytical results. Chemists should note that nitro-naphthalene is recommended as a "solvent" for india-rubber in preference to the nitro-benzene hitherto generally employed.

On the whole, the author's style is lucid and his English readable. Occasionally one meets with a tortuous sentence or a quaint prepositional usage, and the book generally, perhaps, lacks lightness of touch. Here and there, also, a word occurs which does not exactly convey the meaning intended, and rather reminds the present writer of the youthful essayist who, describing a storm at sea, remarked that a boy was drowned before his parents' eyes, and that "it was all the more awful because the father and mother were just on their honeymoon." Such blemishes, however, are small matters in a work of this kind. The book was wanted, and is a welcome acquisition. It is written by a man who knows his subject and who writes as if he loved it. The author is to be congratulated upon a very useful contribution to a somewhat obscure and difficult branch of technical science.

C. SIMMONDS.

A BRITISH BOOK OF CONSTANTS.

Physico-Chemical Tables. Vol. I. *Chemical Engineering and Physical Chemistry.* By John Castell-Evans F.C.S. Pp. xxxii + 548. (London: Chas. Griffin and Co., Ltd.) Price 24*s.* net.

THIS volume is the first half of an elaborate work intended to be a compendium of tables and data covering the whole domain of physical chemistry, for use both in the laboratory and the works. The scheme is an ambitious one, and the labour of compiling the present 548 pages of closely printed matter must have been no light task. The book which Mr. Castell-Evans's work most closely resembles is undoubtedly Landolt and Börnstein's well-known treatise, which is about the only one with which the writer is acquainted covering the same field. The chief difference between the two books lies in the fact that Mr. Evans has included about sixty pages of arithmetical and algebraical data, which should prove quite useful.

The book is, on the whole, well arranged and exceedingly comprehensive, and some of the original tables it contains are among the best. The reviewer feels, however, that one of its chief demerits lies in the over-elaboration of some matters and the very unnecessary rows of figures, which many of the tables give.

For instance, what possible significance can the last two or even three figures have, when from table 47 G we learn that a barometer column of 30 inches at 54° F. is equivalent to 29·940213 inches at 32° F.? or of what use is it to have the equivalent of a mile in metres given to fourteen significant figures when 10^{-8} metre is about the limit attainable in the comparison of primary standards of length of the highest class?

Regarding the material of the work as a whole, a careful perusal gives a general impression that the author collected his materials and retired into his study to write his book six or eight years ago, and when the book came to be published overlooked the fact that our knowledge of some of the most important questions dealt with has advanced very materially during this period. For instance, we look in vain, under the specific heat of water or mechanical equivalent of heat, for mention of the work of Griffiths, of Schuster and Gannon, of Callendar and Barnes, or of Reynolds and Moorby, whose different researches, all published during the past few years, have practically settled this question. While dealing with this point, we notice that there occurs here in the familiar form the good old text-book tradition that Regnault *determined* the specific heat of water between ordinary temperatures and 100° C. In justice to Mr. Evans, however, we should mention that in his book several other similar errors, which we had come to recognise as almost always with us, are conspicuous by their absence, and the book bears strong evidence that in a great many cases the original authorities have been consulted.

We have verified many of the numbers, and have not detected many serious errors properly so called. In some cases, however, this may be due to the decided superabundance of data in many of the tables (as, for example, that of melting points on pp. 380, *et seq*). We find there for the melting point of gold,

1140°, 1200°, 1037°, 1092°, 1240°, 1250°, 1380°, 1100°, 1035°, 1045; most probable value 1050°;

and for silver,

999°, 1024°, 1000°, 1032°, 916°, 1023°, 1040°, 954°, 968°; most probable value 968°;

whereas modern authorities are agreed that 1062 ± 2° is a close approximation for the melting point of gold, that of silver in a reducing atmosphere being very sensibly 100° lower.

The most commendable part of the book is the section dealing with vapour pressures, critical volumes, &c., the results of the voluminous researches of Ramsay and Young and other modern workers being here, with both formulæ and tables, given in full.

In conclusion, we congratulate the author on having carried out so formidable a task as the compilation of these tables apparently single-handed. Should a second edition be necessary, revision of some parts and condensation to two-thirds its present bulk would make it a decidedly useful work. J. A. H.

OUR BOOK SHELF.

Natural and Artificial Sewage Treatment. By Jones and Roechling. Pp. vii + 96. (London: Spon, 1902.)

THE authors state that they are making public in the above treatise information which they have already brought before different societies of professional men, but they claim that while putting the matter forward in a new form, they have also brought it up to date. This is doubtless the case with the statements concerning treatment of sewage on the land, but the treatment by bacteria beds is not so satisfactorily brought up to the date of publication. In fact, the impression produced by a careful perusal of the book is that the presentation of the two methods of treatment by land and by bacteria tanks and beds is such as to indicate a very considerable predilection for the sewage farm. This impression is caused, not by an overstatement of the results of sewage farming, but by an understatement of the permanency and advantages of an artificial bacterial installation. The authors do not lay stress, as they should in fairness do, on the fact that what they term the "artificial" bacterial treatment is the bacterial treatment of the sewage farm carried out under regulated and controlled conditions which add much to the precision, uniformity and regularity of the process of purification. When they place to the advantage of land treatment that it removes pathogenic germs, they are on doubtful ground; and when they speak of the entire loss of manurial value and the production of larger volume of effluent by the artificial bacterial process as disadvantageous, they apparently forget that bacterial effluents are not infrequently directly or indirectly used in certain parts of the year for irrigation, and further, that a larger volume of good effluent turned into a watercourse is usually of direct advantage.

Some statements are, moreover, open to serious question and have not been decided in the sense stated. Such is the oft-repeated one that treatment of ordinary sewage causes bacteria beds rapidly to silt up and that their material requires renewal, that their capacity is not permanently increased by resting, that they are peculiar in requiring careful management and that a covering of scum is necessary to the action in the so-called "septic tank." It should have been stated that beds which silt up are either improperly constructed, are being improperly treated or are receiving abnormal sewage, and that bacterial treatment, whether effected on land or in artificially constructed spaces, is identical in its cause and its nature and requires similar considerate management. Both processes have frequently failed because they have been inconsiderately provided for and dealt with.

If the above considerations are borne in mind, "district councillors, sanitarians and all interested in this complicated process" may with advantage peruse the little book, and they will find that, in the second part more especially, information of real value is presented in a lucid and intelligible form.

It might have been anticipated from the title of the book that chemical processes of treatment received notice. It is satisfactory to find that they are not dealt with, and that the terms "natural and artificial," as applied to sewage treatment, are intended to refer to land treatment and to so-called bacterial treatment respectively. It should be remembered that both these treatments are "naturally" effected in the main by the bacteria present in the sewage itself, and that the laying out of a sewage farm is as truly artificial as the provision of beds of flints, pebbles or other materials for so-called contact treatment.

Thomson's Gardener's Assistant. New Edition. Pp. viii + 607. (London: The Gresham Publishing Company, 1900–1902). Six Vols., 8*s.* each.

THIS important horticultural work, revised and entirely remodelled under the able direction and general editorship of Mr. W. Watson, Curator, Royal Gardens, Kew, has now been completed. It has been published in six divisional volumes, or in two volumes of 656 and 607 pages respectively. Many specialists have contributed to the work, and a glance at a list of their names with the articles for which they are severally responsible is sufficient to prove the value of this great addition to the literature of gardening.

Divisional vol. i. contains about forty pages on "Plant Structure," an epitome of such portions of botanical science as are of most interest to the gardener, by Dr. M. T. Masters. "Insect and other Plant Enemies," as also an article on "Garden Friends," are well treated by Mr. J. Fraser. Mr. G. Massee, our greatest authority, writes on "Plant Diseases caused by Fungi." All these articles are well illustrated and clearly and pleasantly written. Soils and manures are treated at length by Mr. Willis. Tools and instruments and garden structures are thoroughly dealt with, described and, when desirable, illustrated—the underlying principles being explained in a concise and lucid manner.

Divisional vol. ii. has articles, all well illustrated, on heating, propagation, transplanting, pruning, flower-garden and pleasure-grounds, hardy ornamental trees and shrubs, hardy herbaceous perennials, aquatic and bog plants, hardy and half-hardy annuals and popular garden plants.

Divisional vol. iii. treats on the greenhouse and conservatory, gives a select list of desirable stove and greenhouse plants with full cultural details. The orchids are fully treated by Mr. J. O'Brien, a descriptive list of the more important ones from a garden standpoint being given, together with full particulars as to their requirements and cultivation; plans of orchid houses even are given. Other special articles are those on ferns, palms and cycads, succulent plants, summer bedding, the sub-tropical garden, floral decorations, &c.

The remaining three divisional volumes deal fully and carefully with the fruit and kitchen garden. Lists of the best varieties are in each case given, and in some instances, under "Asparagus," for instance, the methods pursued by present-day market cultivators near London, and also about Paris, are described pretty fully.

Calendarial directions for each department of the garden for each month are contained towards the close of the last volume, in which are also treated the best methods of collecting, packing and storing vegetables, &c.

We think that, taken altogether, the present edition of "Thomson's Gardener's Assistant" may fairly be regarded as the standard book on British gardening.

G. N.

Proceedings of the Aristotelian Society. New Series. Vol. ii. Pp. 240. (London: Williams and Norgate, 1902.)

THIS collection of papers read before the Aristotelian Society during the session 1901–2 maintains the decidedly high level reached by previous volumes. For the professed metaphysician there will be special interest in the essays of Dr. G. F. Stout and Mr. H. W. Carr, who both take up, though on rather diverging lines,

the task of disproving some of the contradictions discovered by Mr. F. H. Bradley in the "appearances" with which both popular and "scientific," as distinguished from philosophical, thought do their work. Dr. Stout's paper is specially important, as it deals with the concept of "relation," which is central for all discursive thinking. Mr. G. E. Moore discusses at great length and with considerable acuteness, though not, perhaps, without a tendency to *ignorantia elenchi*, the argument for human immortality put forward in Dr. McTaggart's recent "Studies in Hegelian Cosmology." Mrs. Bryant's paper on the relation of mathematics to general formal logic, though far from easy reading, should be valuable to all who are interested in the problems of general scientific method. Unfortunately, it is disfigured by several misleading errors in the printing of symbols. Dr. Bosanquet supplies a most instructive defence of the ethical doctrines of T. H. Green against recent criticism. For the reader who is interested in topics of a more general kind, there are Mr. Boutwood's "Philosophy of Probability" and Mr. Goldsbrough's essay on "The Ethical Limits of Method in Philosophy." A. E. T.

Directions for Laboratory Work in Physiological Chemistry. By Holmes C. Jackson, Ph.D., Instructor in Physiological Chemistry, Bellevue Hospital Medical College. Pp. 62. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1902.)

THIS little book is intended especially as a guide to the author's own students, and it is a little difficult to understand why it should have a wider circulation. Every teacher has necessarily his own methods, and if all of them were to publish their own rough notes, the number of text-books would be endless. If there is marked originality in any particular teacher's methods, or if he has anything new and important in his material, there would be an excuse for publication, and other students and other teachers would then derive benefit from the book, but in the present case it is impossible to find any such reason. All one finds are directions for performing the stock elementary experiments commonly performed in practical classes. There is no pretence at completeness. The only spark of originality the work possesses is its incompleteness; each exercise is studded with marks of interrogation or terminated by a question or two. These, we imagine, are to be filled in or answered on the blank pages with which the book is interleaved. The student will, therefore, require a second book, or a very inquiring mind, in order that he may give the present note-book any semblance of completeness.

We imagine that the purpose of leaving out so much needful information is to stimulate the pupils to inquire for themselves. Such a method only appeals to the better class of student. It is the rank and file that a book such as this should aim at educating; the best students will find things out for themselves whatever method they are taught by.

The style of the book is as rough as its matter is incomplete; it is written in the note-book or blackboard manner, of which brevity is the soul, and in which such parts of speech as articles, nominatives and verbs are not regarded as essential constituents of a sentence. We have not come across anything in the shape of serious error, but that is hardly to be expected from a teacher of some experience; and doubtless many a first-year's student could write notes of his practical work which would be equally free from mistakes of this nature.

Die Zersetzung stickstofffreier organischen Substanzen durch Bakterien. By Dr. O. Emmerling. Pp. 151 + plates. (Braunschweig: Friedrich Vieweg u. Sohn, 1902.) Price 4 marks.

THIS book is the outcome of a series of lectures delivered by the author before a chemical audience, and is primarily intended for chemists, but is also adapted for all interested in the subject from a physiological standpoint. The treatment is in nature, but not in form, that of a lexicon, being a compilation which is intentionally incomplete, and practically devoid of critical observations and considerations of theory or method.

The work is divided into six sections—(1) fermentations accompanied by oxidation; fermentations yielding (2) lactic acid; (3) mucilage (*Schleim*); (4) butyric acid; (5) fermentation of cellulose; and (6) partly-unexplained fermentations. The fermented substances considered are practically entirely carbohydrates.

Of the 132 pages of text, sixty-one fall to lactic fermentation and, roughly, fifteen each to fermentations accompanied with oxidation, those yielding mucilage and butyric acid respectively, while that of cellulose receives seven.

The general mode of treatment in each section is enumeration of the more important organisms, with a short account of their characteristics, the subsidiary products of the fermentations and substances other than the specific one fermented by the organisms.

In the sections on lactic and butyric fermentations, two acceptable tables occur. These are divided into sections according with the compound fermented. Each section is divided into three columns, giving respectively the names of the organisms, the subsidiary products and the names of the authors responsible for the statements. In the case of lactic fermentations, the photogyric nature of the resulting acids is given.

The economic aspect of lactic fermentations is considered somewhat briefly, but comprehensively. The section devoted to partly-explained fermentations is practically only an enumeration.

The author constantly uses the word fungus (*Pilz*) as equivalent with Schizomycete, a fault that is botanically inexcusable. He also states that respiratory processes, in which small amounts of sugars are decomposed with production of natural gases, are to be strictly separated from fermentation. This is physiologically erroneous.

Seven photographic plates occur at the end. The figures are, on the average, good, although the focus of some is not perfect. The book will be useful to all who desire a partial summary of recent work on this subject within a small scope. F. ESCOMBE.

Das Motor-Zweirad und seine Behandlung. By Wolfgang Vogel. Pp. vii + 154. (Berlin: Gustav Schmidt, 1902.)

A NOTICE of Herr Vogel's "Schule des Automobilfahrers" appeared in NATURE of July 31, 1902 (vol. lxvi. p. 313), and reference was made in it to the motor cycle. In the little manual before us, the same author describes concisely the theory and action of the motor bicycle, and provides in text and illustration just the kind of information which the motorist will find of service. To readers familiar with German, the book will give many useful particulars on the construction of the machine and hints on its care and use.

A Course of Simple Experiments in Magnetism and Electricity. By A. E. Munby, M.A. Pp. xvi + 90. (London: Macmillan and Co., Ltd., 1903.) Price 1s. 6d.

THE careful instructions for the eighty-five experiments contained in this little book, together with the useful hints for the construction of apparatus, should serve very well to introduce young pupils to the practical study of magnetism and electricity. The author gives just enough guidance in the form of statements and suggestive questions to ensure that the experiments will be performed intelligently.

LETTERS TO THE EDITOR.

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

The Holy Shroud of Turin.

WHILE thoroughly agreeing with Prof. Meldola's remarks regarding Dr. Paul Vignon's *étude scientifique* of the remarkable relic known as the Holy Shroud, reviewed at p. 241 of the current volume, there are a few points which he has not enlarged upon, but which may possibly deserve attention and show how largely imaginary and unsupported by the records Dr. Vignon's theory is. No valid determination of the nature of the impressions or of the manner in which they have been produced can, of course, be made without a critical examination of the relic itself, so that any arguments based upon mere assumptions must be purely hypothetical.

First, as regards the possibility of the negative impressions being produced by painting or some analogous method. Dr. Vignon rejects this absolutely on the ground that no one in the Middle Ages had the knowledge for producing them by handicraft, the difficulty of producing a negative picture pictorially or of painting on linen with gum or albumen as media without the colour flaking off, while the linen is too supple to have been painted in oil. If he had consulted the early treatises on painting, some of them dating from long before the fourteenth century and handing down processes derived from ancient Greek art, he would have found descriptions of methods of tracing and transferring pictures which might have modified his opinion. For instance, in Didron's "Manuel d'Iconographie Chrétienne," which contains a translation of a treatise on painting founded on the teaching of the twelfth-century painter Manuel Panselinos, of Thessalonica, we find (p. 15) that the practice of making tracings from pictures for copying purposes was common, and again (p. 17), the opening chapter of the treatise is devoted to this subject, and a method is described of taking a coloured transfer impression on paper from any kind of painting, whether on oiled paper, panel or fresco. It was sufficient to paint in the general outlines, the rest being filled in afterwards. This, at any rate, shows that the early painters of the Middle Ages had sufficient knowledge of technique to produce reversed impressions from paintings, and it seems not unlikely that the impressions on the Turin relic were produced by some method of this kind from an original positive painting. Various traditional methods of tracing pictures may be found in Mrs. Herringham's recent translation of Cenneno Cennini's "Trattato della Pittura" (1437) and in Mrs. Merrifield's collection of "Original Treatises dating from the Twelfth to the Eighteenth Centuries on the Arts of Painting." In the latter work, we also find mention of myrrh and aloes being used as ingredients in oil or spirit varnishes and lacquers, while aloes seems to have been used alone as a yellow glazing pigment analogous to our "brown pink." Caballine aloes is recommended by Leonardo da Vinci for improving the colour of verdigris or for use by itself. Should aloes be actually present in the impressions on the relic, as Dr. Vignon believes, though there is no evidence of it, the fact of its being used in the above manner may offer an explanation. In the above treatises also, there are several references to methods of painting on linen with yolk of egg, thin size and other media in such a way that the cloth would bear folding without injury to the colours or gilding, so that this objection disappears. Chifflet (p. 198) mentions the use of a spirituous tincture of cloves and cinnamon in depicting Phillip II. of Spain in his shroud (*lintes*).

A far more important point against his theory, which has been quite overlooked by Dr. Vignon, is that the best modern authorities seem to be agreed that the "aloes" mentioned in the Bible is not to be confounded with the ordinary medicinal drug, but is the perfume known as "lign-aloes" (Hebrew, *Ahalim*), or the resinous wood of *Aquilaria Agallocha*, which grows in India and other parts of the East (Hanbury, "Scient. Papers," p. 263). The better qualities of this wood have a fine perfume when shredded, and it seems to have been used in that state mixed with myrrh and spices. It is mentioned by J. B. Porta in the *Magia Naturalis* as a perfume. Pingone, in his history of this relic ("Sindon Evangelica," p. 22), in a hymn dated 1562, alludes to myrrh and *fragrant* aloes brought from India and Arabia, the former being an essentially Arabian product. If this or a similar resinous perfume is really referred to by St. John, the only evangelist who mentions aloes, Dr. Vignon's theory at once falls to the ground, because he distinctly alludes to the drug which contains aloin and aloetin and is darkened by the action of ammonia, while, so far as I have been able to ascertain from specimens of the wood and resin of *Aquilaria Agallocha*, from Assam, ammonia produces only a very slight coloration of their tinctures or of linen soaked in them; and as either the wood or the resin would no doubt have been used in the dry state, any slight darkening of their solutions by ammonia would not affect the question of production of the images on the relic. Dr. Vignon assumes that the myrrh and aloes were mixed with olive oil, but there is nothing in the sacred records to that effect. If any such oily mixture were used, the relic could not fail to still bear traces of it and be strongly discoloured all over, regarding which nothing is said by those who have seen it, nor is it so shown in the photographs.

We now come to the "vaporographic" images, and it must be distinctly noted that while putting forward this theory as absolutely explaining and authenticating the impressions on the relic, Dr. Vignon has produced no shred of definite proof in support of it beyond the very partial success of a rough experiment with a plaster of Paris cast moistened with ammonium carbonate, and two failures, together with the opinions of certain eminent physiologists as to the possible decomposition of the excess of urea present in morbid sweats producing ammoniacal fumes, by the action of which on the aloes in the linen he claims that such impressions could have been produced in gradation according to the law of distances.

I have made several experiments on the lines indicated by Dr. Vignon with moulded figures made of flour paste and gelatine mixed with dilute solution of ammonia, so as to act on fine linen cloths soaked in various preparations of Barbadoes, or, by preference, Socotrine aloes, but in no case have I been able to obtain the semblance of a clearly *shaded* image, of parts close to the cloth or within the limit of distance of 1 cm. given by Dr. Vignon. There has always been diffusion, as must necessarily occur by the accumulation of vapour under the cloth, and an entire absence of any delineation, though in some cases there has been an increased darkening of the cloth immediately above the highest parts of the object. If this is the case with dilute ammonia, it is not likely to be otherwise with any product of the decomposition of urea from morbid secretions, but this is a question for pathologists. The most sensitive surface tried was prepared with a mixture of myrrh and Socotrine aloes rubbed up with cedar-wood oil—the latter substance being sometimes used in funeral ceremonies in the East. On one cloth prepared in this way, there is just an indication of a face, which was very roughly moulded in flour paste mixed with ammonia, and a certain amount of vaporographic action, but with no gradation or detail as is shown in the photographs of the relic.

So far as my experiments have gone, I feel almost convinced that if a body were *wrapped* or *wound* in a linen cloth, under the conditions stated in all the Gospels, it would be absolutely impossible for such a detailed impression as that shown on the relic to be produced in the manner suggested by Dr. Vignon, even supposing that medicinal aloes were used, as they sometimes were, like colocynth among the Egyptians, as a preventive against vermin. Bearing in mind, however, the bad record of the relic, remarkable as it is as a work of art, and the fact that it is not considered authentic by the authorities most qualified to judge, any further discussion of Dr. Vignon's theory seems of little importance apart from the possibility of "vaporographic portraits" being produced in the manner he has indicated, but by no means substantiated.

It is, I think, greatly to be regretted that Dr. Vignon should have brought forward his theory with such an array of quasi-scientific authority and argument based on so very slender a foundation.

J. WATERHOUSE, Maj.-General I.A.

January 23.

THE accompanying outline is a reduced photographic reproduction of my tracing from Signor Secondo Pia's positive photograph of the Holy Shroud, as referred to by Prof. Meldola (NATURE, pp. 241–243), and a glance at it is sufficient to show that the original is an inferior (much faded) mediæval

painting. The proportions are such as one sees in figures in certain stained-glass windows and in mediæval illuminations; observe the plane of the elbows and the strange disproportion in the entire arms. One can hardly imagine normal upper and lower arm bones fitting into the ill-drawn shapes into which I have sketched the bones. The radius and ulna of both arms, instead of being much shorter than the humerus, would, if inserted, be longer. If the left humerus of the figure is assumed to be correct in length as shown from A to B in my added black line, then the true length of the ulna should only reach from B to C, and not be half as long again as in the painting. On the other hand, if the length of the right ulna is considered correct as from D to E in my added black line, then the humerus would, in nature, reach from E to F—assuming the relative proportions of humerus and ulna to be 13 and 10½. It is quite within the bounds of possibility to name the painter of this strange figure.

The fold of the shroud is just over the top of the head, yet the painter was so incompetent to deceive that he made the two head-tops touch, like two hemispheres—as shown in the outline—whereas if the material had been folded over a head, a space of 6 inches would have been necessary for covering the neighbourhood of the junction of the coronal with the saggital suture. As painted, the shroud appears to have been folded over a piece of flat pasteboard.

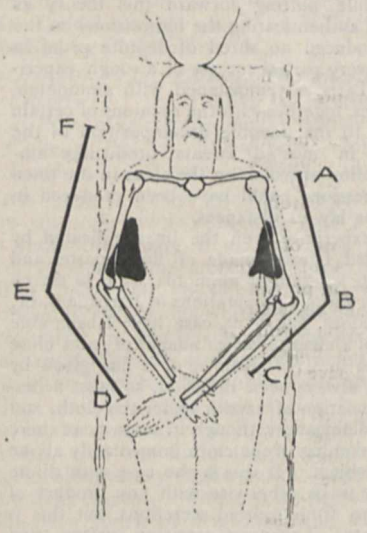


FIG. 1.—Reduced outline of figure on Holy Shroud with arm bones drawn in.

As for an artist—especially a mediæval one—being able to paint a picture in imitation of a negative, as suggested by Prof. Meldola, I have never heard of such a work, but if the painter of this picture had used an inferior white pigment as a body colour, as one of the compounds of carbonate or hydrate of lead, and heightened the light places with this white colour, all the whites by this time would have become black or nearly so, and the positive of mediæval times would be a present-day negative.

When I repainted Sowerby's models of fungi in the British Museum, all Sowerby's whites had become a leaden-black. One sees the same result of time with inferior whites in old coloured prints.

The triangular black patches in the outline are damages upon the shroud.

WORTHINGTON G. SMITH.

Dunstable.

The Theory of Laughter.

PROF. SULLY has given us in his latest work a model monograph on laughter.[1] With much charm and penetration, and in the light of a wide knowledge of the very extensive literature of the subject, he discusses the nature, causes and effects of laughter, its uses, its origin, its development and its future in the race and in the individual. He criticises the more important of the many theories of the ludicrous propounded by philosophers in all ages; he shows that each one of them fails to account for a considerable proportion of the many varieties of the ludicrous, and he concludes "that the impressions of the laughable cannot be reduced to one or two principles." While thus recognising the impossibility of bringing all kinds of laughter-causing things under one formula, Prof. Sully points to two causes of laughter which are closely allied and frequently cooperate, namely a sudden oncoming of gladness and a sudden release from constraint, and these he regards as the two principles most generally applicable to the explanation of the nature of the ludicrous. There is implied here and throughout the book the assumption that "the laugh . . . is in general an expression of a pleasurable state of feeling," an assumption which finds also explicit expression in several passages, *e.g.* "that outburst of gladness which we call laughter" and "laughter being primarily the expression of the fuller measure of the happy or gladsome state." It is assumed, in fact, that that which makes us laugh does so in general in virtue of its pleasing us, or, more shortly, that in general we laugh because we are pleased.

This assumption, which is implied in several of the older theories of the ludicrous, seems to be regarded as self-evident and in need of no justification, and yet it logically leads to some strange and startling conclusions. Thus we are led to infer that to a normal human being the sight of a man on crutches gladdens the eye (p. 89), that there exists a general tendency "to rejoice in the sight of what is degraded, base or contemptible" (p. 89), that very laughable and therefore, according to this theory, very pleasing things are exhibitions of vanity, hypocrisy, lying and deceit. Prof. Sully makes out the following list of twelve classes of laughable things, *i.e.* things the spectacle of which provokes laughter:—(1) Novelties, (2) physical deformities, (3) moral deformities and vices, (4) disorderliness, (5) small misfortunes, (6) indecencies, (7) pretences, (8) want of knowledge and skill, (9) the incongruous and absurd, (10) word-plays, (11) that which is the expression of a merry mood, (12) the outwitting or getting the better of a person. We may perhaps strike out from this list the eleventh class, because it cannot properly be said that we laugh *at* that which is the expression of a merry mood; we should rather say that it excites our laughter through the force of sympathy and imitation. And we may perhaps emend the definition of the twelfth class and say that what we laugh at is the spectacle of the man being outwitted or got the better of. Laughable things, then, fall into eleven classes, each one of which is for most men highly displeasing when the specific character of the class is strongly marked, but provokes laughter in most of us, when in certain moods, if its specific character is but slightly marked, though to many men (the age-lasts) the spectacle of any one of these things (with the possible exception of those of the first class) is at all times and in all degrees displeasing. And, in fact, well-nigh every instance of the ludicrous mentioned in the book is essentially displeasing in character, and even the laughter of the refined individual laugher, the humorist, is said to be fed on "the spectacle of folly, of make-believe and of self-inflation." Surely an unpleasing diet! It is significant, too, that laughter is not infrequently provoked by the sudden announcement of a death or by the description of some extremely horrible experience or series of events, as also by a severe blow on the shin, on the "funny-bone" or on other parts of the body, and by situations that excite an unpleasant state of "nerves" or "needle."

If, then, we rid ourselves of the assumption that laughter is the expression of pleasure, we shall admit that, while on the one hand the noble, the beautiful, the harmonious, the orderly and the sublime are pleasing but not laughable, on the other hand the mean, the ugly, the incongruous, the riotous and the ridiculous are displeasing, although in certain circumstances they may provoke laughter; we shall admit, in short, that the laughable or the ludicrous is essentially displeasing, apart from the laughter that it may provoke. We may put alongside this conclusion two other indisputable facts of great significance; firstly, the fact that laughter, if not excessive, produces beneficial physiological effects of an exhilarating nature, it produces "accelerated circulation and more complete oxygenation of the blood" and "a considerable increase of vital activity by way of heightened nervous stimulation"; secondly, the fact that laughter causes "a *dispersion* of the energies which for the maintenance of the attention ought to be concentrated. We are never less attentive during our waking life than at the moment of laughter."

We have, then, these three facts:—(1) The things we laugh at are in themselves displeasing, (2) laughter disperses our attention, (3) laughter produces a general increase of the vital activities. When thus brought together, these facts irresistibly suggest that we, being but imperfectly adapted to the world in which we live and therefore necessarily surrounded by the depressing spectacle of suffering, of disorder and of incongruities, and *sympathy* being inwrought in the very bases of our constitution, have been endowed by beneficent Nature with the

[1] "An Essay on Laughter." James Sully, M.A., LL.D. Pp. xvi+441. (London: Longmans, Green and Co., 1902.) Price 12*s.* 6*d.* net.

impulse to laugh at what is displeasing and painful in order that the automatically determined movements of laughter may disperse our attention, may prevent us attending to the displeasing spectacle and, by their stimulating effects, may counteract its depressing influence.

These facts suggest, in short, a theory of the ludicrous the exact converse of that which we may call the pleasure-theory; they suggest that we laugh at the ludicrous, not because it is pleasing, but because it is painful.

Such a theory may appear at first sight somewhat paradoxical, and yet as an explanatory principle it may perhaps go further and deeper than any other. The truth of it appears clearly in those cases in which we begin by disliking a thing and proceed to ridicule it, *i.e.* to display it in its ludicrous aspects. Prof. Sully appears as an apologist and advocate of laughter, and yet even he recognises that laughter is not all joy, as when he says of modern laughter "there is in it from the first ejaculation something of a biting sensation or something of a melancholy pain," and again, "the laughable spectacle commonly shows us in the background something regrettable"; and of its function as a vitaliser or stimulant that enables us to bear up against the ills that surround us he has no doubt. "Some hearts of many chords . . . might break but for the timely comings of the laughter-fay with her transforming wand."

In considering any theory of the ludicrous, we must sharply distinguish between "laughter-at" and that simplest, most charming and infectious kind of laughter which is the overflow of good spirits and is fully explained by Herbert Spencer's principle of the overflow of surplus nervous energy into the most open tracks. "Laughter-at" is, of course, often combined with other forms of laughter, and the accompanying mental state may be extremely complex, yet the spectacle of the displeasing seems to be its fundamental cause.

Just as in times and places in which the mass of men live under unnatural and depressing conditions the stimulating effects of alcohol are used not merely as a protection against cold, but are sought for their own sake, so the spectacle of the coarse and brutal comes to be sought for the sake of the stimulating effects of laughter, normally a protection against depressing mental influences; we have then the curious phenomenon of the crowd flocking to the circus and the pantomime (to have a good laugh, as they frequently say), where the staple source of laughter is the buffeting of the clowns, blows being apparently dealt which, if witnessed in real life, would make one-half the spectators feel sick and faint. We may note, too, how in the course of a football match a heavy fall or a violent collision between the players calls forth a roar of laughter from the crowd and so adds to the attractions of the spectacle.

The consideration of the laughter caused by tickling also points away from the "pleasure-theory" and supports the theory here suggested. There can be little doubt that the sensation of tickling is in itself distinctly unpleasant, both to the child and to the adult, even while the victim responds with loud laughter; the enjoyment of the situation by the child seems to be analogous to its enjoyment in being mildly frightened or in any other vivid and lively experience. And Prof. Sully himself tells us that "much, at least, of the later and more refined laughter is analogous to the effect of tickling."

It may seem at first sight that the view proposed is merely an application of, and involves the acceptance of, the Lange-James theory of the emotions, and that Prof. Sully has dealt with it in those pages in which he very properly rejects that theory; but this is by no means the case, for laughter is not an emotion, but a state of the physical organism (producing certain effects in consciousness) that may accompany almost any emotional state. If we accept the view here suggested, we may surmise that the laughter reaction has been developed as a necessary corrective of the effects of sympathy, for the power of sympathy is so great that in the absence of this corrective those spectacles, which meet us on every hand and which we call the ludicrous, might well destroy us.

In making this suggestion, it is not intended to deny the plurality of causes in most cases of "laughter-at," for, though the principle suggested may indicate the predominating factor in the case of the coarse laughter of low minds, in highly developed minds it becomes so overlaid with complicating factors as to be with difficulty distinguishable in many cases. If the principle suggested be regarded as inadmissible, the violence of the laughter-reaction must remain something of a mystery, for it is altogether disproportionate to the causes that are assigned to it. The acceptance of this theory would in no wise invalidate those theories of the social functions of laughter developed by Prof. Sully in a most interesting manner, but would rather strengthen them, because it would make clear the cause of the universal dislike to being laughed at, a point which for the pleasure-theory of laughter remains obscure.

W. McDOUGALL.

Insects and Petal-less Flowers.

PROF. PLATEAU, of the University of Ghent, has for many years carried on a series of important experiments concerning the ways of insects in visiting flowers. He contends that they are not attracted by the brilliant colours of the blossoms, but rather by the perception in some other way—probably by scent—that there is honey or pollen.

I have just received from Prof. Plateau an account of some of his most recent work, and it seems of sufficient interest and importance to lay before the readers of NATURE. His paper, "Les Pavots décorollés et les insectes Visiteurs," is a record of experiments carried on during 1901 and 1902 and published in the *Bulletins de l'Académie royale de Belgique*, November, 1902.

Flowers of *Papaver Orientale*, L., were deprived of their petals, and the number of insects visiting the remaining parts carefully noted and compared with the number of those visiting neighbouring intact flowers.

Now it seems evident that the question, Are insects attracted by the brilliant colours of flowers? should be decisively answered by such experiments. If they are thus attracted, then we should expect them to neglect these petal-less flowers while visiting the others. In removing the petals, Prof. Plateau took certain precautions. The unopened flower was carefully enclosed in a sort of cage, so as to preclude insect visits. When it expanded, the petals were carefully removed by means of a pair of scissors kept specially for this purpose. Great care was taken to avoid touching any of the remaining parts of the flower with the fingers. Prof. Plateau lays special stress on this, as he thinks that certain previous experiments of a similar nature have been vitiated by neglecting such a precaution. The experimenter in removing the corolla has left on the remaining parts the scent of human fingers. Its keen sense of smell enabling the insect to perceive this, it has consequently avoided the flower.

The poppy flowers thus carefully prepared were watched, and the number and kind of insects visiting them noted. At the same time, a number of intact flowers were similarly watched. Here are the results as summed up by Prof. Plateau:—

In the 30 petal-less flowers.	No. of visits.	In the 70 normal flowers.	No. of visits.
Apis mellifica ...	97	... ...	121
Megachile centuncularis	1	... ...	1
Osmia aurulenta ...	0	... ...	1
Halictus sexnotatus	19	... ...	18
Oxybelus uniglumis	14	... ...	29
Small unidentified Hymenoptera	0	... ...	1
Melanostoma mellina ...	4	... ...	0
Syrphus corollae ...	1	... ...	0
Telephorus lividus ...	1	... ...	1
Total	137		172

Or taking the average, each of the 30 petal-less flowers received 4·5 visits, each of the 70 normal flowers received 2·4 visits.

So great, indeed, appeared to be the attraction of these petal-less flowers that on many occasions Prof. Plateau has seen more than one bee in a single flower. Here are his figures on this point:—

	Times.
2 hive bees in same flower	9
3 ,, ,, ...	2
1 hive bee and 1 Halictus	2
2 hive bees and 1 Halictus	1
1 Halictus and 1 Oxybelus	1
2 Oxybelus	1

Insect visits to flowers which have naturally lost their petals are by no means uncommon. Darwin noted them in certain flowers. I have myself seen bees visiting flowers of *Geranium phaeum*, *Helianthemum vulgare*, *Rubus fruticosus* and *Salvia officinalis* which had lost their petals.

13 Vicarage Drive, Eastbourne. G. W. BULMAN.

A ROMANCE OF THE DEEP SEA.[1]

TO those of our readers who have followed our successive notices of the great work achieved by Dr. Alcock in the exploration of the Indian Seas, for which he has just been granted a Coronation honour, the present book, dedicated by the author to his shipmates, will be welcome; while to the general public it ought to be both interesting and instructive, if only by the nature of its contents and its literary style. It is divided into three parts; the first, of fourteen chapters, giving a popular account of the ship and the voyage, and of apparatus and methods employed; the second, of nine chapters, giving a popular account of the deep-sea fauna of the Indian region; the third, in the form of appendices, being a list of dredging stations and depths, and a complete record of the literature of the expedition as thus far published. The Andaman and Arabian Seas, and the Bay of Bengal, were the scene of action; and, in the intervals of dredging and surveying, land parties were daily put ashore to sound and erect survey marks, and were in some cases left there for a month at a time for tide-watching, shore-collecting and other congenial occupations. Among the islands visited were the Andamans (twice), the Laccadives and the Coco set. To Cardamum and Minnikoy a special chapter is given.

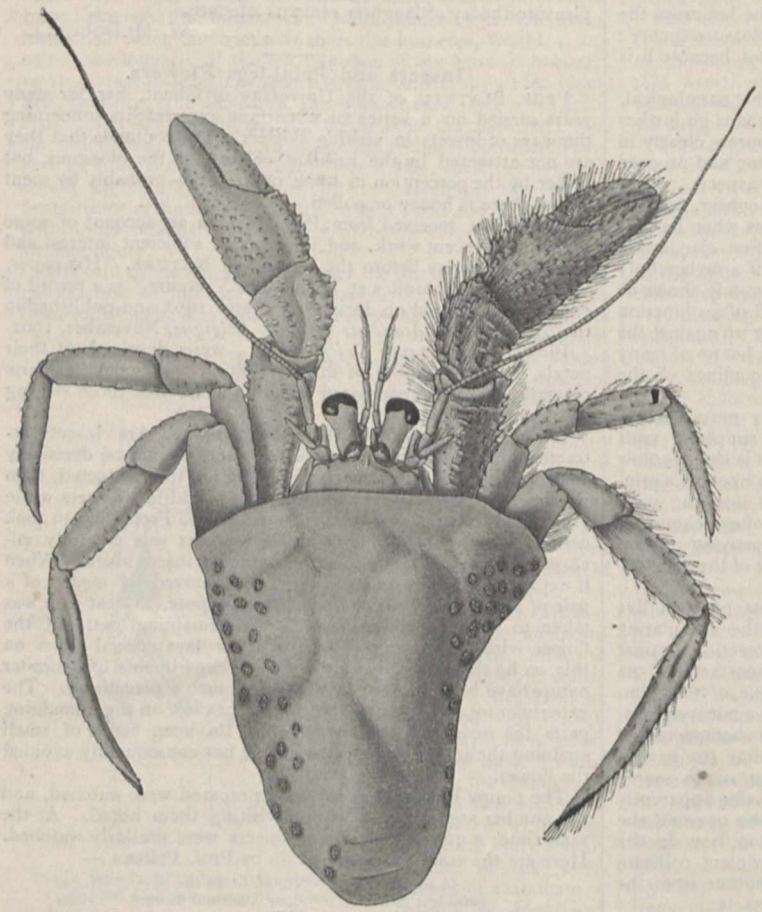


FIG. 1.—*Chlaenopagurus Andersoni*, with its protective blanket of sea anemones. (From Alcock's "Naturalist in the Indian Seas.")

The author pays a just tribute to the pioneer work of Davis and Baffin, to Drake, as the discoverer of the "Robber crab," and to the early labours of the Bombay Marine in 1832 and of the Marine Survey of India in 1874, which, under the stimulus arising out of the *Challenger* expedition, led to the adoption of modern standards and the now memorable series of voyages which will ever be associated with the author's name.

The earlier portion of the book, intentionally popular, is charming in its method. A walk across the bed of the ocean from Madras to the Andamans is idealised in a manner calculated to fascinate the reader and arouse an interest in marine research. The Globigerina ooze, depth and darkness, the essentials of coral reef structure and formation, and other allied topics, are graphically introduced, in terms as far as possible expressive of the author's first impressions and his enthusiasm thereby aroused.

Adaptation to life in deep water and colour variation and resemblance come conspicuously into consideration; and interesting to a degree are the descriptions of a series of hermit crabs, some so little modified as to remain lobster-like in appearance, but still given to the characteristic hiding habit. One of these creatures, from the Andamans at 185 fathoms, "bottles" itself in a piece of mangrove stem or a bamboo internode, filling it tightly, with its great claws so extended that their terminal joints, flexed, close the mouth of the tube as by a lid. Another (Chlænopagurus) from the Malabar coast effects the early attachment to its body of a compound anemone, which, extending with the growth of its host, forms a fleshy pallium bearing two lateral series of polyps. Holding the edge of this with its smaller pincers, the crab not only keeps it in place, but is enabled, as Dr. A. R. S. Anderson (who in the later days of the *Investigator* work dredged these two remarkable animals) has observed, to pull the pallium forwards the more completely to effect a covering for its head.

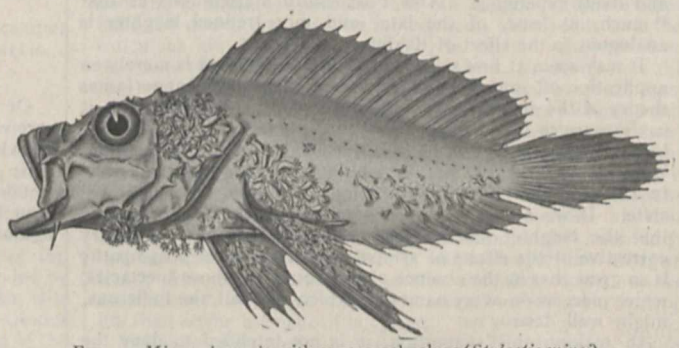


FIG. 2.—*Minous inermis*, with commensal polyps (*Stylactis minoi*). (From Alcock's "Naturalist in the Indian Seas.")

The work teems with charming topics of this order. Croaking crabs, milk-giving rays, luminous fishes and crustaceans are described, the latter as discharging a renal (green-gland) and para-oviducal secretion, and a sea-urchin has been observed which carried rice to its burrow for storage. Among the deep-sea fishes, of

[1] "A Naturalist in the Indian Seas; or, Four Years with the Royal Indian Marine Survey Ship *Investigator*." By A. Alcock, M.B., LL.D., F.R.S. Pp. xxiv + 318; 98 figs., tables and a map. (London: J. Murray, 1902.)

which some 169 species are recorded, the voracious habit of swallowing a prey several times its own size is extended to a powerfully dentigerous Scopeloid Odontostomus, living at 573–870 fathoms.

Most interesting among the fishes is a Scorpænoid (*Minous inermis*), trawled at 45-70 fathoms both N. and S. of the Bay of Bengal and in the Malabar Sea. It has a compound Hydroid (*Stylactis minoi*) living commensally about its branchial region, and of this creature we recall the fact that, in his original memoir upon it, the author tells us how, in the presence of two species of the genus Minous, it will select that after which he has now named it.

Numerous other fantasies are attractive features of the book, as, for example, certain stories of bird-life which have come within the experience of the author and his wife, which almost baffle comprehension. And as a noteworthy scientific fact, the author tells us that while his greatest haul was one at 188 fathoms in the Andaman Sea near the Cinque Islands, his successor, Dr. Anderson, obtained nothing on repeating it.

For those who love sensation and admire pluck, the story of the carrying away by a big shark of a drift-net, which with its sinkers weighed more than 450 lb., the two becoming involved "past all surgery," like that of the fate of the cork of a bottle of "Bass" when lowered to 439 fathoms, where the pressure is equal to two tons to the square inch, and, above all, of the loss of the cap of one of the lieutenants, while returning to the ship after the successful rescue of a gunner from the attentions of three man-eating sharks, are tales of the sea as instructive as they are exhilarating, which must be read to be appreciated.

Among the more important discoveries of the voyage emphasised in the book are those of a "solitary" coral (*Caryophyllia ambrosia*), and the giant ostracod Bathynomus and blind lobster *Phoberus caecus*, hitherto thought to be characteristic of the depths of the Gulf of Mexico; and there are endless other records little less important than these, as all familiar with Dr. Alcock's scientific memoirs may well imagine. The book is interesting and attractive from cover to cover, worthy its author's reputation as a naturalist and explorer; and we know of no popular work of the kind more trustworthy and at the same time better calculated to give the reader an insight into the nature and methods of marine investigation, and to arouse an interest in this charming pursuit and the quaint resources of the deep sea. It is one of the best natural history books published for some time, altogether admirable, and it cannot fail to be widely read and appreciated.

A TRAVELLER IN PATAGONIA.[1]

HUDSON, in his "Idle Days in Patagonia," says "It is not strange that the sweetest moment in any life, pleasant or dreary, should be when nature draws nearer to it, and, taking up her neglected instrument, plays a fragment of some ancient melody, long unheard on the earth." Perhaps in Patagonia, more than in any other part of the western continent, the traveller feels the touch of *aeons* of forgotten centuries. He finds himself in a strange, unfinished world. On the west, a belt of volcanic peaks, snow-crested and glacier-dotted, represents the last fiery effort of the Andes to divide the world into two fractions. Cradled in their ramifications lies an extensive system of great lakes of surpassing beauty—lake succeeding lake for a distance of 600 miles from north to south. On all sides are found ancient moraines and the remains of mountains which have been torn to fragments by volcanic action, and vast cañons and deep river beds through which streams have sometimes found their way to the Atlantic and then again to the Pacific Ocean, or *vice versâ*, according to the convulsions of nature. Between the Atlantic coast and this Andean belt rises terrace after terrace, representing one of the greatest Tertiary deposits known. The shingle- and basalt-covered plains are scored by violent rivers and deep, broad depressions. Everywhere are found evidences that the country has been several times submerged and raised. The plains are the home of the guanaco, the huemul, the puma, the American ostrich and countless varieties of the feathered tribe. Primitive man must have found here a rare hunting-ground. His numerous, sturdy descendants, a nomadic hunting race, without trace of agricultural life, presented a bold front to the Spanish *conquistador*. They had several tribal divisions; the Moluches, or warriors (called Araucanos by the Spaniards), occupied both sides of the Cordillera in Patagonia, and were subdivided into Pehuenches and Huilliches. The former extended to 35° south lat. and derived their name from *pehuen*, a pine tree, and *che*, meaning people. The Huilliches, or southern Moluches, had four subdivisions, and extended along the whole west side of Patagonia south to the Straits of Magellan. The Puelches, or eastern people, so-called by the Moluches, occupied the whole of Patagonia between the Atlantic Ocean and the Andes, but were split into several fractions; the most southern one was known as the Tehuelhets, but called themselves Tehuel-kunny, or southern men, generally known in early writings as Patagones, but in modern times writers have fallen into the error of calling them Tehuel-ches, applying the Araucano *che* instead of the Tehuel *het* to denote people.

All these tribes south of 36° south lat. were the scourge of the Viceroyalty of Buenos Ayres and incessantly raided the Spanish settlements as far north as the line of the present Central Argentine Railway, even as late as 1868. In 1845, they proposed to the Government of Buenos Ayres that the southern frontier of the province should be the River Salado, only eighty miles south of the city of Buenos Ayres. There is now but a remnant of them left.

Such is the country the interior of which Mr. Prichard traversed from the mouth of the River Chubut to Puerto Gallegos, covering about nine degrees of latitude, and such the "Tehuelches," the only indigenous tribe whom he met, from time to time, *en route*. His expedition was generously financed by Mr. Pearson, proprietor of the *Daily Express*, of London, with the hope of discovering a living specimen of the Giant Ground Sloth—the prehistoric Mylodon—a portion of the remains of one having been previously found, at Last Hope Inlet, by the well-known Argentine *savant*, Dr. F. P. Moreno. In his quest, Mr. Prichard was unsuccessful; and it recalls to mind that a King of Spain was also unable to obtain a live Megatherium which he had ordered a Buenos Ayrean Viceroy to obtain and send to him. But if Mr. Prichard could not bring a Mylodon to life, he has at least given a life colouring to Patagonia in his charming book. It is profusely and richly illustrated from photographs and maps drawn from the inexhaustible collection made by Dr. Moreno during his years of explorations there. After devoting a few interesting pages to the physical features of Patagonia, its discovery, and some mention of some of the travellers and writers who preceded him, Mr. Prichard takes us with him to the Welsh Patagonian settlement, at the mouth of the River Chubut, and tells us that "the older and younger generation are unlike each other now, and will probably continue to become more so as time goes on. Physically, the younger people are far better developed than their elders." The splendid climate is evidently destined to grow a superb race of men—such, in fact, as Pigafetta and others, of Magellan and Drake's

[1] "Through the Heart of Patagonia." By H. Hesketh Prichard. (London: William Heinemann, 1902.)

time, found round the margin of the country. Mr. Prichard says: "Although not giants, the Tehuelches are certainly one of the finest races in the world. Most of them average six feet, some attain to six feet four inches, or even more; and in all cases they are well built and well developed." . . . "Progress, the white man's shibboleth, has no meaning for the Patagonian. He is losing ground day by day in the wild, onward rush of mankind. Our ideas do not appeal to him. He has neither part nor lot in the feverish desires and ambitions that move us so strongly. As his forefathers were, so is he—content to live and die a human item with a moving home. . . . He is far too single-minded and too dignified to stoop to a cheap imitation."

Like many other travellers, Mr. Prichard appears to have initiated his explorations with much impedimenta, the care of which, for weeks, entailed a life of misery—eight men, sixty horses, two wagons with luxuries, and "drafts on Cook and Son" (not easily cashed at a Tehuelche bank) might have provoked some criticism from the army which San Martin marched across the Andes. But our author, be it said to his credit, soon redeemed himself and put his expedition into light marching order. In time, he might have got down to gaucho methods of travel, five horses to a man, a herd of horned cattle for food and nothing more, for months together.

A sportsman's veins must throb as he reads Mr. Prichard's volume, for it is one long tale of hunting exploits; but one must applaud the author for killing for food alone, and not for gratification of the love of slaughter. Of large game, the guanaco proved to be most abundant, but bird life was myriad. Altitude seems to make no difference to that representative of the camel species, the guanaco; he thrives equally at sea-level and, in great herds, at an elevation of from 10,000 to 13,000 feet among the Bolivian and Peruvian Andes, almost rivalling the condor in this respect.

Here and there, the author makes an interesting remark upon the effect of his surroundings on the mind: "The farther you penetrate into Patagonia, the more its vast emptiness weighs on you and overwhelms you. . . . Out there, in the heart of the country, you seem to stand alone with nothing nearer or more palpable than the wind, the fierce mirages and the limitless distances. A man accustomed to cities would here feel forlorn indeed. . . . Nature, with her large, loose grasp, enfolds you. There is no possibility of being mentally propped up by one's fellow man."

On reaching Lake Buenos Ayres, he found it "measured seventy-five miles in length; vast masses of milk-white timber, blanched by the influences of sun and water, and eloquent of the mountain land and forest whence they have been washed down, lie at the lip of the flood-level. . . . Around the lake lay piled the skulls and bones of dead game, guanaco and a few huemuels."

"There are many thousands of square miles of unexplored forest in Patagonia. It is a region unknown and mysterious, which has never been deeply penetrated by man owing to the practical absence of game on which he might subsist."

Mr. Prichard's book is replete with interest, and shows that he put himself into close touch with the region which he examined. His final chapter treats of the future of Patagonia, a large portion of which he believes suited to pastoral purposes. It is evident that the emigrant will soon destroy the varied and beautiful forms of animal life which nature has placed there, and substitute for them horses, sheep and other cattle—then Patagonia will be civilised.

G. E. CHURCH.

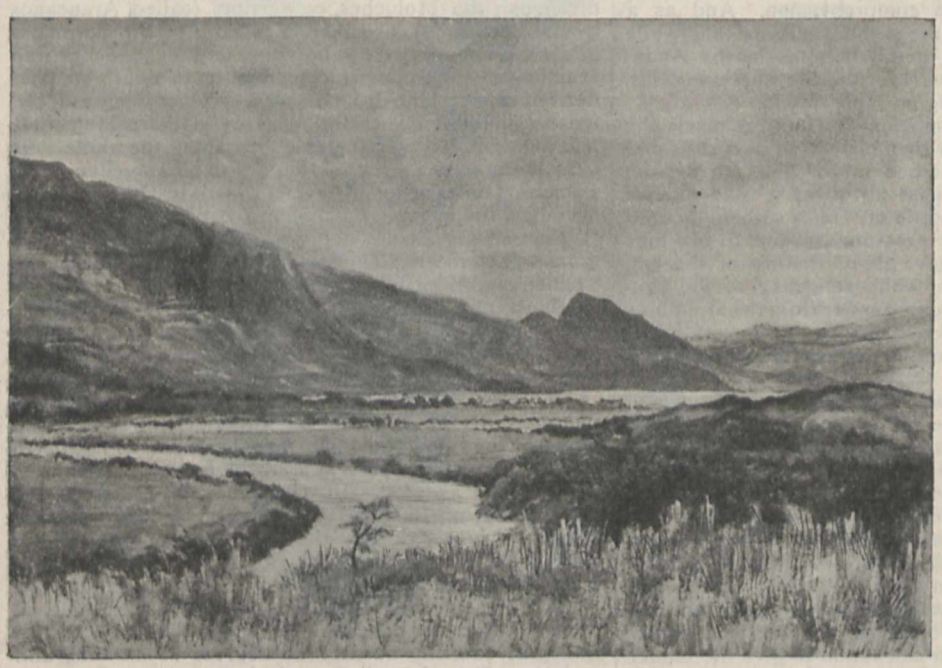


FIG. 1.—Cañadon of the River Katarina. (From Prichard's "Through the Heart of Patagonia.")

THE GEOGRAPHY OF NORTH-WEST EUROPE.[1]

IN this second volume on Europe in the new issue of Stanford's "Compendium," the chief place is given to the British Isles. Chapters on Belgium, the Netherlands, the Grand Duchy of Luxemburg, Scandinavia, Denmark and Iceland occupy about a quarter of the volume, and contain descriptions of the physical features of these countries, with brief references to the geology, and accounts of the climate, the agricultural, mining and other industries, the ethnology, and of the changes introduced by man, notably in the Netherlands. These subjects are necessarily dealt with far less fully than in the case of the British Isles.

The chief aim of the work is to show "how geographical conditions have affected the course of history." Hence it is needful to gather the lessons which geology teaches, and in dealing with our country the author

[1] "Stanford's Compendium of Geography and Travel" (new issue)—Europe. Vol. ii. The North-west. By G. G. Chisholm, M.A. Pp. xxviii + 742. (London: Edward Stanford, 1902.) Price 15s.

enters rather fully into the main geological and topographic features, and if his account is somewhat rambling, it has evidently been prepared with pains. Thus we learn how the geological formations have influenced the physical features, the mineral wealth and the soils, and have determined the development of industries and of population.

The reader, however, must be warned not to take everything he reads as sound geological doctrine. Thus (on p. 75), "It is estimated that in comparatively recent (post-Miocene) times the higher peaks of Britain were about 3000 feet higher than they are now above the present sea-level, and as the sea-level of these times relatively to this portion of the land was 3000 feet lower than it is now, the absolute elevation of those higher peaks must then have been about 9000–10,000 feet." There are probably few geologists who would support this statement.

Moreover (on p. 81), it is not right to say that in the lake district "the ancient stratified rocks of Cambrian or Silurian age" are extensively covered with volcanic deposits, the fact being that the Skiddaw slates are overlain by the Volcanic series of Borrowdale, which is an important member of the Lower Silurian or Ordovician system.

On p. 98, we read that the chalk with flints is for the most part "a lower zone than the chalk without flints," whereas the reverse is usually the case. The same remark applies to a paragraph on p. 116, wherein it is stated that "the difficulty of obtaining water retarded the spread of London northwards over the London Clay and Boulder-clay in the direction of Islington, Highbury, &c., until water was conveyed there by pipes, while sands and gravels in the north-west allowed of an early extension of the suburbs towards Hampstead."

As a matter of fact, Islington is on gravel, and although the old village of Hampstead is on Bagshot Sand, which locally yields springs, the large area of London Clay north and north-west of the Marylebone Road was long thinly populated in the districts now known as Camden Town, Kentish Town, St. John's Wood and Kilburn. In Middlesex, the Boulder-clay does not occur south of Finchley.

After the general geological account of England and Wales, a chapter of twenty pages is given to the volcanic phenomena of the British Isles, based on Sir Archibald Geikie's "Ancient Volcanoes of Great Britain," as duly acknowledged. Interesting as this subject is, it appears hardly to require separate treatment in a work intended as a "Compendium of Geography and Travel." Curiously enough, no mention is made of the Cuillin Hills of Skye, the roughest mountain group in Britain, and one which especially tempts the rock-climber.

We pass on to chapters having special reference to England and Wales, and dealing with the climate, rivers and lakes, and the inhabitants from Palæolithic times to the present day. There is only a brief reference to modern views on the origin of rivers, but we find much interesting matter of all sorts, with statistics where needful and references to authorities.

English agriculture, with an account of the open field system, mining and smelting, manufactures and commerce, and the political situation from "Domesday to 1800" are dealt with in separate chapters. Consequently we are led back again to early English and Roman times when reading of land customs and lead-mining; while coal-mining, dealt with briefly in earlier chapters, is also touched on as regards its history, and again dealt with from a statistical point of view in the subsequent chapter on the nineteenth century. A certain amount of repetition can hardly be avoided. The sites of villages as dependent on geological conditions, mainly on water-supply, are discussed briefly in the geological chapters. Later on, there is a chapter devoted to the chief towns. their history and growth. Thence we pass on to local, government, with which the account of England and Wales terminates. In this last chapter, it is interesting to read of the utilisation of Carrington Moss and Chat Moss for the town refuse of Manchester, and we believe that the value of the Carrington estate has been increased to the extent of 35,000*l*.

Scotland and Ireland are dealt with less fully, but the same general subjects are discussed, including Highlanders and Lowlanders, mineral products (with a mention of the many old bloomeries), Scottish agriculture, the growth of towns, &c. With reference to Ireland, there is a chapter on the Irish land question, the causes of Ireland's decay, and possibilities for the future. It is concluded that much may be done if hereditary sloth be shaken off and industrial knowledge be acquired.

Frith, photo.

FIG. 1.—Tintagel. (From Chisholm's "Europe.")

British dependencies in Europe, including the Isle of Man, the Channel Islands and Malta, are disposed of in five pages. The Orkney and Shetland Isles, though not mentioned in the index, are briefly referred to. St. Kilda is not noted. The index is not all that could be desired. Thus, no reference is given to coal, chalk, geology or Old Red Sandstone, while Weybourn Crag and Wadhurst Clay are indexed.

Despite the few criticisms we have ventured to make, we can commend the work as containing a very large amount of useful and interesting information, pleasantly written, on what may be termed the geographical history of north-western Europe, and of the British Islands in particular.

It is well printed, and illustrated with two geological

and fourteen other maps. There are also eighty-six text illustrations, mostly of towns and of striking physical features. By the courtesy of the publishers, we are enabled to give one of the illustrations.

BRITISH FORESTRY.

THE recommendations in the report which has just been issued by the committee appointed by the President of the Board of Agriculture "to inquire into and report upon British forestry" follow very much the trend of the opinions that have in recent years been expressed in NATURE and elsewhere. As was expected from the terms of the reference to the committee—"to consider whether any measures might with advantage be taken, either by the provision of further educational facilities or otherwise," to improve and encourage the "position and prospects of forestry"—the report deals chiefly with the root-matter of the forestry question—education. To such an extent is this the case that other elements of the forestry problem in Britain, such as the incidence of rates, the taxes upon timber transport, inequality in the levying of estate duty and the game question, are treated as minor considerations.

The report recognises the different classes requiring education in the country—landlords, land-agents and wood-foresters. In the forefront of the recommendations, the committee places the acquisition by the State of "two areas for practical demonstration," "one in England and the other in Scotland, of not less than 2000 acres, if possible, nor over 10,000 acres in each case," to furnish an object-lesson and to serve as areas of instruction for working foresters. They also recommend that forestry should be a subject of instruction at Oxford and Cambridge as it is at Edinburgh, and that example-plots of 100–200 acres in extent should be formed in the vicinity of these universities for the illustration of forestry teaching, and in this connection they also express the opinion that the forestry department of Coopers Hill should be transferred to a university centre. Forestry should also, they recommend, be a subject of study in the curricula of all agricultural colleges, and the teaching of forestry by county councils is recommended.

The whole tenour of the report is sound, although timidity and want of grasp might be indicated in several places, and it is satisfactory that the President of the Board of Agriculture has now in his hands a statement showing the main lines upon which, in the opinion of those who have given their attention to the subject, the forestry of this country may be improved. It remains to be seen whether any action will follow upon the report.

NOTES.

IT is with deep regret that we announce the death of Sir George Gabriel Stokes, Bart., F.R.S., at Cambridge on Sunday last, at eighty-three years of age. By direction of the president, the ordinary meeting of the Royal Society announced for to-day will, out of respect for his memory, not be held. We believe that representatives of all the scientific organisations with which Sir George Stokes was connected will attend he funeral at Cambridge to-day.

WE regret to see the announcement of the death of the Rev. Norman Macleod Ferrers, F.R.S., master of Gonville and Caius College, Cambridge, in his seventy-fourth year. Dr. Ferrers graduated in 1851 as senior wrangler and Smith's prizeman. He was the author of several mathematical treatises, including one on trilinear coordinates and another on spherical harmonics. He was appointed master of his college in 1880, and was elected a fellow of the Royal Society in 1877.

IT is reported that the Lick Observatory has received from the Carnegie Institution a grant of 800*l*.

THE annual meetings of the Institution of Naval Architects will be held on Wednesday, April 1, and the two following days at the Society of Arts, London, W.C. The Earl of Glasgow, president, will occupy the chair.

MR. HENRY PHIPPS, who is now travelling in India, has given Lord Curzon the sum of 2000*l*. to be devoted to an object of practical benefit or scientific research promising to be of enduring good to India.

THE *Times* correspondent at Rome states that on January 30 the Chamber of Deputies unanimously passed a vote of congratulation and thanks to Mr. Marconi for the great services he had rendered to the world and the glory he had won for his country, Italy.

THE annual meeting of the Society for the Protection of Birds will be held on Tuesday, February 10, at the Westminster Palace Hotel, Victoria Street, London, S.W. The chair will be taken at 3 p.m. by His Grace the Duke of Bedford, K.G.

IT was hoped that Gilbert White's house, "The Wakes," at Selborne, Hants, and the grounds of thirty acres, would be secured by the nation as a memorial to the famous naturalist. Announcement has, however, just been made that the property has been purchased by Mr. Andrew Pears.

THE International Congress of Historical Science will be held in Rome on April 2–9, 1903. Among the eight sections is one of history of the mathematical, physical, natural and medical sciences. Communications should be addressed to the secretary, Via del Collegio Romano, 26, Rome.

THE great electric generating plant at Niagara Falls was destroyed by fire on the night of January 30. The correspondent of the *Standard* says the fire was caused by lightning, which struck a cable with defective insulation. The short circuit thus caused resulted in the explosion of one of the big transformers in the electric power-house operated by the Falls.

ACCORDING to a Reuter message from St. Petersburg, the total number of deaths caused by the earthquake at Andijan on December 16 last was 10,000. Nearly every day, subterranean tremblings of varying intensity are still felt at Andijan; on January 19 and 20 there were violent shocks, and at Uzgent, some ninety kilometres to the east of Andijan, cracks appeared in the walls of the houses.

DR. HENRY WOODWARD, F.R.S., has been re-elected president of the Royal Microscopical Society. Two visits of members of the Society to the Natural History Museum, South Kensington, have been arranged. The first will be on February 14 at 2 p.m., and the party will be conducted by Dr. H. Woodward; the second visit will take place on March 14, when Mr. W. Carruthers, F.R.S., will act as conductor.

A REUTER message from Bologna announces that Prof. Tizzoni, who recently presented to the Royal Academy of Science a report containing the results obtained from the use of a serum which he has discovered for the cure of pneumonia, states that his discovery is, so far, of purely scientific interest. Prof. Tizzoni has obtained satisfactory results from experiments with the serum on animals. Experiments have been also made with the serum in a hospital at Rome with excellent results.

PROF. SIRODOT, whose death was announced in a recent number, was professor in the Faculty of Science at Rennes for many years. Referring to his contributions to science in an

address before the Paris Academy of Sciences, M. Bornet mentioned the important work which Prof. Sirodot published on the Lemaneaceæ, Chantransia and other genera of the Florideæ. Prof. Sirodot was the first to observe the sexual organs and method of fertilisation in Lemanea, and also established the fact that some of the fresh-water species of Chantransia represent merely stages in the life-history of Batrachospermum.

THE Department of Agriculture and Technical Instruction for Ireland has taken steps to place on view for a period of three months, at the Imperial Institute, London, the extensive collection of Irish minerals and building stones which formed one of its exhibits at the recent exhibition in Cork. The exhibit will embrace samples of the varied and excellent building materials and marbles in which Ireland is particularly rich, and it is expected that the opportunity of examining these samples will be of advantage to those who are concerned in the many large building schemes now in progress in London and elsewhere in Great Britain.

THE Berlin correspondent of the *Times* reports that an influential meeting, attended by experts in fire prevention and fire brigade work from all parts of Germany, was held on Monday, February 2, to decide as to the part to be taken by Germany in the impending international fire exhibition in London. It was decided that, under the direction of an influential executive committee, a large hall should be employed exclusively as the German section. Many gentlemen present expressed their intention to attend the International Fire Prevention Congress next July.

ACCORDING to a report by the French Minister at Mexico City published in the *Moniteur Officiel du Commerce* of January 22, the mineral prospectors sent to Mexico by American capitalists have for some time been directing their efforts towards the discovery of coal deposits. The first borings have led to the discovery at El Gallo, in the district of Mazas, of coal, of which the quality is said to be excellent. The French Minister adds that his private information confirms the announcement.

THE decimal division of time has been advocated for some years by writers in several French scientific periodicals. A Geneva correspondent of the *Globe* states that a number of manufacturers in the Neufchatel canton have already taken to the manufacture of clocks and watches on the decimal system. Chambers of commerce and other trade organisations are also supporting the change. The Cantonal Commercial Chamber at Chaux-le-Fonds has issued a notice calling for models, drawings and designs for appliances and "works" applicable to the decimal adjustment of clocks and watches with the least possible departure from forms now in use.

FATHER LOUIS FROC, director of the observatory at Zi-ka-wei, informs us that since the beginning of this year the noon time-ball at the port of Shanghai has been dropped 5 minutes 56·7 seconds later than previously, so as to bring the time into connection with the international zone system. The meridian adopted is the same as that used for time in the Philippines; it is sixteen hours from the Greenwich meridian and differs from Japan time by exactly an hour. Greenwich time will also be adopted by the Great Northern Telegraph Co. along the coast of China, and it is hoped it will be gradually accepted as the standard in the other open ports.

THE *British Medical Journal* says that during the annual meeting of the American Society of Naturalists recently held at Columbia University, Washington, Prof. William H. Welch, of the Johns Hopkins University, made a preliminary announcement as to an important addition to the list of such endowments. While he was not yet prepared to make the formal public announcement, he stated that within the near future a specially endowed institute or laboratory for research in scientific medicine would be founded in the United States. The institute would, he said, be in a general way similar to the Pasteur Institute of France, and would greatly facilitate and energise special research along lines that would be of incalculable benefit to humanity.

IT is reported that Mr. John D. Rockefeller has announced his intention of spending about 1,450,000*l.* on an institution at which research will be directed towards the discovery of a cure for consumption. The plans contemplate the immediate expenditure of the sum mentioned on a medical department of the University of Chicago, following on the annexation of the Rush Medical College. They involve an elaborate scheme for a great research hospital. Mr. Rockefeller has made it known to the trustees of the University that he wishes to assist the University to evolve men who will take up original research to find cures for stubborn diseases, particularly consumption. One entire division of the new medical department will be devoted to efforts to discover a tuberculosis serum.

REFERRING to the return of Lieuts. Matissen and Koltchak, members of Baron Toll's polar expedition, and nine men of the *Zaria's* crew, the *Westminster Gazette* states that the members of the expedition passed the second winter, 1901–2, in Nerpitchiei Bay, in the island of Kotelnyi, New Siberian group, where they lost one of their number, Dr. Walter. The party did not suffer from scurvy, and the great abundance of drift-wood furnished them with material for the construction of dwellings and for fuel, while the reindeer supplied them with fresh meat. Baron Toll, who, accompanied by M. Zebert, the astronomer, left the *Zaria* to explore the interior of Bennett Island, and M. Bialznitsky, the zoologist, who had gone on an expedition to New Siberia, did not return to the ship before her departure, and were left behind. No fears are, however, entertained for their safety.

REUTER'S agency says that the secretary of McGill University College, Montreal, writing to the Press, opposes the establishment of a wireless telegraphy station on Mount Royal in the following terms:—"The physical laboratories are continuously and extensively used for teaching the curriculum of the University, the subjects taught in them being not only an essential part of the University course, but also of fundamental necessity in training men for all branches of engineering and practical science. The operation on Mount Royal of a wireless telegraphy station would seriously impair the usefulness of the physical laboratories and would prevent the University from effectively carrying on in them the work for which they were especially designed and equipped."

AT the annual banquet on January 28 of the Chamber of Commerce of Newport, Mon., Mr. Gerald Balfour, in replying to the toast of "the President of the Board of Trade," made some observations on the recent demands for a Minister and Ministry of Commerce. Referring to the great increase in the staff of the Board of Trade, he said at present the staff amounted to nearly 600, and the first cause of the great augmentation since 1786 was, of course, the immense increase in the wealth and population of the country, and its world-wide activities caused by the introduction of railways, steamships and telegraphs into the apparatus of our civilisation. Another cause was the tendency in these days to throw more duties and responsibilities upon the executive departments of the State. He thought the chambers of commerce were right when they said that, having regard to the importance of the interests of

commerce in this country, these interests should be represented by a Minister and by a department whose rank and *status* corresponded to the importance of the interests with which the Minister and department were entrusted. He was not prepared to admit, however, that a reform of the Department of State entrusted with the interests of commerce should carry with it an entire revolution in the fiscal and industrial policy pursued by this country for the last two generations.

REFERRING to Dr. Charcot's proposed north polar expedition, mentioned in last week's NATURE (p. 303), the Paris correspondent of the *Times* says that the expedition, which is under the patronage of the French Academy of Sciences and, indeed, subsidised by that learned body, will include a scientific campaign in Iceland, Spitsbergen and Novaya Zemlya. One of its chief objects is to study the habits and, in general, the biology of the codfish. In the neighbourhood of Spitsbergen, the expedition will spend some time in the investigation of those ocean currents the influence of which is so important a factor in the determination of the climate of northern Europe. At Novaya Zemlya, it is hoped to fix with more precision the limits of the islands which have thus far been insufficiently mapped out upon the marine charts. Two zoologists are to accompany the expedition, as well as a geologist and naval officers, specialists in taking astronomical and meteorological observations. It is also probable that M. de Gerlache, the head of the Belgian Antarctic expedition, will assist Dr. Charcot.

THE changes which are being made this year in the publication of *Science Abstracts* will increase the sphere of usefulness of that admirable periodical. Two separate sections will in future be published, dealing respectively with pure and applied branches of physical science. One section will embrace abstracts of papers on light, including photography; heat; sound; electricity and magnetism; chemical physics and electrochemistry; general physics; meteorology and terrestrial physics; and physical astronomy. The abstracts in the other section will refer to steam plant; gas and oil engines; automobiles; oil engine driven ships and launches; balloons and airships; general electrical engineering, including industrial electrochemistry, electric generators, motors and transformers; electrical distribution, traction and lighting; and telegraphy and telephony. The subscription prices will be eighteen shillings or four and a half dollars for each section separately, including index: for the two sections thirty shillings or seven and a half dollars. The American Physical Society is now joined with the Institution of Electrical Engineers and the Physical Society of London in the direction of the publication, and has elected Prof. E. H. Hall, of the Harvard University, as its representative on the publishing committee. In consequence of this arrangement, the physics section will in future be received by all members of the American Physical Society. The American Institute of Electrical Engineers is also cooperating with the committee and taking special means to bring the publication to the notice of all its members.

NEWSPAPER up-to-date science has of late undergone rapid developments, and now the buyer of a halfpenny paper expects to be regaled, not only with politics and general news, but to have laid before him in very succinct form all scientific results that are expected to have any immediate practical bearing. There is occasionally, we regret to say, an ulterior object in these abstracts, and the expert can often detect the cloven hoof of advertisement for either author or remedy, although this in many cases is ingeniously disguised. The last of this class of jotting dealt with the fact that a dog's life could be maintained for several hours after decapitation by means of the perfusion of a solution of adrenalin or suprarenal extract, and artificial respiration. The only thing new in this somewhat startling announcement is the substitution of the animal's blood by a solution containing the adrenalin. That life can continue after division of the spinal cord at its junction with the brain, and that the ordinary blood pressure can be maintained by many agents, physical and pharmacodynamic, is, of course, no new fact. Recently the power of duly oxygenated saline solutions to maintain the activity of the mammalian heart for hours has been clearly demonstrated, as indeed has also the vaso-constrictor and hence blood pressure raising power of adrenalin. Whether the alleged life restorer was the adrenalin or the saline is not clear to the public, but to the man of science the latter is more important than the former.

WE have received from Prof. F. H. Bigelow a set of reprints of his articles that have appeared in the U.S. *Monthly Weather Review* from January–July, 1902, on "Studies on the Statics and Kinematics of the Atmosphere in the United States," many of which have been previously referred to in this Journal. These reprints are seven in number, and are on the following subjects:—A new barometric system for the United States, Canada and the West Indies; method of observing and discussing the motions of the atmosphere; the observed circulation of the atmosphere in the high and low areas; review of Ferrel's and Oberbeck's theories of the local and general circulations; relations between the general circulation and the cyclones and anti-cyclones; certain mathematical formulæ useful in meteorological discussions; and, lastly, a contribution to cosmical meteorology.

THE rainfall of Madras has often been investigated as regards its relationship to the sun-spot curve, and the first indication of a probable periodicity with sun-spots was pointed out by Sir Norman Lockyer in 1872 and later by Dr. Hunter, in 1877. Both showed that the rainfall was generally greater at the times of sun-spot maxima than at those of minima. In a recent number of the United States *Monthly Weather Review* (vol. xxx. No. 9, September, 1902), Mr. M. B. Subha Rao, of the Madras Observatory, contributes an article on "The Rainfall in the City of Madras and the Frequency of Sun-spots." The author first investigates the connection between the temperature and rainfall of Madras, but comes to no very definite conclusion on this point. Dealing with the variation of the rainfall and the sun-spot curve from the year 1811, he is led to deduce that the minimum rain "occurs almost exactly on the year of minimum frequency of sun-spots, the difference being only a year in a few cases." He finds, further, that the "maximum rainfall also takes place when we have the maximum frequency of sun-spots," but he guardedly adds that the difference amounts sometimes to two or three years. Anyone who has examined the figures representing the rainfall of Madras will have noticed that there is a general trend towards an eleven-year variation; there is, however, a much shorter and more prominent period of variation, which has recently been shown (Roy. Soc. *Proc.*, vol. lxx. p. 503) to be very closely connected, not only with the variation of atmospheric pressure from year to year, but with the variation of the percentage frequency of prominences seen on the sun's limb. That this is so is strengthened by the fact of the great similarity, on the whole, of curves representing, not only the rainfall of Madras, but those of Malabar, the Western Ghats and Ceylon, and the Indian pressures.

WE have received from Dr. Hergesell a preliminary report upon the international balloon ascents of October 2 and November 6, 1902. The countries which cooperated in these interesting researches were Austria, France, Germany, Italy (for the first time), Russia, Spain, Switzerland and the United States (Blue Hill Observatory). In October, nearly all the

ascents were made in an area of low barometric pressure. The highest altitudes attained by unmanned balloons were :—Strassburg, 13,700 metres, minimum temperature −51°·6 C. (on the ground 5°·2); Berlin, temperature at starting 4°, at 13,930 metres −25°·0, but the minimum temperature, −44°·2, was recorded at an altitude of 9214 metres. On November 6, an altitude of 15,612 metres was reached at Chalais-Meudon, minimum temperature recorded −55°·2 (on the ground 11°); Strassburg, 11,300 metres, minimum −53°·4, temperature at starting −3°·6; Berlin, 12,985 metres, −52°·6 (on the ground 1°·2). During these ascents, an area of high barometric pressure lay over N.E. and E. Europe, and extended nearly to the western coasts.

THE yearbook of the Meteorological Observatory of Agram for the year 1901 has been received. This is the first volume issued under the new service for Croatia and Slavonia, which is now placed under the superintendence of Dr. Mohorovićié, director of the observatory. Observations for Agram and two other stations were first published in the Austrian yearbook for 1853, and from 1871 by the Hungarian meteorological service. Under the new *régime*, the number of stations which already existed has been considerably increased, and much advantage will necessarily accrue from the fact that greater uniformity will be introduced by the centralisation of the stations under one authority instead of being dependent on at least three local organisations. The publication of the observations is carried out according to the usual international scheme, but the large-folio shape of the work is somewhat inconvenient for library shelves.

MR. C. E. STROMEYER has exhibited to the Manchester Literary and Philosophical Society samples of boiler scale which show excrescences having a striking resemblance to volcanic cones (Fig. 1). Mr. Stromeyer endeavours to show that the formation of these cones is due to unequal heating of the boiler

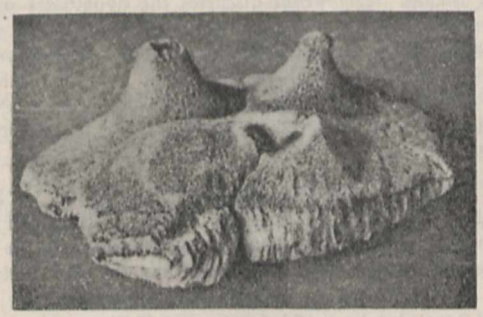


FIG. 1.—Miniature Volcanoes in Boiler Scale.

scale when varying in thickness. He suggests that a similar action may account for the formation of volcanoes and their position near ocean shores. For his arguments upon this subject, we must refer to the *Proceedings* of the Manchester Literary and Philosophical Society for October 21, 1902.

WE have received from Mr. C. T. Whitmell a small brochure entitled "Velocities, Paths and Eclipses in the Solar System," being a paper read before the Leeds Astronomical Society. There is nothing, perhaps, new in the paper, but much that can instruct and interest. We could have wished, however, that the author had been a little clearer in the use of his units. For instance, on p. 2, where a mass of velocities in miles per sidereal hour are given, there is nothing to indicate this, but of course it is readily inferred. The paths of satellites about their respective primaries are very well illustrated, and are especially interesting as showing some of the curves in which our satellite must have moved from the time of its separate existence near the surface of the earth to its present position, and will assume in its possible subsequent career. In the last section of total eclipses, the author considers the cases in which total solar eclipses can be produced on the various planets of the solar system by the interposition of the various satellites. Here, of course, the data are somewhat doubtful, but we have the advantage of seeing in one table the main conditions of the problem.

AMONG other interesting papers in the last number of the *Journal* of the Quekett Microscopical Club, Mr. Wesché gives an account, with figures, of three male rotifers which have hitherto not been illustrated or described fully. He also describes a new mastaxed male, which has not yet been identified. The males have only been seen in about 20 per cent. of the known species of rotifers.

MAJOR RONALD ROSS'S report on malaria at Ismailia and Suez has been issued by the Liverpool School of Tropical Medicine. No larvæ of anopheles were detected in the freshwater canal and its branches, and Major Ross ascribes this to the presence of fish, which devour them. Numerous larvæ of anopheles were, however, found in the marshes connected with the natural waters round Ismailia. Major Ross considers that it should be an easy matter to abolish malaria in these districts by drainage of swamps and other measures.

COUNTING the red corpuscles of the blood is a tedious and trying process when great accuracy is aimed at. At the meeting of the Physiological Society on January 17, Dr. C. A. MacMunn showed several lantern slides illustrating how this can be done by photographing the blood, diluted to half or to one per cent., in the hæmocytometer of Thoma-Zeiss. Not only are the red corpuscles seen on the plate, but also all the ruling of the cell. The most suitable power of the microscope for this purpose was found to be a ⅔-inch objective and Zeiss eyepiece No. 4, with the 6-inch tube-length. About 350 small squares of the instrument are seen on the plate, and if we take, *e.g.*, an average of 7 per square for a dilution of 1 in 200, we have 2450 corpuscles on the plate. A second, a third or more drops can be photographed if necessary, and thus great accuracy can be attained. This method enables one to keep a permanent record of the blood counts, and enables the enumeration to be made at any time that may be convenient. It has numerous applications, obvious to anyone interested in the subject. Of course, the microscope and camera must be used in the vertical position.

REFERRING to the killing of trout by lightning mentioned in last week's issue (p. 304), a correspondent writes to record a similar incident which occurred at Cirencester several years ago. After a vivid flash of lightning, three young gold fish were found dead in their glass bowl near the window of a house. A house not far off was struck by the lightning at the time, and badly damaged.

MR. T. S. HALL, writing from the University of Melbourne, states that from the remarks of Captain G. E. H. Barrett-Hamilton in the British Museum Report on the *Southern Cross* collections, it appears that the Victorian record of the occurrence of the crab-eating seal has escaped notice. The skin and skeleton of one of these seals, a female, caught at Portland, Victoria, in January, 1894, have been on view for some years in the Victorian National Museum. The colour of the skin is a yellowish-white, and the length of the mounted skeleton is about 6 feet 9 inches from snout to tip of tail. A second specimen came ashore at St. Kilda, a suburb of Melbourne, in July, 1897. Its length was 7 feet 4 inches, and it was a pure glossy white. These two occurrences were recorded by Mr. Hall in the *Victorian Naturalist* for August, 1897. Berg's Argentine

record appeared about the same time as the capture of the second specimen. It will be noticed that the first specimen was taken in the height of the Australian summer and the second in the winter.

ATTENTION is directed by Dr. W. Innes, in vol. iv. No. 6 of the *Journal* of the Khedivial Agricultural Society, to the marked diminution which has taken place in the numbers of the more common species of birds met with in the neighbourhood of Cairo. The rock-dove, it is admitted, does an appreciable amount of damage to agricultural products, but the majority of species, and especially the birds of prey, are beneficial. In the last-named group, the diminution in numbers is very noticeable; but quite as serious is the almost total extermination of the cattle-egret, which a few years ago was common on wet lands, or might be seen following the plough in search of mole-crickets and larvæ. "This bird was so common in the past and did so much good that many travellers confounded it with the sacred ibis of ancient times. Although its flesh is poor, this bird has not escaped so-called sportsmen, who kill it simply for the sake of killing." If the birds are not speedily rehabilitated, resort to other and expensive means of destroying deleterious insects will be necessary. The writer urges the authorities to take such steps for bird protection as may seem most suitable without loss of time.

IN the December issue of the *Quarterly Journal of Microscopical Science*, Prof. J. G. Kerr continues his account of the development of the South American lung-fish (*Lepidosiren paradoxa*), treating in this instance of the skin and its derivatives. In a previous communication, the author has referred to the remarkable difference in the appearance of a young Lepidosiren by day and by night, the creature at a certain stage of development being of a deep brownish-black by daylight and quite colourless at night. This change of coloration is found to be associated with the withdrawal of the dendritic pseudopodia of the chromatophores. Attention is directed to the fact that the so-called "cement-organ" is developed from the deep layer of the epidermis, instead of, as in amphibians, from the superficial layer. In another communication to the same journal, Prof. W. A. Haswell describes a new species of cestode worm infesting the alimentary canal of the Port Jackson shark. It belongs to the group in which the "proglottides" are set free from the "strobila" long before full maturity has been reached, and only attain a stage corresponding to the "ripe proglottides" of an ordinary Tænia after having pursued an independent existence for some considerable time.

FURTHER observations on the habits of Hypopeltis, an insect which causes serious damage to the tea bushes, are recorded by Mr. E. E. Green, the entomologist at the Royal Botanic Gardens, Ceylon. There are two periods of inactivity, during January to March, a season of comparative drought, and again from June to August, the season of heavy rainfall. The present paper deals with observations made during the former period. Attempts were made to capture the insects by means of a powerful acetylene light, but failed, partly, perhaps, on account of their relative scarcity; the females when caught were found to contain a large number of eggs, but detailed examination of shoots and leaves showed that very few eggs had been deposited, and such as were found were mostly empty. The writer condemns the system of close plucking, whereby a brush-like formation of small shoots is produced which is particularly suited to the tastes of the Hypopeltis; he points out that systematic capture of the insects would be economical, and suggests an arrangement of cutting up the plantation into blocks, each block being screened off by a narrow belt of trees.

SHORT abstracts of the papers which were read at the International Conference on Plant Breeding and Hybridisation, held in New York last October, appear in the U.S. *Experiment Station Record*, published by the United States Department of Agriculture. The papers by Dr. Bateson and Mr. C. C. Hurst both deal with aspects of Mendel's laws. Allusion was made to the inconstancy of crosses, which often results in reversion, and the explanation was offered that this may be attributed to the crossing of species which are not constant in character. Prof. de Vries took for his subject "Artificial Atavism," defining atavism as the occasional restoration of an old type in a compound cross. The paper by Mr. M. Leichtlin, on some points essential to success in plant breeding, drew forth several remarks on the vitality of pollen, which may maintain its potency for months. Dr. D. Morris gave some account of the experiments which are being made in the West Indies to improve the sugar-cane, and mentioned that improvements have in some cases been obtained by making use of bud variations. The inconstancy of plants produced by crossing finds an excellent illustration in the experiments made by Dr. L. H. Bailey with pumpkins.

THE unique features of the flora and fauna of the Galapagos Islands have been well described by Darwin in the account which he gave of his visit during the voyage of the *Beagle*, and Sir W. J. Hooker remarked upon the similarity of the flora to that of the mainland. The most recent information on this subject appears in a memoir written by Mr. B. L. Robinson and published in the *Proceedings* of the American Academy of Arts and Sciences. Mr. Robinson has, with the aid of specialists, not only worked through the rich collection of plants brought back by the Hopkins-Stanford expedition, but has summarised the results of previous accounts and records. The present more extended knowledge still bears out the specialised nature of the Galapageian flora, which is related to that of the adjacent continent and yet distinguished by peculiar varieties, and which is characterised by discontinuity of species and forms even on adjacent islands. The writer discusses the hypotheses which have been advanced regarding the origin of these islands, and, basing his arguments on the limited possibility of seed transference from the mainland to the islands or from one island to the other, and also upon the opportunity for variation owing to specialised conditions, he is led to favour the theory of emergence.

THE attractive "Open-air Studies in Geology," by Prof. Grenville A. J. Cole, published by Messrs. Griffin and Co., Ltd., in 1895, have now reached a second edition. In the new issue, several changes have been made and the book will thus pursue its useful career with renewed vigour. A few new pictures have also been added.

BOTANICAL material of all kinds required for purposes of instruction has been supplied for some time by Messrs. J. Backhouse and Son, Ltd., York, and many teachers and students have availed themselves of this convenient means of obtaining specimens and preparations. The British Botanical Association has been formed to carry on and extend work of this kind, hitherto undertaken by Messrs. Backhouse. The managing director of the Association is Dr. A. H. Burtt, and the address is The Laboratories, Holgate, York.

A COPY of the third German edition of Prof. E. Mach's "Popular-wissenschaftliche Vorlesungen" has been received from the publisher, Herr J. A. Barth, Leipzig. Fortunately for students of science who do not read German easily, Prof. Mach's popular scientific lectures have been translated into English, and the third English edition contains substantially the same articles as those in the present volume. Students of

physics having but a slight knowledge of German could easily follow Prof. Mach's writings, and would gain both pleasure and profit by becoming acquainted with his many suggestive views.

AMONG scientific articles in the magazines for February, the following are noteworthy. In the *Fortnightly Review*, Mr. Maurice Maeterlinck writes of the beauty of field flowers in his usual charming style. Prof. R. A. Gregory contributes to the *Cornhill Magazine* a paper on the astronomy of the unseen, in which he describes the evidence which has been accumulated in recent years as to the existence of dark stars and other non-luminous matter in the stellar universe. The *Royal Magazine* contains an account, by Mr. W. M. Webb, of school gardens in connection with a number of English schools of different grades; the educational value of nature-study in the open air is accentuated in this essay. Mr. F. W. Stokes contributes to the *Century Magazine* an article on the Aurora Borealis, which is illustrated with four coloured plates reproduced from the author's own paintings.

THE additions to the Zoological Society's Gardens during the past week include a Fennec Fox (*Canis cerdo*) from North Africa, presented by Dixon Bey; a Mandrill (*Cynocephalus mormon*) from West Africa, presented by Mr. M. Vickers; a Buffon's Touracou (*Turacus buffoni*) from West Africa, presented by Mr. V. G. Gane; an Elate Hornbill (*Ceratogymna elata*) from West Africa, presented by Mr. Francis Hart; a Water Rail (*Rallus aquaticus*) British, presented by Lieut.-Colonel L. H. Irby; a Kinkajou (*Cercoleptes caudivolvulus*) from South America, a Great Wallaroo (*Macropus robustus*) from South Australia, deposited.

OUR ASTRONOMICAL COLUMN.

COMET 1903 *a* (GIACOBINI).—The following observations of this comet are reported in No. 3841 of the *Astronomische Nachrichten*:—

January 20, 6h. 54m. 12s., Göttingen, $\alpha = 22h.\ 58m.\ 4s.\cdot8$, $\delta = +2^\circ\ 30'\ 4''$. No nucleus.

January 21, 6h. 22m. 0s., Strasburg, R.A. = 22h. 59m. 51s., Dec. = $+\ 2^\circ\ 44'\ 8''$.

January 21, 7h. 9m. 30s., Heidelberg, R.A.(app.) = 22h. 59m. 52s.·4, Dec. = $+2^\circ\ 44'\ 38''$, mag. = 10·0.

January 22, 6h. 29m. 30s., Heidelberg, R.A.(app.) = 23h. 0m. 54s.·6, Dec. = $+2^\circ\ 58'\ 37''$.

RETURN OF PERRINE'S COMET, 1896 vii.—Herr Ristenpart has calculated the corrected elements and the ephemeris, given below, for the return of this comet during the present year.

T = April 26·6, 1903.

$$\left.\begin{aligned} L &= 35^\circ\ 50'\cdot84 \\ \pi &= 49\ \ 4\cdot02 \\ \Omega &= 242\ 20\cdot40 \\ i &= 15\ 41\cdot28 \end{aligned}\right\} 1903$$

$\log q = 0\cdot54313$

Ephemeris 12h. M.T. Berlin.

Date		α 1903·0 h. m.	δ 1903·0 ° ′	log *r*	log Δ	Brightness.
Feb. 6·5	...	22 5·9	− 1 27	0·1840	0·3856	0·22
,, 14·5	...	22 28·0	+ 0 21	0·1670	0·3780	0 25
,, 22·5	...	22 52·5	+ 2 17	0·1501	0·3703	0·28
March 2·5	...	23 17·4	+ 4 20	0·1337	0·3627	0·31
April 3·5	...	1 9·0	+12 47	0·0806	0·3385	0·44
May 5·5	...	3 12·7	+18 49	0·0690	0·3354	0·47

Unit brightness at time of discovery (*Astronomische Nachrichten*, No. 3841).

PHYSICAL CONSTITUTION OF JUPITER.—As chairman of the Mathematics and Astronomy Section of the American Association for the Advancement of Science, Prof. G. W. Hough read a paper on the above subject at the Washington meeting held on December 29.

After reviewing the history of the observations of Jovian phenomena, Prof. Hough gave a detailed account of his own observations, which date from 1879. All the measures made by him were micrometrical, and he strongly deprecates the making of mere visual observations wherever it is possible to use a micrometer. Details are given of his measurements of the change of latitude and the rotation period of the Great Red Spot, and the variations are illustrated by four curves which accompany the paper. From the fact that some spots have shorter periods than others, Prof. Hough deduces that the spots must exist at various heights in the planet's atmosphere.

Some observations of transits and eclipses of the satellites led to the deduction that the satellites have no inherent light of their own and that the planet is not hot enough to produce light.

Prof. Hough also draws some very interesting conclusions as to the density and general physical constitution of the planet, and the nature of the various markings seen projected on its surface, and these conclusions argue strongly against the theory that the markings—excepting the belts—are of the nature of clouds in the planet's atmosphere.

The complete address is published in *Science* for January 16.

OBSERVATIONS OF VARIABLE STARS.—Mr. A. Stanley Williams communicates his observations of thirteen recently discovered variables to No. 529 of the *Astronomical Journal*.

DEFINITION OF JUPITER'S MARKINGS. ACCELERATION IN THE MOTION OF THE GREAT RED SPOT.

THE study of Jovian markings has been rendered very difficult for European observers in recent years owing to the position of the planet far south of the equator. Telescopic definition has been rarely good, and the more delicate and diminutive of the surface features have usually been obliterated amid the turmoil of seething vapours in which the image has been involved. The effect of unsteady, confused definition is to smooth off objective irregularities and to produce momentary displacements and contortions, giving rise to false appearances which are sometimes considered real by imaginative or inexperienced observers. When the disc is affected by rushing vapours, the belts often appear as the only distinguishing marks on the planet, and they look even and spotless, so that the observer may readily conclude that Jovian phenomena are temporarily quiescent. But when the disc is outlined with livid sharpness and the details stand out boldly, as they often do in the comparative absence of atmospheric ebullition, the aspect of the planet seems to have been transformed, and a crowd of interesting features immediately present themselves for examination. On special occasions of this kind, it is possible to take between fifty and a hundred transit-times of well-defined marks in the course of a few hours.

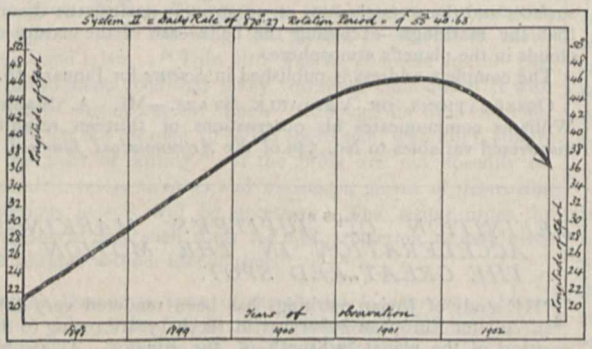
On July 11 and 13, 1902, Jupiter appeared in my 10-inch reflecting telescope under a power of 312, magnificently defined. The whole face of the planet seemed figured over with rugged detail. I saw many features on those nights which were not seen again, though repeatedly looked for with the utmost care. The belt scenery was very diversified, and it struck me as being totally dissimilar to the smooth indefiniteness commonly displayed under less suitable conditions. During the progress of my observations at Bristol in recent years, I have usually recorded the state of the seeing, and the following is a summary of the records for the last five oppositions of Jupiter:—

Observations of Jupiter, 1898–1902.

Opposition.	South declination of Jupiter.	Nights of observation.	Nights when seeing recordd	Definition. Very good.	Good.	Fair.	Bad.	Very bad.	Transit-times taken.
1898	° 1	51	41	5	8	11	11	6	280
1899	12	76	69	7	13	20	19	10	668
1900	20	36	30	2	7	9	8	4	307
1901	23	76	71	5	10	11	24	21	547
1902	18	89	81	6	14	15	31	15	1005
5 years	...	328	292	25	52	66	93	56	2807

The table shows that the "very good" and "good" nights, taken together, included little more than one-fourth of the aggregate number of observations during which the state of definition was recorded.

Though frequently marred by bad atmospheric conditions, a number of very interesting formations were visible on the planet in 1902. Perhaps the most noteworthy feature of the opposition was the very marked acceleration which occurred in the rate of motion of the great red spot. The longitude of this marking in April, 1902, was 46°, but early in January, 1903, it had declined to 37°, and the resulting mean rotation period during about eight months was 9h. 55m. 39s., or 3 seconds less than the period in 1899, when it was nearly 9h. 55m. 42s. The following diagram will exhibit the changes in the longitude of the spot during the last five years :—



The equatorial region of Jupiter was very brilliant during the past opposition, and the interval separating the dark belts on either side of it seemed filled with glowing material. The usual dark and white spots were distributed along the north side of the south equatorial belt, and the mean rotation period of these was found to be 9h. 50m. 26s. 7, or about 2½ seconds less than last year. The observations indicate that this equatorial current became rather suddenly accelerated towards the close of the opposition. It will therefore be rather important to determine its rate as early as possible in the ensuing spring, when Jupiter reappears in the morning sky. It will also be interesting to observe the position of the red spot in order to find whether the recent marked increase in its motion has been maintained.

W. F. DENNING.

SOCIETY FOR PSYCHICAL RESEARCH.

SIR OLIVER LODGE, in the course of his address before the Society for Psychical Research on Friday last, said that a few friends who desired to remain anonymous had started an endowment fund, amounting at present to 2000*l.*, in order to set the Society upon a sound and permanent basis, and in order to provide the material means of attacking the problems which the future might bring before them. As soon as a capital sum of 8000*l.* had been attained, it was proposed to offer a research scholarship in psychical science, to which a holder, irrespective of sex or nationality, might be appointed for one year and from year to year as might seem good, his or her time to be devoted to the work of psychical investigation. When practical benefits could be definitely foreseen, people felt justified in spending money even on science, though as a rule that and education were things on which they were specially economical.

And why should not psychical investigation lead to practical results? Were we satisfied with our treatment of criminals? Were we, as civilised people, content to grow a perennial class of habitual criminals and to keep them in check only by methods appropriate to savages—hunting them, flogging them, locking them up and exterminating them? Any savage race in the history of the world could do as much as that, and if they knew no better, they were bound to do it for their own protection. Society could not let its malefactors run wild any more than it could release its lunatics. Until it understood these things, it must lock them up; but the sooner it understood them the better. Force was no remedy; intelligent treatment was. Who could doubt but that a study of obscure mental facts would lead to a theory of the habitual criminal, to the tracing of his malady as surely as malaria had been traced to the mosquito? And, once we understood the evil, the remedy would follow. It was unwise and unscientific to leave prisoners merely to the discipline of warders and to the preaching of chaplains. That was not the way to attack a disease of the body politic. He had no full-blown treatment to suggest, but he foresaw that there would be one in the future. Society would not be content always to go on with these methods of barbarism; the resources of civilisation were not really exhausted, though for centuries they had appeared to be. The thing demanded careful study on the psychical side, and it would be a direct outcome of one aspect of their researches. The influence of the unconscious or subliminal self, the power of suggestion, the influence of one mind over another—these were not academic or scientific facts alone; they had a deep practical bearing, and sooner or later it must be put to the proof.

They sought to unravel the nature and hidden powers of man; and a fuller understanding of the attributes of humanity could not but have some influence on our theory of divinity itself. If any scientific society was worthy of encouragement and support, it should surely be that. If there was any object worthy the patient attention of humanity, it was surely these great and pressing problems of whence, what and whither that had occupied the attention of prophet and philosopher since time was. The discovery of a new star, or a marking in Mars, or of a new element, or a new extinct animal or plant was interesting. Surely the discovery of a new human faculty was interesting too? Already the discovery of telepathy constituted the first fruits of that society's work, and it had laid open the way to the discovery of much more. Their aim was nothing less than the investigation and better comprehension of human faculty, human personality and human destiny.

THE MEXICAN AXOLOTL.

WHEN I was in Mexico during the last summer, I naturally paid attention to the Axolotl question, a problem which in spite of, or perhaps because of, the various articles written on this subject has remained in a state of confusion. I am now able to make statements which will afford a solution.

In the normal course of events, Amblystoma spawns in the water and the larvæ metamorphose into the entirely lung-breathing, terrestrial creature which alone is sexually ripe.

A. tigrinum, the image of the Axolotl, has a wide distribution, ranging from New York to Colorado and to the valley of Mexico. Velasco,[1] received metamorphosing larvæ of the typical *A. tigrinum* from the little lake Santa Isabel, near Guadeloupe, about five miles north of the capital. There is no reasonable doubt that this species occurs in the perfect form in various other parts of the valley of Mexico, for instance, around Lake Zumpango. A sure sign of the approaching metamorphosis is the appearance of large yellow, irregular patches on the surface, which is at first uniformly dark. By some individuals, this adult coloration is assumed early, when the larvæ are less than half grown; in others it is delayed.

There are various places in Mexico and in the United States where not all the larvæ metamorphose. Some remain more or less uniformly dark, retain their gills and fins, but become sexually ripe. Such typical Axolotl occur side by side with metamorphosing and with metamorposed specimens. Examples :—The Natural History Museum at South Kensington possesses a gravid female, a big typical Axolotl from Anclan, Jalisco; from the same locality are four half-grown larvæ which have assumed the tiger spots, a sure sign of approaching metamorphosis. There are further, from St. Mary's Lake, Estes Park, Colorado, 7400 feet altitude, two full-grown perennibranchiate males in breeding condition and one big female. Lastly, from the Cumbre de los Arrastrados, Jalisco, 8500 feet, there are several young larvæ of the unmistakable spotted type, and one large male larva which is dark and spotless and with all the appearance of not going to change.

In a few favoured localities, none of the larvæ change into the complete Amblystoma, but propagate as permanent Axolotl. This applies to that clan of *Amblystoma tigrinum* which inhabits some of the lakes near Mexico City. It is well known

[1] *La Naturaleza*, vol. iv. (1879), pp. 209–233, pls. vii.–ix.; *cf.* also Spengel, who gives a much condensed *résumé* with remarks upon Velasco's paper, *Biolog. Centralblatt*, vol. ii. (1882), pp. 80–83.

that the offspring of these specimens can easily be induced to metamorphose, witness the European stock of Axolotl and Amblystoma, which all have descended from the classical specimens in the Jardin des Plantes.

Velasco's important announcement that regularly metamorphosing Amblystoma occur near the city of Mexico has become complicated by a more recent discovery. The numerous streams of the well-wooded mountain slopes which border the valley of Mexico to the west and south are inhabited by *A. altamirani*, a species very distinct from *A. tigrinum*. This *A. altamirani* metamorphoses regularly. It was described by Dugès.[1] Specimens seem to be very rare in collections, perhaps because nobody has taken the trouble of collecting any since Dugès. The types were found about fifteen miles to the west of the city, at an altitude of about 8800 feet, in the Montes de las Cruzes. On June 18, we went by the Mexican National Railway to the station Dos Rios, 8800 feet above sea-level, and fished out of the streams several dozen spotted larvæ of some three inches in length and several adult males and females in perfect Amblystoma condition. Towards the end of September, we again took some specimens from the same streams. The larvæ averaged perhaps half an inch more in length, otherwise there was no change visible. The adult Amblystomes were still in the water, one of them a beautiful, yellowish albino. On September 28, we went by the

FIG. 1.—Chinampas or "floating" gardens of Lake Xochimilco, June, 1902.

Cuernavaca Railway to the station of Contreras, altitude 8090 feet and in a bee-line about twelve miles south-south-west from the city. Following up various streams, we again found the newts, larvæ and adult, at an altitude from 8500 feet upwards to 8800 feet; further up, the rivulets were apparently too small. The creatures lived in the cool, rushing stream, preferring the sheltered side of large boulders, the larvæ working their gills vigorously, the adult motionless and never coming to the surface; all extremely shy and very quick. One of the specimens was full of nearly ripe eggs.

Searching in the streams only a little above the city, which lies at an altitude of about 7600 feet, was fruitless.

To return to *the* Axolotl, the permanent and sexually ripe larva of *A. tigrinum*. This is restricted to the Lakes Chalco and Xochimilco, to the south and south-east of the capital. No larval or adult specimens of any kind of newt occur in the Lago de Texcoco, the largest of the lakes. Its water is too brackish, and it was already quite undrinkable at the time of the conquest, when this lake extended to and surrounded the city. Its present mean level is six to seven feet below the zero of the town, from which it is about three miles distant. This lake is now silting up fast, since the marvellous drainage canal not only intercepts the dangerous spates of the western streams, but also drains the lake whenever its level rises a few feet. However such a low rise suffices for the lake to extend over many square miles of the neighbourhood, which during the dry period is covered with a white saline crust, interspersed with scanty grass, on which cattle and horses eke out a precarious existence. The lake is not quite dead; it contains several kinds of fish, only one of commercial value, and numerous waterfowl visit it in the late autumn.

Lakes Chalco and Xochimilco are a paradise, situated abou ten feet higher than the Texcoco Lake and separated from it by several hills. High mountains slope down to the southern shores, with a belt of fertile pastures, with shrubs and trees and little streams, here and there with rocks and ravines. In fact, there are thousands of inviting opportunities for newts to leave the lake if they wanted to do so. Close to the southern end of Lake Xochimilco, absolutely clear water wells up from the bottom, forming the famous *ojos de agua* or springs, which are thirty to forty and more feet in depth. Much of the lake, perhaps half of its surface, is filled with the celebrated *chinampas* or "floating gardens," *i.e.* many hundreds of islands surrounded by ever so many wide and narrow canals, here and there with a large stretch of water. Young little islands are still in process of formation, floating masses of entangled peat, rushes, moss and grass. Such floating clumps are caught, combined and anchored by stakes or long saplings of willows and poplars, which are driven into the muddy ground, where they soon take root. The fertile mud is ladled up from the bottom, heaped upon the float, which thereby is converted into an island proper, until a garden is produced in which are cultivated masses of all kinds of flowers, melons, pumpkins, gourds and all other produce, which is taken daily to the market through the Viga Canal right into the city. The larger islands are mostly surrounded by tall poplars, planted in rows along the edges, thus forming a firm boundary. Undue shade is prevented by lopping off the side branches. None of the islands is higher than a foot or two; some are now firm enough to support houses. The depth of the water averages perhaps five to ten feet, shallower towards the north-west, where the lake gradually changes into a swamp of rushes. The further away from the powerful springs, the muddier and darker appears the water, full of suspended fresh and decomposing vegetable matter, teeming with fish, larvæ of insects, Daphniæ, worms and Axolotl. These breed at the beginning of February. The native fishermen who punted us about in dug-outs through this paradise knew all about them; how the clusters of eggs were fastened to the water plants, how soon after the little larvæ swarmed about in thousands, how fast they grew, always remaining dark and never piebald or marbled with yellow, until by the month of June they were all grown into big, fat creatures ready for the market. Indeed, we could not get any small specimens in the month of June, when we paid our first visit. Later in the summer they take to the rushes, in the autumn they become scarce.

None has ever been known to leave the water or to metamorphose, in spite of Valasco's hearsay statement. But *axolotes sin aletas* (*i.e.* without winglets, meaning gills) are called *axolotes del cerro* (mountain-axolotl), or *axolotes sordos* (deaf, having no ears). However, none of these, many of which are undoubtedly *A. altamirani*, are found in the vicinity of the two lakes.

The reason why there are only perennibranchiate, permanent Axolotl in the lakes of Chalco and Xochimilco is obvious. The constant abundance of food, stable amount of water, innumerable hiding places in the mud, under the banks, amongst the reeds and roots, all these points are inducements or attractions so great that the creatures remain in their paradise and consequently retain all those larval features which are not directly connected with sexual maturity. There is nothing whatever to prevent them from leaving these lakes, but there is also nothing to induce them to do so. The same applies occasionally to European newts, of most of which we now know instances of sexually ripe "larvæ." Nevertheless, in the case of our Axolotls the latent tendency to metamorphose can still be revived. When once sexually ripe, the Axolotl are apparently incapable of changing, but that their ancestral *régime* is still latent in them, not quite forgotten, is shown by the metamorphosing offspring of Axolotl bred in Europe.

My explanation suggested itself during our visits to these lakes, which in every respect are so totally different from any other lakes, pools and rivers we have seen in that wonderful country. The only objection is that nobody has thought of this explanation before, but I do not know of any zoologist who has

[1] *La Naturaleza*, 2nd ser., vol. ii. (1896), p. 459.

studied the question on the spot, except de Saussure,[1] who was there some thirty years ago. He suggested that the swamps which extend between the water and the dry land prevented the creatures from gaining the latter and therefore from transforming. But thick rush-swamps fill only the north-western extent of the region. Then Weismann speculated upon the dismal condition of the salt-incrusted surroundings which were supposed to have hemmed in the Axolotl. This dream could apply only to Lake Texcoco, where there are none! The latest suggestion has been made by Herrera,[2] the professor of zoology in Mexico. He puts it categorically that the Axolotl cannot transform for want of food. Fancy the idea that overcrowding of the lakes, which are teeming with food, causes famine and at the same time produces big, oily, fat Axolotl!

The inducements to remain in the water, their birthplace, have become too strong for the larvæ to yield to their innate tendency of further development. Nothing is stunted in their bodies. On the contrary, they become to a certain extent overgrown, and the sexual organs, which anyhow in most terrestrial Urodela are active only during the temporary aquatic life, undergo their normal course of development and function. H. GADOW.

ISOMERIC CHANGE IN BENZENE DERIVATIVES.[3]

IN recent years, it has become realised that in many chemical reactions, isomeric changes—that is, the change of a given substance into another of identical composition, but possessing a different and under the conditions a more stable constitution—play an important part; thus, as is well known, from the salts of certain organic acids, the acid frequently cannot be obtained, but a neutral isomeride (the pseudo-acid) into which the acid changes is alone isolated. One very interesting instance of isomeric change is to be found in the process of substitution in certain benzene derivatives. As long ago as 1887, Armstrong suggested that the ready production of para-derivatives from amino- and hydroxy-aromatic compounds—anilines and phenols—was due to the formation initially of isomeric compounds in which the amino- or hydroxylic hydrogen was displaced by the substituting group. Since that date, these labile precursors (phenyl chloramines, nitramines, &c.) of the ordinary substitution products (chloro-, nitro-anilines, &c.) have been isolated in numerous cases. They can always be transformed into the stable isomeride, but this change seems to be conditioned by the presence of some other substance—the catalyst. As Armstrong has suggested, these isomeric changes are "fermentative" in character, often taking place with great facility and under the influence of minute amounts of the catalyst. Measurements of the velocity show that changes of this type are always apparently monomolecular (that is, each molecule changes *per se*); but such a result only proves that the slowest reaction is monomolecular and does not exclude the possibility of the simultaneous occurrence of other more rapid transformations, which form part of the complete change.

A most instructive example of isomeric change is found amongst diazobenzene derivatives. The diazobenzene salts are derived from the base, diazonium hydroxide, to which is now generally assigned the expression $Ph.N(OH)\equiv N$. On treatment with alkalis, this base is converted into the salts (diazotates) of an isomeric acid, to which the formula $Ph.N:N.OH$ is given. On attempting to isolate the acid from these salts, a neutral isomeric substance (the pseudo-acid) is obtained; this is probably a phenylnitrosamine, $Ph.NH.NO$. In this paper, the author describes a new case of intramolecular change of a remarkably interesting kind:—Chloro- and bromo-benzenediazonium hydroxides, $C_6H_2X_3.N(OH)\equiv N$, readily change into isomeric hydroxybenzene derivatives, $C_6H_2X_2(OH).NX\equiv N$, the hydroxyl group and one of the halogen atoms (an ortho-placed halogen atom) having exchanged positions. This change not only affords another illustration of the transference of a group from the side chain of an aromatic compound into the benzene nucleus, but further shows the tendency, which has been occasionally noticed, for an ammonium base to change into an isomeric substance of neutral character. Under all conditions, when it is possible for the diazonium hydroxide to be present, the wandering of the hydroxyl group takes place. Thus in dilute aqueous solution of such diazonium salts as the nitrate or the hydrogen sulphate, the small quantity of diazonium hydroxide which arises from hydrolytic dissociation undergoes this change. In the presence of excess of acid, there is no hydrolytic dissociation and consequently the isomeric change does not take place. In the case of the salt of a weak acid, as the acetate, where the hydrolytic dissociation is considerable, the rate of interchange of halogen for hydroxyl is greatly increased. In the naphthalene series, this intramolecular change occurs with even greater ease and rapidity than in the benzene series.

The elucidation of the nature of the process by which halogen is eliminated from diazobenzene compounds (a reaction first observed by Meldola in the naphthalene series) has rendered possible the removal of certain errors in the statements regarding the changes undergone by diazonium compounds. Thus Hantzsch has recently stated that *s*-tribromobenzenediazonium hydroxide, $C_6H_2Br_3.N(OH)\equiv N$, changes into the corresponding phenyl nitrosamine, $C_6H_2Br_3.NH.NO$, not realising that under the conditions (presence of acetic acid) an isomeric change has taken place, bromine being eliminated.

[1] *Verhandl. Schweizer naturforsch. Gesellsch. Einsiedeln* (1868), p. 89.
[2] *La Naturaleza*. 2nd ser., vol. iii. (May, 1900).
[3] Abstract of paper on "Isomeric Change in Benzene Derivatives—The Interchange of Halogen and Hydroxyl in Benzenediazonium Hydroxides." By Dr. K. J. P. Orton. Read before the Royal Society December 4, 1902.

A DAYLIGHT PHOTOMETER.

A "DAYLIGHT PHOTOMETER" described by Mr. A. H. Munsell, of Boston, Mass., is designed mainly for the comparison of the brightnesses of various coloured surfaces illuminated by daylight or artificial light. The instrument consists essentially of two "cat's-eye" shutters placed symmetrically towards a source of diffused light. Through one of these the light falls on the coloured surface to be tested, through the other upon a standard white surface. The second shutter is then gradually closed until the resulting grey produced on the white screen just matches the coloured surface in intensity, whilst a dial connected with this shutter shows, in percentage, how much darkening has been necessary to match the coloured surface under test. The instrument has also been applied to the testing of light transmitted through coloured media. Owing to the wide variation in the sources of light used, as well as in the colour perceptions of different observers, no degree of absoluteness can be attached to the readings. As Purkinje and Dove showed, the relative brightness of two differently coloured surfaces changes as the strength of the illuminating source is altered. But although the readings of the instrument must for these reasons be interpreted with great caution, the arrangement seems capable of supplying much interesting information on the variations of colour perception under different conditions. ALBERT CAMPBELL.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It was agreed by the senate on January 29, by a large number of *placets* to one *non-placet*, to appoint two additional demonstrators of human anatomy.

The funeral service for the late Master of Caius, Dr. N. M. Ferrers, F.R.S., took place privately in the college chapel yesterday, February 4. The public service for the late Sir G. G. Stokes, F.R.S., Master of Pembroke, is to be held in St. Mary's Church to-day, and will be attended by a large number of members and officers of the University and representatives of learned societies.

By the will of the late Mr. F. J. Quick, of Trinity Hall, the residue of his estate, valued at some 50,000*l.*, is placed in trust for the promotion of study and research in vegetable and animal biology. The University is to draw up a scheme for the administration of the trust, wherein it shall be provided that no office or appointment paid from the income of the fund shall be held by the same person for more than three years without being thrown open for a fresh election.

The election to the Lucasian professorship, vacant by the death of Sir G. G. Stokes, will take place at noon on February 28. The electors are the heads of colleges.

Miss I. Sollas, Newnham College, has been nominated to

occupy the University table at the Plymouth Marine Biological Laboratory.

Dr. W. N. Shaw, F.R.S., is to lecture on Thursdays during the present term on the physics of the ventilation of buildings. The lectures are given in the Cavendish Laboratory at 4.30 p.m.

The Arnold Gerstenberg studentship, value 90*l.* for two years, will be awarded in the Lent term, 1904. It is open to men and women who have obtained honours in the natural sciences tripos and propose to pursue philosophical study. The award will be made by means of essays on subjects set forth in the *University Reporter* (p. 431).

DR. G. N. STEWART, of Cleveland, U.S.A., has been offered and has accepted the professorship of physiology in the University of Chicago.

SPEAKING at a meeting of the Derbyshire Dairy Farmers' Association at Derby, on January 30, the Duke of Devonshire said he did not know what our educational system, as it had too generally been administered in the past, had done for the advantage of the farmers. They had seen it mainly from this point of view—that it had taken the best and brightest boys and girls from the country districts away to employment in the towns, and that it had done nothing to improve the character of the labour which was still left to them in the country. The education which the children received in rural districts might have been such as to fit the children for occupations in towns in various branches of industry, but it had not been such as to make a boy or a girl a better member of the agricultural community. What they wanted was, first, to form the character of the children, to make them honest, industrious, more reflecting and steadfast; and, next, to improve their intelligence so that they might be more capable of doing whatever class of work might fall to their lot in life in a better, more conscientious and intelligent manner. The village school which did not have this effect upon the children was not a school conducted as it ought to be. What was wanted for the children was not the cramming of them with facts, but teaching them something which might be applied to their daily life and might so interest them that they would prosecute its study after they left school and thus fit themselves more effectively for their daily labour, whether it were in the town or in the country. The training of their teachers had hitherto been too exclusively of a literary character, with, perhaps, a scientific smattering. It had not been directed to those subjects which related to agricultural life, to farming, dairying or the household.

IN proposing the toast of "The Mining and Metallurgical Industries," at the 30th annual dinner of the Royal School of Mines on Tuesday, the chairman, Mr. A. C. Claudet, referred to the steps that had been taken by the council of the Institution of Mining and Metallurgy with a view to effect the reorganisation of the Royal School of Mines. The *Times* reports Mr. Claudet to have said that, in the interests of the Empire no less than of the mining and metallurgical industries, prompt and far-reaching action was imperatively necessary if British-trained mining engineers and metallurgists were to hold their own in the future with foreign-trained engineers, and it was this conviction which led the council of the institution to take the matter in hand. Systems in force in America and elsewhere had been investigated, and the results communicated to the council of the college, with certain recommendations and the offer of material assistance in carrying them out. The matter was receiving the serious attention of the Board of Education, and the council of the institution had good grounds for feeling confident that comprehensive improvements would be effected at no distant date. It was believed that, if nothing unforeseen happened, British mining and metallurgical students would soon have facilities for training equal to the best in the world. The institution council proposed that a post-graduate course in practical work in mines and works at home or abroad should be established, and they had offered to give very material assistance in providing the necessary facilities for such a course on lines which they believed would be of the greatest possible benefit to British graduates. In connection with this post-graduate course the institution had presented scholarships to the Royal School of Mines, and to three or four other colleges as a beginning, and it was hoped that before long further scholarships and prizes would be available. The endowments and grants by Government in connection with mining and metallurgical training in this country were, as every one knew, ridiculously inadequate, and out of proportion to the vast interests involved—interests not merely local, but affecting the whole British Empire. However, there were many signs that the Government and other authorities were alive to the necessity of doing something promptly for this branch of education, and if they pressed their claims strongly and persistently he had no doubt at all that they would be met in a satisfactory manner. There was every reason to believe that their school would again occupy the position it once held, and ought still to hold—that of the premier mining school of the Empire, and second to none in the world.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 22.—"On the Electrodynamic and Thermal Relations of Energy of Magnetisation." By Dr. J. **Larmor**, Sec.R.S.

The main points which the author has sought to bring out in this paper are as follows:—

(1) In an electrodynamic field, there exists the usual specification of electrokinetic energy, but also *in addition* the energy of magnetisation of magnetic material.

(2) This energy of magnetisation appears as made up of a part given by the ordinary formula, which (when paramagnetic) is derived from thermal sources, and so in the absence of hysteresis has the limited mechanical availability of thermal energy, together with a local part which is to some extent thus available, but is also in part permanent intrinsic energy of the molecules, regarded temporarily as magnetic energy.

(3) The law of Curie, that the susceptibility of weak paramagnetic substances is inversely proportional to the absolute temperature, is involved in these statements.

(4) The extent of the direct (non-thermal) availability of *retained* magnetism can be inferred only by empirical procedure, for example, in general features by inspection of the hysteresis diagram as pointed out by Lord Rayleigh.

Physical Society, January 23.—Prof. S. P. Thompson, president, in the chair.—A paper on an oscillating table for determining moments of inertia was read by Mr. W. H. **Derriman**. The apparatus consists of a circular wooden table which can be suspended from a wire by means of brass supports. A pointer is attached to the centre of the bottom of the table and immediately below is another fixed pointer. In the top of the table a circular groove is cut, in which pieces of lead can slide. These pieces of lead form together half of a circular ring of rectangular cross section. The body, the moment of inertia of which is required, is placed in position on the table, and the lead weights moved until the two pointers are opposite to one another. The table therefore always oscillates about the same axis, and since the lead weights are at a fixed distance from this axis, the moment of inertia of the table remains constant. The apparatus can be employed for determining the moment of inertia of a body about any axis, and is useful for proving the law that the moment of inertia of a body about any axis is equal to its moment of inertia about a parallel axis through its centre of gravity, together with the moment of inertia of the whole mass, collected at its centre of gravity, about the given axis.—Mr. **Skinner** described an inertia balance by means of which moments of inertia can be determined without the use of stop watches. The table which carries the body is suspended by a wire. Fixed to the centre of the bottom of the table there is another wire, similar to the first, but twice as long. This wire carries a screwed brass bar, the axis of the bar being at right angles to the wire. At the middle point of this wire there is a pointer fixed at right angles to it, and on the brass bar are two weights which can be placed at varying distances from the axis. To the bottom of the bar is attached a fourth wire, the same length as the first one, and its lower end is clamped. By arranging so that the upper table oscillates to the left when the bar is oscillating to the right, and adjusting the weights on the brass bar until the pointer is stationary, the moments of inertia of bodies placed upon the table can be determined. The chairman referred to an inertia table designed by Prof.

Perry in which an aluminium ring was supported by a trifilar suspension.—A paper entitled "Note on an Elementary Treatment of Conducting Networks," by Prof. L. R. **Wilberforce,** was read by Mr. Derriman. In this paper the author shows that the well-known reciprocal relations between the parts of a conducting network can be readily established without an appeal to the properties of determinants.—A paper on the theory of the quadrant electrometer was read by Mr. G. W. **Walker.** For the purpose of some experiments which the author is taking up, he has found it necessary to examine carefully the theory of a symmetrical quadrant electrometer, and the results of his investigations are put forward in this paper. The late Dr. John Hopkinson pointed out the imperfection of the usual formula given by Maxwell, and also gave an empirical formula which closely represented his experiments. The general result is well known, namely, that the sensibility of the electrometer rises to a maximum as the potential of the needle is raised, and that any further increase in the potential of the needle reduces the sensibility. The author's experiments have been made with a sensitive electrometer by Bartels, of Göttingen, which shows a maximum sensibility when the potential of the needle is about 100 volts. The sensibility seems to go on diminishing after this, at least until very high voltages are used. The formula for a quadrant electrometer is investigated more rigidly than in the text-books, and an equation is arrived at which is practically identical with the empirical formula of Hopkinson, and represents exactly the results obtained by the author from a Bartels' electrometer. The equation contains a constant which must be positive to explain the results, and it is shown that this is the case. An investigation is then undertaken to obtain a numerical value for this constant.

Zoological Society, January 20.—Prof. G. B. Howes, F.R.S., vice-president, in the chair.—Mr. **Budgett** read a report on his recent expedition to Uganda. At Butyaba, on the east shore of Lake Albert, *Polypterus senegalus* and *Protopterus aethiopicus* were both abundant, and collections were made of the fishes of the lake and of the higher vertebrates. Mr. Budgett proceeded through the Budonga forest, where very large herds of elephant were frequently seen, to the Victoria Nile below the Murchison Falls. Here ten days were occupied in endeavouring to obtain the early stages of Polypterus, which was fairly abundant and was found to be spawning. The fertilisation of more than a hundred ova obtained, however, was not successful, and the most promising attempt yet made to breed Polypterus artificially again failed. Mr. Budgett proceeded to Wadelai overland, staying there a week, but was not very successful here in obtaining material of Polypterus; but some collections of fishes and birds were made. At Fashoda, several weeks were spent, and a good deal of information concerning *Polypterus senegalus*, *P. bichir* and *P. endlicheri* was obtained. Many anatomical preparations of fishes were also made here. Throughout the journey, many observations were made upon the birds and mammals, and the striking parallelism of the country of the Nile province of Uganda in its flora and avifauna to that of the Gambia colony on the west coast was especially noticed. Though some new light was shed upon the problem of the life-history of Polypterus, earlier stages than those previously observed were not obtained.—Mr. J. S. **Budgett** also read a paper on the spiracles of Polypterus, in which he stated his opinion that the spiracles of this fish were used to take in and give out air from the swim-bladder.—Mr. F. E. **Beddard,** F.R.S., read a communication dealing with the surface anatomy of the cerebral convolutions in Nasalis, Colobus and Cynopithecus. The wide differences which the brain of Cynopithecus shows from that of the baboons and its many points of resemblance to the brain of Semnopithecus were pointed out. Colobus was shown to closely resemble Macacus in the structure of its brain. Three brains of Nasalis were reported on, two of which the author owed to the kindness of Dr. Charles Hose, of Borneo. It was stated to be practically impossible to distinguish the brain of this genus from that of Semnopithecus.—Mr. G. A. **Boulenger,** F.R.S., read a paper on the fishes collected by Mr. G. L. Bates in Southern Cameroon. Examples of thirty-five species were contained in the collection; these were enumerated and the new species, nine in number, were described. One of the species was made the type of a new genus—Microsynodontis.—A communication from Mr. W. K. **Hutton** contained an account of the anatomy of a gephyrean worm from the Firth of Clyde. As the worm appeared to be hitherto undescribed, Mr. Hutton proposed to name it *Phascolosoma teres*.—A communication from Dr. J. G. **de Man** contained the description of a new species of fresh-water crab from Upper Guinea, under the name *Potamon* (*Potamonautes*) *latidactylum*.—Mr. R. I. **Pocock** read a paper, prepared by the Hon. N. C. **Rothschild** and himself, containing a description of a new species of spider of the genus Phrynarachne, discovered by Messrs. Rothschild and E. E. Green in Ceylon. The members of this genus were noteworthy on account of the perfection of their imitation of a patch of bird's dung, which acted as a lure to butterflies.—A communication received from Dr. H. J. **Hansen,** of Copenhagen, contained a monograph on the crustacean genera Sergestes and Petalidium, with an excursus on the luminous organs of *Sergestes challengeri*, n.sp. During a visit to England last summer, Dr. Hansen was empowered by the authorities of the British Museum (Natural History) to examine all the specimens of reputed species of these genera preserved under their care in the extensive "Challenger" Collection. A minute investigation of all the specimens called for some systematic changes, but on the whole confirmed the view which he had expounded in 1896, namely, that many specific names had been needlessly applied to larval forms of species already known in the adult condition. On the other hand, Dr. Hansen found one single specific name covering specimens of four distinct species, two of these being new to science, and one of the new ones being exceptionally remarkable for the possession of luminous organs. These, which were not known to occur in any other species of the genus, were distributed in great numbers over the whole fabric of *Sergestes challengeri*.

EDINBURGH.

Royal Society, January 5.—Prof. Flint in the chair.—A paper by Mr. George **Romanes** was communicated in which the author argued that it was not necessary to suppose that the earth in the course of its evolution had passed through a molten or semi-fluid condition. He showed by definite calculations that the great compression of the interior parts of the earth implied an evolution of heat sufficient for all purposes. The paper gave rise to a lively discussion as to the internal condition of the earth and its probable history, Prof. Knott pointing out that the Helmholtz theory of gravitation, when applied to the earth in its present state, amply sufficed to account for the annual loss of heat. A very slight contraction would prevent the average temperature becoming lowered, although a certain amount of heat was lost every year.—In a paper on the isoclinal lines of a differential equation of the first order, Mr. J. H. Maclagan **Wedderburn,** following Lie's idea of a differential equation, namely, that the equation $\phi(x, y, p)=0$ attaches to every point (x, y) a direction $p\,(=dy/dx)$, discussed geometrically the singular loci of the integral curves by means of the singular loci of the family of curves obtained by regarding p as an arbitrary constant. This family it is proposed to call the isoclinal family. An isoclinal line has the property that the differential equation attaches the same direction to every point on it. The cases dealt with were where the p discriminant was (1) an envelope of the isoclinal family, (2) a locus of nodes, (3) a locus of cusps, the corresponding loci on the integral curve being (1) a locus of cusps, (2) a tac locus, (3) a locus of ramphoid cusps. Tac loci were divided into three classes, according as the curvature was in the same or opposite direction in the two cases, or an inflection on one of the curves. The method was applicable to equations of higher order than the first, and to partial differential equations.

January 19.—Lord Kelvin, president, in the chair.—Lord **Kelvin** read a paper on the reflection and refraction of light, in which further developments were given of two previous papers. In the earlier of these (*Phil. Mag.*, August, 1900), the dynamical difficulty of conceiving ponderable bodies capable of motion through the highly elastic solid such as ether seems to be was surmounted by supposing that within the sphere of action of an atom of matter the ether varied in density according to definite laws conditioned by assumed attractions and repulsions between the atoms and the elements of ether. As the ether flowed through the space occupied by the matter, or as the atom passed through the ether, the ether was imagined to become condensed towards the centre and rarefied towards the surface of the spherical atom in such a manner that the amount of ether within the spherical boundary was the same as if no atom were present.

This condensation and rarefaction of the ether gave to the matter a quasi inertia, in virtue of which particular kind of loading of the ether the velocity of light was affected and a change of refractive index produced. In the second paper referred to (see *Archives Néerlandaises des Sciences*, &c., November, 1901), the single electric fluid theory of Aepinus was "atomised," the negative electricity consisting of minute atoms called electrions much smaller than the atoms of ponderable matter. These electrions freely permeate the spaces occupied by the material atoms as well as empty space. They repel one another, but attract the atoms of matter, and the atoms of matter also repel one another. The electrions passing within the spherical atom tend to neutralise the action of the atom of matter, and in the overlapping of two atoms and the consequent transformation of old configurations of equilibrium of the atoms and the associated electrions into new configurations, an endless scope was found for explaining many electrical phenomena. Any such change in configuration would be followed by the electrions vibrating about their new positions of equilibrium and sending off ethereal waves through space. The non-neutralised material atom is supposed to repel the ether and the electrion to attract it. In the neighbourhood of a neutralised atom, the ether is unaffected; but within the atom there are condensation and rarefaction of the ether, depending upon the particular distribution of electrions within it. When we consider the behaviour of such a dynamical system in regard to trains of ethereal waves incident upon it and, it may be, passing through it, not only are the well-known Fresnel laws for the reflection of polarised light at once obtained, but the phenomenon of metallic reflection finds an immediate explanation.—Sir John **Murray** and Mr. Laurence **Pullar** presented the first of a series of communications on the bathymetrical survey of the fresh-water lochs of Scotland, this first paper dealing with the lochs of the Tay Basin. During last summer, the work had been vigorously prosecuted, depths, temperatures, vegetable and animal life being specially studied. The oscillations familiar to the Swiss geologists and known as *Seiches* were also observed.—Dr. **Horne** followed up this paper with a lucid account of the geological features of the Tay Basin, illustrating the tectonic structure of the Highlands by means of sections, and drawing attention to the succession of uplifts and denudations which had affected the Tay Basin during geological time. The importance of the results obtained by Sir John Murray and his associates was dwelt upon, especially in regard to the strong evidence in favour of the glacier origin of certain of these lochs, notably Loch Tay itself, which could be nought else than a true rock basin produced by ice erosion.

PARIS.

Academy of Sciences, January 26.—M. Albert **Gaudry** in the chair.—Researches on the chinchona alkaloids: cinchonine, cinchonidine and cinchonamine, by MM. **Berthelot** and **Gaudechon**. A thermochemical paper giving the heats of combustion, formation and solution of these alkaloids and some of their salts. Recently precipitated cinchonine appears to possess the same physical state as crystallised cinchonine; cinchonidine behaved in a similar manner.—On some functions and point vectors in the motion of a fluid, by M. Paul **Appell**.—On the reducibility of differential equations, by M. Paul **Painlevé**.—The theory of the absorption of light by symmetrical crystals, by M. J. **Boussinesq**.—On the magnetic deviability and the nature of certain rays emitted by radium and polonium, by M. Henri **Becquerel**. It has been shown that the radiation from radium is partly deviated by a magnet, and that this portion of the rays is identical in properties with the kathode rays. The other part, considered as unaffected by a magnetic field, consists of two kinds of rays, one very penetrating and the other easily absorbed. The latter have recently been identified by Rutherford, under the name of the α-rays, with the canal rays of Goldstein. The electrical method used by Rutherford was one of extreme delicacy, but it appeared desirable to confirm this result by an independent method, and for this purpose measurements were made by a modification of the photographic method previously used by the author. The results were in general agreement with Rutherford's experiments, the α-rays resembling the canal rays in carrying positive charges with greater masses and smaller velocities than those of the kathode rays.—On the use of a telegraph wire for registering automatically earth vibrations and measuring their velocity of propagation, by M. G. **Lippmann**. In a continuous seismograph, considerations of cost necessitate a reduction of the curve to small dimensions, and an apparatus designed to give the curves on a large scale must be started during the earthquake, with the result that the first portion of the record is lost. A telegraphic arrangement is described by the author by which the arrival of the seismic wave at a distant station works a relay, starting the clockwork of the recording apparatus at a second station, advantage being taken of the relatively slow rate of transmission of the seismic disturbance. The same apparatus will also serve to measure this rate.—The principal results obtained in 1902 on the radial velocities of the stars, and on the causes of error peculiar to these researches, by M. H. **Deslandres**. The causes of error are numerous: optical and mechanical defects in the telescope and spectrograph, errors in adjustment, the effects of temperature changes on the flexure of the supports, and the varying condition of the atmosphere.—On two recent comets, by M. **Perrotin**. Of the two comets recently discovered by M. Giacobini at the Observatory of Nice, the first is new; the second may be identical with the Tempel-Swift comet, the return of which is expected about this time.—On the fourth campaign of the *Princess Alice II.*, by Prince **Albert I. of Monaco**. The work was carried out partly in the Mediterranean and partly in the North Atlantic. A summary of the results obtained in oceanography and zoology is given. In view of the results of M. Armand Gautier on the normal presence of arsenic in the animal organism, systematic search for this element was made on the animals caught during the voyage by M. Gabriel Bertrand, M. Gautier's views being completely confirmed.—The eruptions of dense clouds from Mont Pelée, by M. A. **Lacroix**. It was found possible to fix approximately the temperature of one of the hot blasts at a distance of 6 kilometres from the volcano; it was lower than the melting point of tin (230° C.) and higher than 125° C., since the latter was the temperature found for a layer of ashes some time after the eruption.—The Observatory of Besançon. The elements of the Giacobini comet (1902 *d*), by M. P. **Brück**, and observations of the Giacobini comet (1903 *a*), by M. P. **Chofardet**.—On regular differential systems, by M. Ch. **Riquier**.—On induced radio-activity and on the emanation from radium, by M. P. **Curie**. In a former note it was shown that the disappearance of the radio-activity induced by radium in a closed vessel and maintained at a constant temperature followed an exponential law with the time. Similar experiments have now been carried out at 450° C. and −180° C., and it has been found that the law is the same. From these results it is regarded as improbable that the effects accompanying the existence of the emanation can have their origin in chemical action, since there is no known chemical reaction the velocity of which remains constant over a temperature range from −180° C. to +450° C.—On the micrography of the nickel-steel alloys, by M. Léon **Guillet**.—On the existence of electrolytic superoxides of lead, nickel and bismuth, by M. A. **Hollard**. From the chemical formula, any weight of lead peroxide deposited electrolytically, multiplied by 0.866, should give the weight of lead.—Experiments were carried out with amounts of lead varying from 0.01 gr. to 10 gr. of lead, and the amount of peroxide deposited weighed. The results show that the factor 0.866 is only approached when large quantities of lead are present, the factor falling to 0.74 for the smallest amount. The author interprets this as being due to the formation of a higher oxide of lead, but no direct evidence of this is produced. Similar experiments with nickel and bismuth lead to the conclusion that the oxides NiO_4 and Bi_2O_7 can be separated electrolytically.—On the equilibria produced between copper, silicon and manganese, and on the silicide of manganese Si_2Mn, by M. P. **Lebeau**.—On two acids containing phosphorus derived from methyl-ethyl-ketone, by M. C. **Marie**.—On a new diiodophenol, by M. P. **Brenans**.—On the rotatory power in homologous ethers of borneol, isoborneol and camphocarbonic acid, by MM. J. **Minguin** and Gr. de **Bollemont**.—On the chlorination of aromatic substituted hydrocarbons by ammoniacal plumbic chloride, by MM. A. **Seyewetz** and P. **Trawitz**. The chlorinating action of $(NH_4)_2PbCl_6$ on chloro-, bromo-, iodo- and nitro-derivatives of aromatic hydrocarbons has been studied. Ortho-chlor-toluene is attacked ex-

clusively in the methyl group; the para-derivative behaves similarly.—Researches on the αβ-dimethylglutaric acids, by M. E. E. **Blaise.**—The preparation and properties of 1 : 6 hexanediol or hexamethylene glycol and its principal derivatives, by M. l'Abbé J. **Hamonet.** Diphenoxyhexane is converted into diiodohexane by the action of hydriodic acid, and from this the acetin is obtained and hydrolysed, yielding the glycol, the properties of which are described.—Contribution to the physiology of the internal ear, by M. **Marage.** The experiments described are not in exact accordance with either of the current theories of audition. A third theory is developed, one of the consequences of which is that the variations of pressure in the internal ear are of the same order as actions affecting other nerves. The acoustic nerve thus ceases to be exceptional in its behaviour.—The evolutine cycle of tissues deprived of their intimate relations with nerves, by M. N. Alberto **Barbieri.**—On the ovule and fertilisation in the Asclepiadeæ, by M. Paul **Dop.**—Contribution to the study of the epiplasm in the Ascomycetes, by M. A. **Guillermond.**—On a cave containing fossils near Châteauneuf-les-Martignes, by MM. A. **Cotte** and Ch. **Cotte.**—On the former existence of a direct communication between the Parisian and Belgian basins, by M. Maurice **Lericho.**—On the laccolites on the north side of the Caucasus, by Mlle. Véra **Devis.**—On a drawing in the cave of Mas-d'Azil, by M. Edouard **Piette.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 5.

ROYAL SOCIETY.—In consequence of the death of Sir George Gabriel Stokes, no meeting will be held.

ROYAL INSTITUTION, at 5.—Arctic and Antarctic Exploration: Sir Clements Markham, K.C.B.

CHEMICAL SOCIETY, at 8.—(1) A New Vapour-Density Apparatus; (2) A New Principle for the Construction of a Pyrometer: J. S. Lumsden.

LINNEAN SOCIETY, at 8.—Stephanospermum, Brongniart, a Genus of Fossil Gymnospermous Seeds: Prof. F. W. Oliver.

RÖNTGEN SOCIETY, at 8.30.—Discussion on Some Points suggested by the Presidential Address of November, 1902, opened by J. H. Gardiner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Adjourned Discussion on the Metric System.

FRIDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 9.—George Romney and his Works: Sir Herbert Maxwell, Bart.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—The President will deliver an address on The Recent Geological History of the Bergen District of Norway.

MONDAY, FEBRUARY 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Changes in the Neapolitan Coast Line: R. T. Günther.

SOCIETY OF ARTS, at 8.—Paper Manufacture: Julius Hübner.

TUESDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 5.—The Physiology of Digestion: Prof. Allan Macfadyen.

SOCIETY OF ARTS, at 5.—Women in Canada: Countess of Aberdeen.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—On Two Medicine Baskets from Sarawak: R. Shelford.—The Lo-Los and other Tribes of Yunnan: A. Henry.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Manufacture and Efficiency of Armour-piercing Projectiles: D. Carnegie.

WEDNESDAY, FEBRUARY 11.

SOCIETY OF ARTS, at 8.—The Port of London: Dr. B. W. Ginsburg.

THURSDAY, FEBRUARY 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers:*—On the Decline of the Injury Current in Mammalian Nerve, and its Modification by Changes of Temperature: Miss S. C. M. Sowton and J. S. Macdonald.—On the Negative Variation in the Nerves of Warm-Blooded Animals: Dr. N. H. Alcock.—On the Optical Activity of Hæmoglobin and Globin: Prof. A. Gamgee, F.R.S., and A. Croft Hill.—On the Nucleo-Proteids of the Pancreas, Thymus and Suprarenal Gland, with especial reference to their Optical Activity: Prof. A. Gamgee, F.R.S., and Dr. W. Jones.—Studies in the Morphology of Spore-producing Members. No. V. General Comparisons and Conclusion: Prof. F. O. Bower, F.R.S.—Primitive Knot and Early Gastrulation Cavity coexisting with Independent Primitive Streak in Ornithorhynchus: Prof. J. T. Wilson and J. P. Hill.—The Brain of the Archæoceti: Prof. Elliot Smith.

ROYAL INSTITUTION, at 5.—Arctic and Antarctic Exploration: Sir Clements Markham, K.C.B.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—If the adjourned discussion on the Metric System is concluded at the Meeting on February 5, the adjourned discussion of Messrs. Scott and Esson's paper will be taken.

MATHEMATICAL SOCIETY, at 5.30.—Note on a Point in a Recent Paper by Prof. D. Hilbert: E. T. Dixon.—Some Properties of Binodal Quartics: H. Hilton.—The Field of Force due to a Moving Electron: Prof. A. W. Conway.—On Birational Transformations of the Type of Inversion: Prof. W. Burnside.

FRIDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 9.—Health Dangers in Food: Prof. Sheridan Delépine.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 5.—Address by the President elect.

MALACOLOGICAL SOCIETY, at 8.—Annual General Meeting.—Address on the Molluscan Larva in Classification: Prof. G. B. Howes, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction and Setting-out of Tunnels in the London Clay: H. A. Bartlett.

CONTENTS.

SUPPLEMENT.

SUPPLEMENT TO 'NATURE."

THE LATE LORD LILFORD.

Lord Lilford on Birds. Being a Collection of Informal and Unpublished Writings by the late President of the British Ornithologists' Union. With contributed Papers upon Falconry and Otter Hunting, his favourite Sports. Edited by Aubys Trevor Battye, M.A., F.L.S., &c., Member of the British Ornithologists' Union, and illustrated by Archibald Thorburn. Pp. xvii + 312. (London: Hutchinson and Co., 1903.) Price 16*s.* net.

Lord Lilford. Thomas Littleton, Fourth Baron, F.Z.S., President of the British Ornithologists' Union. A Memoir by his Sister. With an Introduction by the Bishop of London. Illustrations by Thorburn and Others, and a Portrait in Photogravure. (London: Smith, Elder and Co., 1900.)

THE figure of the late President of the British Ornithologists' Union, one of the earliest supporters of the *Ibis*, seen as sketched unconsciously by himself in the extracts from private correspondence and diaries given in Mr. Trevor Battye's beautifully got-up and illustrated volume, and in the memoir published a little earlier by a sister, is very attractive and very pathetic—the bodily presentment of the fascination of wild nature triumphant over pain.

Lord Lilford's life is the story of "a buoyant and vigorous nature, slowly cut off by the inexorable trammels of physical disability from what it most keenly enjoyed, the opportunity of personal observation in a large sphere, the delight of new impressions, the large sympathy with a perpetually increasing world of nature and man," but retaining to the end the lightheartedness and kindly consideration for others, and the absorbing interest in bird and beast which distinguished him as a boy.

The words quoted above in inverted commas are taken from Bishop Creighton's introduction to Mrs. Drewitt's book.

The prematurely old man, crippled with gout, who hopes it may clear up in the afternoon that he may be wheeled out to see a new consignment of owls just arrived from Finland, and writes from his sick room to a friend who had been near a rock reputed to be the home of a reptile to be found nowhere else, without having been able to land, "I would have seen those lizards or known the reason why," is the child who, half-a-century before, had begged his mother to let him bring home in a band-box a lizard caught at Holland House, where they had been calling, and had jumped up from his first whipping for some infantine offence with "It didn't hurt very much! Look! There is a brown owl flying by!"

"E'en in our ashes live their wonted fires."

Like Edward, the Banff shoemaker—his counterpart in a humbler sphere—Lord Lilford was a born naturalist. The two men—wide as they stood apart on the social ladder—had much beside a Christian name in common. The "ruling passion" which made the ragged urchin Tom Edwards carry the wasp's nest to school tied up in his shirt and earned him many "skelpings" for frightening his mother and her neighbours by bringing home "puddocks," horse-leeches and other "venomous critters" was the same that led Tom Powys to smuggle little bitterns into his Harrow study and brought tears into the eyes of the "Irish Slavey" in Half Moon Street when the armadillos brought home in a four-wheeled cab by the gentleman lodger—"scaly beasts"—killed her cat.

A new or rare bird had the same magic power on both. The sight could charm the one into unconsciousness of gout and helplessness, and make the other forget the pinch of hunger and empty pockets.

It is for its aviaries that Lilford Hall is best known to readers of NATURE. Of these—at one time among the most extensive and best cared for in England, perhaps in Europe—a very interesting description is given in a presidential address to the Northamptonshire Field Club delivered by the owner in 1894 and now reprinted in Mr. Trevor Battye's book.

Like most carefully thought-out things, they were of slow growth. Lord Lilford had kept birds from childhood, and in Christ Church days was already able to send Prof. Newton an imposing list of his possessions. But it was not until later that he began collecting in earnest.

"I have only gone in for a large and serious collection," he wrote the year before his death in a touchingly apologetic letter to a lady who had apparently expressed her views on keeping birds in confinement, "since I became crippled and, therefore, could not see birds elsewhere than at home."

He was always ready to give from his stock to help the acclimatisation of a new or reestablishment of a vanishing bird.

In 1872, he wrote to Lord Walsingham, at the time personally unknown to him, offering a present of twenty brace of Virginian colins to be turned out at Merton, where, as he thought, the country should exactly suit them. A few years later, at first one, and after that a second, hen great bustard was sent to the same neighbourhood in the hope of inducing a fine old cock who had appeared on a fen near Thetford to set up house again in an old favourite home of the family. Unluckily, the experiment was not successful.

"When the great bustard honoured me with its visit," writes Mr. Upcher, on whose property the bird had established itself, "Lilford, in his desire to reestablish them in the country, sent me a female from his aviaries. I kept a man watching night and day lest some conscienceless collector should come on the prowl. He reported that they seemed to get quite fond of one another and he verily believed almost touched. Then, alas! came an out-of-season snowstorm and the poor hen succumbed. Lilford, in his generosity, sent another lady, but my lord did not approve of the change and departed, getting safely out of the country."

On almost every page of Lord Lilford's notes are to be found texts on which sermons on natural history might be written. But these and the journals of yachting trips

and ornithological rambles on the plains and mountains of Spain or among Mediterranean islands, full as they are of pleasant suggestions, and other matters of equal interest—his views on protective legislation, among others—must be left unnoticed, if only to leave a corner for the charming little word pictures painted for the guidance of Mr. Thorburn when drawing the pictures for Lord Lilford's last beautiful work, "Coloured Figures of the British Birds."

"Monumentum ære perennius."

The following are specimens taken at random. All are equally good.

The first is for the picture of the storm petrel, the second for the puffin.

"It would perhaps be best to make him skimming the water with legs at their full length and toes extended; in fact, running on the water with wings extended. What I want to try to get is the very striking effect of these little black birds against a deep blue ocean sea and foam."

"A group in full summer dress on steep slope of short turf over sea. Cliff honeycombed with burrows—rabbits, sea pinks."

The only objection to be taken to Mr. Trevor Battye's work as editor of Lord Lilford's papers, which is excellently done, is that his book is rather too patchworky to be read smoothly as a whole. The fault, if fault it is, is, perhaps, in view of the nature of his materials, one which could not have been altogether avoided.

A book of extracts, however carefully chosen, is like the kinematograph. Unless very skilfully managed, the effect is apt to be a little spoilt by jolts and jerks as the moving pictures succeed one another. Mr. Trevor Battye, some readers may think, has gone out of his way to drop pebbles into the machinery by inserting, as integral parts of the book, articles on hawking and on otter hunting by other pens, between two sections of Lord Lilford's own writings, to neither of which has either article any special relation.

That both papers are charming in themselves and well worth reading does not necessarily imply that they are good where they appear. Dirt, as someone once defined it, is "good matter misplaced"; but none the less it is better away.

Another small criticism, to satisfy Mr. Trevor Battye that all he has written has been thought worth reading carefully. On p. 144, he says Lord Lilford's preference for wild pheasants was owing to "the instinctive and *unsportsmanlike* shrinking from the idea of the non-natural culture of the pheasant." Is not *sportsmanlike* the word he had intended to write?

One good story, which, as Lord Lilford tells us, "amused" him "vastly at the time," and this rambling notice must end. A visitor to Lilford, who evidently took a great interest in the birds, was just leaving when he suddenly turned to his conductor and said, "By the way, I saw in the paper some time ago that Lord Lilford had given a very long price for an egg of the great auk. I trust that he was successful in hatching it?"

Mr. Thorburn's pictures are, as usual, delightful.

T. Digby Pigott.

THE PRINCIPLES OF TEACHING.

Principles of Class Teaching. By J. J. Findlay, M.A., Head Master of the Cardiff Intermediate School for Boys. Pp. xxxvi + 442. (London: Macmillan and Co., Ltd., 1902.) Price 5*s*.

It is a wholesome sign of our times that so many attempts are being made by experts in education to find a scientific basis for the procedure and organisation of schools. Within the teacher's profession, and outside of it, there is a growing conviction that education is a science and not merely an art or even a fine art, but that its practitioners are bound to investigate the *rationale* of their methods, and the philosophy which underlies and justifies all really effective rules of practice. Mr. Findlay's book is an honest and successful effort in this direction. He has somewhat needlessly, as we think, restricted the aim and the possible usefulness of his work by calling it the "Principles of *Class* Teaching," Teaching in a class is, after all, teaching under one particular set of conditions, whereas the principles of teaching, the art of communicating, the relative values of different kinds of knowledge, the fitness of certain subjects for scholars at different stages of development, and the influence of different studies and forms of intellectual discipline on the formation of the tastes and the moral character, are matters of large and universal interest which deserve consideration in their relation to teaching under all conceivable conditions, whether learners are taught in a class or not. To do Mr. Findlay justice, these are topics which he has not overlooked, but which are handled incidentally and often with considerable acumen and judgment in the course of his treatise. The book is, in fact, what its title professes, and something more.

At the outset, the author discusses the constitution of a class and the number which should be found in it. He says that

"A teacher of experience will usually be willing to handle a class of thirty pupils, if the thirty are fairly equal in attainments; he would be unwilling to go up to forty or to fall below twenty."

But, in fact, no such general rule as this is of much practical value. The number of scholars in a class should depend largely on the nature of the subject to be taught. For a construing lesson, for one in which constant appeal is needed to individual scholars and for close intellectual intercourse between teacher and taught, the number should be small; while for certain forms of collective teaching, for demonstrations, for music lessons, for the use of pictorial or other illustrations, for telling a story and for moral and hortative lessons, in which what David Stow called the "sympathy of numbers" has to be invoked, the numbers in a class might well be larger. But, as Mr. Findlay justly says:—

"The unit in education is not the school or the class, but the single pupil. However fruitful it may be to discuss the 'psychology of the crowd,' whether in school or in the streets, the value of the study depends upon our previous acquaintance with single individuals."

The most serviceable and suggestive part of the book is that which deals with the curriculum of instruction in schools of different types, from the kindergarten to the

high school and the college. Except that the author has burdened himself needlessly with the Herbartian terminology, which often tends to obscure what for plain and uninitiated readers might easily have been treated more simply, there is little but praise to be given to the manner in which the book discusses in detail the numerous topics which come under review. For example, in treating of early and infant education, Mr. Findlay analyses with much ingenuity and force the true meaning of Fröbel's teaching, and helps the reader to distinguish between the essential verity which underlies that teaching and the travesty of it, which too often satisfies the merely mechanical kindergarten instructor. He shows that

"The final value of Fröbel, as of his master Pestalozzi, is to be found rather in the spirit of his work than in the particular devices he employed." "Instead," he says, "of the tedious and useless paper-folding 'occupations,' which are a part of the Fröbel fetish, we may find it possible even with little children to cultivate the decorative art; they may trace the snowdrop pattern on flannel or cardboard, and then cut it out to stitch or paste on to darker material serving thus as a rug or tablecloth to please mother at home, as something of service to her. Taste on the teacher's part quickly develops appreciation for simple forms of beauty."

In like manner, this book shows how easy it is for even the best theories of enthusiasts to degenerate into formalism and pedantry, unless the nature of child-life and the possibilities of intellectual development are looked at with fresh eyes, and unless teachers can emancipate themselves from traditional methods. This is well illustrated by the chapters in which the claims of the humanities are examined both in their relation to later childhood and to more advanced stages of progress. At first, "Robinson Crusoe" and the "Odyssey," "Tales of Greek Mythology," the story of Joseph and his brethren and that of King Alfred are cited as examples of narratives which are likely to touch the imagination and arouse the sympathy of the learner none the less because they are remote from his present environment and experience. They

"bring family relations into prominence. Odysseus never forgets Ithaca; the tragedy of Joseph's life centres round his father's home. The child is still a home-bird, and in the humanities, above all, this sentiment must find a place right through into boyhood."

On the subject of teaching science, Mr. Findlay rightly insists on the importance of such preliminary training as may awaken the faculty of observation and kindle in the pupil an interest in the phenomena of the visible world before proceeding to the technicalities of science as generally understood in schools. The true scope and meaning of "Nature-study" as a means of giving the basis of ideas and experience on which formal lessons on science may hereafter be wisely built are thought out and explained with much care.

Throughout the book, the author shows himself to be a faithful disciple of Herbart, and enforces in various ways the need of kindling interest and securing the co-operation of the scholars in the business of learning:

"The child is supremely an active being, and it must be the teacher's care, not only to provide suitable material for thought, but for action. Hence, in our scheme of a curriculum we shall recognise the arts and occupations of the young in drawing, in music, in games, in manual training, as worthy to take rank side by side with those branches of knowledge which, since the Renaissance, have sought to usurp the whole field. In so doing, we shall be simply reverting to the older and more generous method of the Greeks."

Space forbids further detailed reference to the ways in which the author has sought to illuminate the path of the teacher and to define his aims. There are some disputable propositions in the book, and good teachers will not be unanimous in approval of all the methods recommended. But it will suffice here to say that the author's effort to find a rational explanation of the best practical and professional rules has been successful and that the book will take rank among the most thoughtful contributions to educational science which have appeared in recent years. J. G. F.

A WORK ON SURVEYING.

Surveying, as Practised by Civil Engineers and Surveyors, Including the Setting-out of Works for Construction and Surveys Abroad, with Examples taken from Actual Practice. By John Whitelaw, jun. Pp. xiv+516. (London: Crosby Lockwood and Son, 1902.)

THIS book cannot be considered altogether satisfactory or as fulfilling the purpose the author proposes to himself. One gathers from the short preface that it is his intention to present a useful text-book of principles and methods for students, as well as a guide to the actual practice of surveyors and civil engineers in the various branches of surveying. This is a sufficiently ambitious programme, and for its successful accomplishment it demands, not only a practical training in the field, but some facility of mathematical manipulation, since there must be constant reference, not only to the methods and details of actual measurement required for various practical purposes, but to the theory of instruments, the application of the theory of errors, geodetic problems and the principles involved in hydrographic surveying.

Up to a certain point, we have the greatest confidence in our author. Wherever he is describing work of which he has had actual experience, he is a welcome guide. In various commercial undertakings, such as the preparation for railroads, or waterworks, there is abundant evidence that his work is competent and trustworthy; but to write a book on the lines proposed, more is needed than familiarity with practical surveying within a limited area. One begins to lose confidence when he reads what the author calls the theory of the sextant, but which is limited to the demonstration of an elementary proposition in geometrical optics. It is true, at a later stage the author gives rules for the practical adjustment of the sextant, but such ordinary matters as the errors produced by a prismatic form of the index glass, or by the inclination of the index or horizon glass are either entirely ignored or not brought before the student with the necessary detail.

This confidence sinks still lower when we get a rule for the determination of the probable error from two

observations only. One feels that the theory of errors has not been grasped with a complete mastery. After glancing at such uncomfortable-looking formulæ as $BC' = d \tan (BAC + 0{\cdot}000069\,d)$ and wondering whether there is any advantage in such forms of expression as cos. of co-dec., in place of the more familiar Sin. dec., we turn to the section on longitude determination to learn how the method is practised by civil engineers and surveyors. And in this chapter one learns some strange things. It does not appear to be at all necessary to take into account the parallax of the moon in the method by lunar distances, and the problem of "clearing the distance," a problem fraught with much pain and anxiety to many, does not seem to trouble engineers and surveyors. Similarly, the longitude by lunar occultations is treated with equal lightness and brevity. We are told that the Greenwich mean times of the occultations of fixed stars by the moon are given in the *Nautical Almanac* for both immersion and emersion, and that by applying the approximate longitude in time, the approximate local mean time of the occultation may be found, and the observer will know approximately when to begin to observe. We recommend the two or three pages of explanation of the section "Elements of Occultation" given at the end of the *Nautical Almanac* to the author's attention.

These remarks are not made in any unkind spirit, but, if possible, to warn the student to what extent he may trust his author. We can readily believe that with his chain and his theodolite, the writer of the book has done, and will continue to do, good work, and if he had been content to describe accurately what he knew thoroughly, he would have given us a valuable practical treatise. But he has ventured on subjects of which his experience has not qualified him to treat, and in these directions we can neither follow him with satisfaction nor unreservedly recommend his book to the careful study of the large class of students who might have profited by it.

W. E. P.

PROTOZOAN NATURAL HISTORY.

Faune Infusorienne des Eaux stagnantes des Environs de Genève. Par Dr. Jean Roux, Assistant au Laboratoire de Zoologie de l'Université de Genève. Pp. 148; 8 plates. (Genève: H. Kundig, 1901.)

Faune Rhizopodique du Bassin du Léman. Par Dr. Eugène Penard. Pp. 714. (Genève: H. Kundig, 1902.)

THE systematic study of the natural history of the Protozoa in past years has, in general, lagged far behind that of the higher groups of animals. In large part, no doubt, this has been due to technical difficulties of collection and examination, but it has resulted also from a delay in recognition of the fact that the same problems of species and of their geographical distribution which have stimulated and directed the detailed study of Metazoan natural history for so many years have equivalent applicability and interest among the Protozoa. The brilliant labours of Ehrenberg, however, who concerned himself largely with the local distribution of Protozoan forms, and the later work of Bütschli, have been increasingly fruitful. The conception by Bütschli of the "cosmopolitanism" of the Protozoa has been supported by the results of numerous workers in various countries and continents, and found its fullest sanction in the studies of Schewiakoff during his voyage round the world. Schewiakoff, indeed, by showing in how large a proportion the Protozoan species already well known in Europe were spread through other continents, opened the most attractive field for the study of the problem of species among the unicellular animals.

The two valuable monographs we now owe to Drs. Roux and Penard will rank high among the later contributions to the Protozoan natural history. Concerned as they are with the exact description of a purely local fauna, they may be considered to be in a sense complementary to the extensive researches of Schewiakoff—they have a value which is intensive, rather. With the general idea of Protozoan ubiquity and specific "cosmopolitanism" well grounded, we may hope that by the sufficient accumulation of exact local studies, and perhaps in no other way, we may eventually see unravelled the intricate relationships of nutritive conditions and of the environment in general, not only to secondary body characters, but to the processes of fission and its secondary developments, which determine to so large a degree the life-histories of the Protozoa. Not the morphologist alone, but the physiologist too, will welcome the advances of our knowledge in this direction, for the latter must hope to gain a widely increased outlook upon the significance and origin of many cellular processes by the determination of the phylogenetic relationships among groups of Protozoa.

Dr. Jean Roux has collected, identified and described in detail the species of Infusoria occurring in the stagnant waters, in pools, marshes and basins in the neighbourhood of Geneva. His work gives fresh verification, if any were required, to the very generalised distribution of Protozoa throughout the world, for he has already found in his own district three-fifths of all the forms of non-marine Infusoria which have been described for other countries. His arrangement of the species follows Bütschli's classification, except in the order Holotricha, in which the divisions of Schewiakoff are adopted. Very complete systematic descriptions are given of every form, the arrangement and shape of its organs, its characteristic movements, and, in most cases, its normal *habitat* and mode of nutrition.

The text is illustrated by well executed coloured plates, which give figures, drawn by the author, of about 170 species. Some interesting points are raised by Dr. Roux in connection with the seasonal changes of population among the Infusoria. Statistical inquiry has shown that the population of a given species exhibits maxima and minima of seasonal incidence. In general, a maximal population is found both in spring and autumn, a fact which has not yet received adequate explanation. These two maxima may be real; they may be due to increased reproductive activity both in preparation for, and in con-

sequence of, the encystment or quietude of the winter, or they may result from an improved food supply dependent upon similar seasonal maxima in the population of Algæ and Diatoms. The maxima, on the other hand, may be only apparent, and exhibited relatively only to a summer minimum which may be supposed to coincide with the maximal development of the natural enemies of the Infusoria, such as the crustacean Cyclops and the like. These difficulties of explanation may be taken to represent only one set out of many problems in natural history which the systematic study of these lowly forms is likely to suggest.

The appearance of Dr. Penard's companion monograph upon the Rhizopod forms of the same locality is very aptly timed. It contains the results of his laborious researches into the very numerous and often ill-defined species of this large group, with the fullest systematic descriptions of their structure and habits, and it is abundantly illustrated throughout with accurate drawings. The author has not included among the Rhizopoda the group Heliozoa, generally, but not very suitably, associated with them. Dr. Penard has already published studies of the Rhizopoda he has found elsewhere in Europe and in North America, and it is significant, in connection with what has been said above, that in his collections of purely local forms in the Genevan district he finds represented no less than 92 per cent. of the species which have been described for the whole world, although he has added a few hitherto undescribed species to the list. In this estimate, he does not include, it should be said, those forms of the Amœba class which are entirely devoid of skeleton and less easily defined or identifiable. The volume contains a large bibliography, and indices both to the subject-matter and to the species described.

In addition to the systematic description of the Rhizopod fauna, Dr. Penard gives a series of separate essays upon special points of interest in their general morphology and behaviour—he deals with their growth, the skeleton and its appendages, with the plasma, its inclusions and pseudopodia, the nucleus, the contractile vacuole, and finally with general questions of geographical distribution, reproduction and hybridity. The most important variations of the shape and disposition of the nucleus throughout the group are described and figured, and these are strikingly numerous and diversified. The author does not, however, give any systematic account of the distribution within the Rhizopoda of the chief Protozoan types of nuclear division. It has already been shown by Schewiakoff and others that complexity in the process of karyokinetic nuclear division is by no means exhibited only by the more highly organised forms among the Protozoa, and a good deal of light might be expected to be thrown upon the relationships between cellular elaboration and the karyokinetic figure by a systematic examination of the nuclear behaviour throughout the species of one group. Much no doubt remains to be done, but Dr. Roux and Dr. Penard are to be congratulated alike upon very notable achievements of skill and industry. Their labours have borne fruit already, and will long, we believe, remain profitable to fellow-workers in the same field.

A NEW ATLAS OF THE ATLANTIC OCEAN.

Atlantische Ozean. Ein Atlas von 39 Karten, die physikalischen Verhältnisse und die Verkehrs-strassen darstellend. Zweite Auflage. Herausgegeben von der Direktion. Deutsche Seewarte. (Hamburg: L. Friederichsen und Co., 1902.)

TOWARDS the end of the year 1898, the Deutsche Seewarte published the second edition of its well-known "Segelhandbuch" for the Atlantic Ocean, but it was regretted at the time by the director, Prof. Neumayer, that a new edition of the atlas was not forthcoming. There were, however, very good grounds for its non-appearance, since it was considered that there was not sufficient new material available to make it worth while undertaking such a large piece of work.

During the many years that have now elapsed since the first edition of this atlas was published, a very considerable amount of valuable information has been accumulated, and advantage is now taken to bring the atlas up to date and to make it complete and trustworthy as regards every piece of information it conveys.

Among some of the sources of the new data which have been embodied in the work is that of the valuable series of observations made by the *Valdivia*. Further, advantage has been taken of another large piece of work which has recently been brought to a conclusion, namely, the ten-degree square investigation of the North Atlantic; these observations covered a zone extending from 20° to 50° north latitude and stretching from the west of Europe to the east of North America, and they have been published recently in no less than nineteen volumes.

Another store of valuable data was also ready at hand, namely, that which had been collected by the Deutsche Seewarte in connection with the Danish Meteorological Institute and utilised for making its synoptic weather charts. The work also of our own Meteorological Office and Hydrographic Department has also been usefully employed on many occasions, and especially to fill up gaps not covered by German observations.

It will be seen that there was no lack of good material, and Prof. Neumayer has so marshalled his facts that he has been able to present seafaring men and meteorologists with a trustworthy series of maps which illustrate our present knowledge of the mean physical and hydrographical conditions of this important region of the world.

The thirty-nine maps that compose this atlas are accompanied by clear explanatory remarks which describe their mode of construction and include the sources of all the data that are contained in them.

In a brief notice, it is not possible or even necessary to describe each of the maps in this atlas, but it will suffice to remark that they are arranged, not only to give the mean meteorological, hydrographical, &c., condition for the year, but the mean, in many cases, for important individual months or groups of months.

Thus, for instance, in the case of barometric pressure, we have a chart showing the mean isobars of the Atlantic Ocean for the whole year and four maps for

the four months February, May, August and November, and also mean monthly charts of the North Atlantic for each month, showing the pressures for every five-degree square.

Not only do the charts give information on the numerous meteorological elements such as temperature, wind tracks of storms, rain, &c., but they refer to the depths, temperature at different depths, specific gravity, currents, &c., of the water in this ocean, the magnetic elements for the year 1902, mean ship routes for two seasons of the year, and the distribution and chief hunting grounds of the most important species of whales.

A word further may be said in praise of the reproduction of the maps, which are all neatly and distinctly coloured, and on scales which are sufficiently large for the purposes for which they are intended.

Both the distinguished director of the Deutsche Seewarte and his co-workers are to be congratulated on the completion of this important work, and for their successful efforts in bringing before the world in such a concise form the results of so many observations. British meteorologists and sailors will certainly find this work of great utility, and they, like the present writer, will no doubt appreciate the service that has been rendered by their German confrères at the Seewarte.

W. J. S. L.

THE WANDERINGS OF A NATURALIST.

Aus den Wanderjahren eines Naturforschers, Reisen und Forschungen in Afrika, Asien und Amerika, nebst daran anknüpfenden meist ornithologischen Studien. Von Ernst Hartert. Pp. xiii+329. (Berlin: Friedländer und Sohn; London: Porter, 1901–2.)

A SHORT time ago (NATURE, vol. lxiv. p. 249, July 11, 1901), we called attention to the scientific work carried on at the Tring Museum and to its excellent results as regards the advancement of zoology. In *Novitates Zoologicae*, the organ of that institution, has been lately published a series of articles written by Mr. Ernst Hartert (one of Mr. Rothschild's staff of naturalists, whose name is well known to all zoologists), containing an account of the various expeditions which he has made, in the intervals of a very busy life, to the tropics of three continents. These articles are reprinted in the volume now before us, and are accompanied by some excellent illustrations.

Before noticing this work, we may express some regret that Mr. Hartert did not write it in English, with which language, we believe, he is quite as familiar as with his native tongue. All educated Germans can read English; but it is a fact, we regret to say, that many highly educated Englishmen do not read German with facility, although they may be able to comprehend its general meaning. By writing in English, we believe, Mr. Hartert would have secured a much larger number of readers for his interesting narrative.

Mr. Hartert is so fortunate as to have visited the tropics of Africa, Asia and America in the course of his wanderings—a feat which we suppose few other naturalists have achieved. In April, 1885, he left Hamburg as a volunteer zoologist in company with Flegel's Niger-Benué Expedition, to an account of which the first section of this work is devoted. From Loko, on the Benué, a successful journey to Sokoto and Kano was made across Hausaland, but the talented leader of the expedition lost his life on the way back and others were very sick. Various zoological notes will be found in the text of the narrative of this excursion, and special chapters on the birds of the Canary Islands and of Hausaland are added.

In August, 1887, our author turned his face to a very different part of the earth's surface, and started for Penang and Sumatra, with the object of making entomological collections for the late Dr. Richter's cabinets. The journey was subsequently extended to the attractive island of Salanga, on the coast of the Malay Peninsula, and to the British Protectorate of Perak, where both fauna and flora seem to be of the richest and most varied character. An account of these journeyings, interspersed with zoological notes, and of the return home through British India occupies the second section of our "Naturalist's Wanderings." Special chapters are devoted to an annotated list of the birds of Deli, in Sumatra, where examples of 212 species were met with. In this exuberant avifauna, the hornbills, of which no less than nine species are enumerated, must form an attractive feature.

In the third section of his journal, Mr. Hartert takes us across the Atlantic, and tells us of Venezuela and its islands, which he visited in 1892, accompanied by his wife, who, we have been informed, is an accomplished collector of birds and insects. The principal exploit of the journey was the complete ornithological exploration of the three Dutch Caribbee Islands of Curaçao, Aruba and Bonaire off the coast of Venezuela, of which very little was previously known. Mr. Hartert published his account of this excellent piece of work in the *Ibis* for 1893. He now adds many details about his adventures and experiences of all kinds. He has come to the conclusion—no doubt correct—that, though many West Indian forms are represented in Curaçao and "its satellites," the greater part of their fauna has been acquired from the neighbouring continent.

In the fourth and concluding section of his volume, the author takes us back to Africa, not, however, to the fever-stricken banks of the Niger, but to the wholesome and charming sea-board of Morocco, which, according to Hooker and Ball, will ultimately become one of the finest winter-resorts of the Eastern Hemisphere. It is remarkable that a fresh and wild land so easily accessible to Europeans is not more frequented. Mr. Hartert descants fully upon the birds met with in the vicinity of Mazagan, whence he crossed the sea to Teneriffe and returned home by Madeira.

AN ASPIRING GLACIALIST.

The Cause of the Glacial Period. By H. L. True, M.D. Pp. 162. (Cincinnati: Robert Clarke Company, 1902.)

GEOLOGISTS and physicists have been at their wits' end to discover the cause of the Glacial period. They may now cease from cudgelling their brains—Dr. True, of McConnelsville, O., has finally solved the mystery. The explanation is so simple that all who have meddled

with the question must be chagrined to think that a solution so obvious should have escaped them. The author tells us that when he

"first began to read on this subject, he had a preconceived opinion of the cause, which to him seemed so reasonable that he wondered why others had not come to the same conclusion."

Ah, but that is always the way! It is only after the riddle is solved that it seems so simple—but the apparent simplicity of the solution should not detract from the merit of its perspicacious discoverer.

We give, in a few words, Dr. True's inspired "theory":—Up to and during part of the Tertiary period, the earth had so far cooled and the crust had become so thickened that it was just able to support itself.

"But finally the point was reached when it could sustain it (the pressure) no longer. The last grain of sand broke the camel's back."

Suddenly the floor of the ocean settled down, while the mighty north and south mountain ranges of the globe were ridged up. Concurrently with these movements, the polar regions were elevated into dry land, and their supply of warm water from the south being cut off, the formation of ice-fields forthwith began and finally culminated in the Glacial period. The Arctic lands then existed as plateaus—miles in height—an amount of elevation

"amply sufficient to produce almost any degree of cold, and also a slope extending several hundred miles, sufficient to account for the motion of the ice in a southerly direction. Here is where the northern elevation, which nearly all geologists say must have accompanied the Glacial period, comes in. The great wonder is that they have not seen what caused it."

It is needless to say that under such conditions the ice continued to accumulate until not only all N. Europe and N. America, "but the whole bottom of the N. Atlantic, as far south as the southern border of the telegraph plateau," were covered with an ice-sheet. While this mighty ice-sheet overwhelmed those regions, N. Asia escaped glaciation. Why? Simply because it was deeply submerged at the time, and so the polar ice advancing southwards broke off in icebergs and floated over north and south Siberia. The withdrawal of so much water from the ocean and the piling of it up in the form of ice on the western hemisphere naturally disturbed the earth's equilibrium. We should not be surprised, therefore, to learn that all of a sudden the earth "tipped" or "toppled over," in order to bring about "a readjustment of matter to the stationary axis."

"N. America and W. Europe moved down out of the cold region, while N. Siberia, on the opposite side of the earth, moved up into it."

Of course, these changes produced a cataclysm—"great tidal waves, perhaps miles in height," sweeping the ice-sheet out of the N. Atlantic and flooding much of the continents.

And so the Glacial period came to an end in N America and Europe. But, as our author remarks,

"it is plain that when the west side of the earth warmed up, the east side became cold, and it is also plain that the transition was sudden."

This is shown by the admirable preservation in N. Siberia of the carcasses of mammoths and woolly rhinoceroses—"the congeners of those now inhabiting a tropical climate."

"It seems that when the east side of the earth tipped northward, the reaction caused a great tidal wave that caught the animals which roamed over the regions south of and adjacent to the then northern ocean, and carried them away as drift, to become frozen in ice, and there they have remained ever since."

Who will not sympathise with glacialists? Their occupation, alas! is gone; no more difficulties are left for them to encounter; with a wave of his magic pen, our inspired doctor has banished darkness and laid bare every secret of the Ice Age. He knows the past of our globe so well that one cannot wonder he should be equally confident as to its future. His theory is a true "open sesame." The same succession of remarkable changes which he has unveiled for us will, we are assured, again supervene; and his readers may well shiver and shudder at the "gloomy picture" he presents for their contemplation. They are advised, however, by the considerate author not to be "uneasy" because of that dismal future—it is still a long way ahead. "They will not be here when it comes." J. G.

PROPERTIES OF MATTER.

A Text-Book of Physics. By J. H. Poynting, Sc.D., F.R.S. and J. J. Thomson, M.A., F.R.S. Properties of Matter. Pp. vi+228. (London: C. Griffin and Co., Ltd., 1902.)

THIS volume is to be regarded as the opening one of a series forming a text-book of physics, of which the second part, namely, "Sound," was published some two years ago and is now in its second edition. The remaining volumes, dealing with "Heat," "Magnetism and Electricity," and "Light," will be published in succession, it may be hoped at somewhat shorter intervals.

The book is not intended for elementary students on the one hand or for mathematicians on the other, and the authors make a welcome innovation in entirely omitting the more purely mathematical side of mechanics with which text-books on the properties of matter are usually encumbered. After a brief preliminary chapter dealing with the experimental evidence for the constancy of weight and mass, about fifty pages are devoted to a most interesting and complete account of the experimental work on the measurement of the acceleration of gravity, the figure of the earth and the constant of gravitation, introducing the student to a number of most instructive physical methods, described with the discrimination of a practised experimentalist who has made a special study of the subject. The next seven chapters (60 pp.) deal with the elasticity of solids from an experimental standpoint, mathematics being introduced only so far as is necessary to permit a comparison of theory and observation in a few simple cases, which serve to illustrate the physical principles involved. Many comparatively recent experiments are described, such as those of Ewing on the yielding of crystalline substances by slipping along the cleavage planes. The remainder of

the book deals with the compressibility of liquids and gases, and the phenomena of capillarity, diffusion and viscosity. In discussing these subjects, the molecular theory of matter has of necessity been very freely introduced, but the detailed account of the theory has been reserved for the volume on heat. Among the subjects incidentally discussed in the present volume are Van der Waals's equation for the relation between the pressure and the volume of a gas, reversible thermal effects accompanying alterations in strains, effect of temperature on surface tension, change of vapour-pressure under stress, osmotic pressure, vapour-pressure of solutions, lowering[1] of the boiling point of solutions, lowering of the freezing point of solutions, variation of viscosity with temperature, and explanation of viscosity and diffusion on the kinetic theory. An elementary knowledge of heat may reasonably be expected of the student, but it would seem preferable to have reserved some of these subjects until the kinetic theory and the second law of thermodynamics had been discussed.

It is hardly necessary to say that the book is of a thoroughly practical character, and will commend itself both to the teacher and the student. The book is written from the point of view of the experimental physicist, and the subjects selected for illustration are those most useful and instructive to the student. The mathematical methods employed are generally of a simple character. In many cases, these may appear cumbrous and difficult to the student who possesses a knowledge of more advanced mathematical methods. But even for such fortunate students, there is some compensation in the fact that the more elementary method compels attention to the physical meaning of the processes employed. In the case of many of the subjects discussed, it would be difficult for the student to find an equally concise and clear account of the theory and the experimental methods in any other book at present accessible, and we are confident that the present volume will be found to be a useful addition to the text-books available for advanced students of physics.

H. L. C.

ZITTEL'S TEXT-BOOK OF PALÆONTOLOGY.

Text-book of Palaeontology. By Karl A. von Zittel. Translated and edited by Charles R. Eastman. Vol. ii. Pp. viii + 283. (London: Macmillan and Co., Ltd., 1902.) Price 10*s.* net.

NEARLY three years have elapsed since we received the first volume of the English edition of Prof. Karl A. von Zittel's well-known "Grundzüge der Palæontologie." We therefore open the newly published second volume with some fear lest the long delay in its production be due to a complete remodelling, such as that which we criticised on the last occasion. This new instalment, however, is a welcome surprise; for, while the sections with which it deals have been judiciously edited and somewhat brought up to date, the author's original plan is strictly followed, and it still remains essentially the work of the Munich professor.

[1] This is evidently a misprint for "raising of the boiling point," which is the term used near the end of the section, but the sign of the change is not clearly brought out in the analysis.

The present volume deals with Pisces, Amphibia, Reptilia and Aves, and extends only to 278 pages—a slight increase on the original text from which it is translated. The Mammalia will form a third and concluding volume, to be issued later. This plan of subdividing the text-book into instalments of convenient size for ready reference will be appreciated by all who have been compelled to use the ponderous German edition, which is a volume much too bulky for comfortable handling.

The section on Pisces, occupying 114 pages, has been translated and revised by Dr. Smith Woodward. The author's original classification has only been slightly modified to incorporate Dr. Traquair's recent descriptions of Upper Silurian and Lower Devonian fishes, and the translator's own observations on the Pycnodonts and some of the Teleosteans. These changes are evidently approved by Dr. von Zittel himself. Traquair's figures of Drepanaspis, Birkenia and Lasanius appear for the first time in a text-book and his remarkable discoveries are now made accessible to an elementary student. The revised account of the Teleostei is also the first condensed synopsis of recent discoveries which has been published in a general treatise.

The section on Amphibia, occupying twenty-five pages, has been translated and revised by Dr. E. C. Case. There are no new figures, and the changes consist merely in a few allusions to recent discoveries.

The revision of the section on Reptilia, now occupying 116 pages, was begun by the late George Baur, whose untimely death prevented his accomplishing more than part of the chapter on Chelonia. Most of the present translation has been done by Dr. E. C. Case. The chapters on Squamata and Pterosauria have been revised and extended by Prof. S. W. Williston, who has also contributed notes on Plesiosauria and Chelonia. The chapter on Dinosauria has been brought up to date by Prof. H. F. Osborn, Dr. O. P. Hay and Mr. J. B. Hatcher. Dr. Case himself appears to be responsible for the removal of the Clepsydropidæ from the Theromorpha to the Rhynchocephalia. The revision, on the whole, is a distinct improvement on the original work. The supplementary details concerning the fossil reptiles, especially of North America, will prove very useful for reference; while a few new figures of restorations by Williston, Smith Woodward and Hatcher add to the educational value of the book.

The section on Aves has been doubled in extent by Mr. F. A. Lucas and now occupies twenty-three pages. No new figures are given, but the text is well up to date, and it is especially valuable as being a critical summary combined with original observations.

The volume concludes with a good index to the names of genera, and forms the most exhaustive work of reference on the extinct cold-blooded vertebrates and birds which has hitherto been published in the English language. Dr. Eastman and his colleagues are, indeed, to be congratulated on the successful completion of this new instalment of their undertaking, which will prove of the greatest service to all English-speaking students both of geology and zoology.