THURSDAY, AUGUST 7, 1902.

HANN'S METEOROLOGIE.

Lehrbuch der Meteorologie. Von Dr. Julius Hann, Professor an der Universität in Wien. Mit 111 abbildungen im text, 8 tafeln in lichtdruck und autotypie, sowie 15 karten. (Leipzig: Chr. Herm. Tauchnitz, 1901.)

THIS remarkable book had its origin in a suggestion by the publishers that Dr. Hann should write a text-book of meteorology for students. As the author himself points out, it has travelled far beyond its original object, and as it stands it constitutes substantial ground for increased gratitude to Dr. Hann from meteorologists of all countries, by whom he has long been recognised as a master in the subject. The book is a veritable encyclopædia of meteorological science. It consists of 792 pages of text, and each page is made up of small type, smaller type and smallest type. The small type gives the professor's current narrative; the smaller type gives a large number of technical details; the smallest type embodies a most valuable series of references with critical notes; and the whole constitutes a complete representation of the present position of meteorological science apart from those climatological details which are given in Dr. Hann's well-known "Climatologie."

The arrangement of the book is on physical lines. After a general introduction, temperature in all its relations, pressure, moisture, wind phenomena and dynamical meteorology, *i.e.* the meteorology of atmospheric disturbances, are successively treated, while an appendix gives some of the most important of the mathematico-physical theories of meteorology.

One striking feature which illustrates the wide range of the book is the number of distinguished physicists and chemists whose researches have contributed to the development of meteorological science and whose papers are quoted or referred to. Among English physicists the names of J. W. Strutt, Lord Rayleigh, Lord Kelvin, Stokes, Osborne Reynolds, Shelford Bidwell, W. Ramsay, J. J. Thomson, Abney, Schuster, Oliver Lodge, Poynting, all appear as responsible for various meteorological contributions, and a similar list of names might be adduced for other countries. It may surprise physicists generally to learn how many of their distinguished colleagues are referred to in a work which deals with the present state of meteorology adequately. It is satisfactory evidence that meteorology has not yet drifted out of touch with modern physics.

The arrangement is so skilful that every page of the book is full of interest. It takes a thoroughly rational and impartial view of all meteorological theories and speculations, gives an account of the results derived from the discussion of most voluminous meteorological observations, and in spite of the huge mass of material with which it deals it manages to keep the reader's attention. It is, indeed, difficult to read because it is so full of matter and so skilfully arranged that the reader is hardly willing to regard one page as exhausted and to go on to the next. The illustrations are all most carefully selected, excellently reproduced, and some of them are impressive examples of the possibilities of photographic reproduction in what may be called the department of the natural history of the atmosphere. They make one wonder whether it is not really an advantage for other departments of natural history and for the public that their specimens are so unwieldy that they must be broadly displayed in a suitable museum instead of being neatly folded away in books and stored on the upper floors of an office. No doubt Dr. Hann, who for so many years has been in touch with meteorologists of all countries, is in a position of special advantage in regard to the work of compiling such a book, but when all his advantages are taken into account the reader cannot help being amazed at the skill and judgment with which the organisation of the facts has been carried out. Whether one deals with the variation of meteorological elements from hour to hour, from day to day, from month to month or from year to year, the statistical results are so clearly and concisely expressed and the salient features so well marked by special type or other devices that the reader can draw his own conclusions with ease. To take a trivial example, on p. 335 we find statistics of the diurnal distribution of rain. Those who are interested in such matters may see at a glance that at Kew in summer the most unfavourable hours for a garden party are from 2 to 4 in the afternoon, and next to those from 4 to 6, when the frequency of rain is about half as much again as it is between 6 and 8 a.m., whereas in winter from 4 to 6 is the best time of the day from the point of view indicated. On the other hand, at Valencia the frequency of rain from 4 to 6 in the afternoon in summer is not much more than half the frequency at the corresponding morning hours.

The work is brought very closely up to date. The most recent developments of the study of the upper atmosphere by means of kites, balloons and clouds are noted, and some of the results of the simultaneous balloon ascents under the auspices of the International Aëronautical Committee are included.

In dealing with the physical aspects of meteorology the author exhibits the same comprehensive grasp of the subject and the same conciseness of style as when dealing with the direct results of observation, but here the reader may find himself at fault. The science requires a knowledge, not only of meteorological facts, but of the physical and chemical theory which is necessary for the appropriate coordination of the facts. The author briefly incorporates all contributions to the science, and naturally when he makes use of physics or chemistry or mathematics he does not stay to develop the necessary introductory study of those sciences. The consequence is that many concise and comprehensive sentences require a considerable amount of antecedent knowledge for their full appreciation. As an example of the rapidity with which subjects are passed under review, I quote the paragraph which deals with the selection of the thermometric scale, as follows:—

> "Die Fahrenheitsskala ist noch in allen Ländern englischer Zunge, selbst in wissenschaftlichen Werken üblich. Als ein Vorteil derselben wird angeführt dass man weniger mit negativen Graden zu rechnen hat und dass der Grad kleiner ist, weshalb es vielfach genügt die Temperatur nur in ganzen Graden anzugeben,"

with the footnote,

"Sehr auffallend muss es erscheinen dass die namentlich für physikalische Formeln ganz unbehilfliche Fahrenheitsche Skala noch jetzt bei Männern der Wissenschaft Verteidiger findet. M. S. z. B." Buchanan, in NATURE, August 17, 1899. "Auch Sir John Murray ist für die Fahrenheitsche Skala."

The words are few, but they give a remarkably vivid picture of the present position of a very important question, and the example is quite typical of the author's style.

When an author with this power of concise representation deals with the present state of our knowledge of the composition of the atmosphere, solar radiation and its measurement, the general circulation of the atmosphere, the thermodynamics of the atmosphere and the modern developments of atmospheric electricity, it will be evident that he has gone far beyond the limitations of an introductory text-book and addresses himself to mature students.

In order to deal more completely with the theoretical side of the subject, an appendix of sixty-eight pages is devoted to the exposition of some of the most important mathematico-physical theories of meteorology and their applications. In this are included (1) the calculus of periodic phenomena; (2) the distribution of heat in the ground; (3) thermal distribution in the atmosphere; (4) nocturnal changes of temperature and the coefficient of radiation of atmospheric air; (5) the vertical distribution of pressure and its relation to temperature and moisture; (6) measurement of height by the barometer. These involve an adequate knowledge of mathematical processes and may be found difficult by those who are not familiar with mathematical physics.

For this reason the book must be regarded as encyclopædic rather than didactic. The beginner who reads it will be conscious that he has much to learn, and even the expert will realise that there are many things he would like to pursue further. Yet the style is happily chosen. It will be recognised that means of obtaining the necessary information are everywhere available for students who desire it, and to have amplified the work by including instruction in the indispensable preliminary knowledge would have spoilt it. Dr. Hann is entitled to the sincerest congratulations on the rapid completion of so thoroughly comprehensive a treatise. There can be no question that the publication of so complete a summary of meteorological knowledge must lead to important developments from the many points of scientific and practical interest which are exhibited. It is indeed fortunate for the science that the University of Vienna is able to afford to so distinguished a meteorologist opportunity for the prosecution of this important work.

W. N. SHAW.

THE FIBRE INDUSTRIES.

The Textile Fibres of Commerce. By William S. Hannan. Pp. x + 236. (London: Charles Griffin and Co., Ltd., 1902.) Price 9*s.* net.

THE title of this work raised a hope that the author had seized the opportunity open to any specialist of carrying on the critical labours of Vetillart, Wiesnet, Hugo Müller, J. Christie, Otto Witt, and the experts of the Colonial and Indian Exhibition, now almost of ancient history. The opportunity is a great one; for the subject-matter is vast, the interests involved are stupendous, while the first principles of the subject are few, very few, and so are they who recognise them. The opportunity is one, not merely for a book enunciating in one comprehensive view the relationships of our highly developed textile methods to one another and to the properties of the ultimate spinning units, but for a definite forecast of the progressive future, which is of obvious commercial moment.

The book before us, however, neither aims at nor claims to reach the pioneer standard of technical literature, and must be judged accordingly. The author's labours have no doubt been exhaustive and minute. But the failure to attain to the ideal standard is self-predicted by the opening sentence of the introduction:—

"The vegetable and mineral fibres of commerce may be arranged in four groups, viz. (1) plumose fibres; (2) stem and leaf fibres; (3) fruit fibres (all derived from plants); and (4) mineral fibres. These groups are represented by the fibres used in various important industries, and by other vegetable fibres which at present are of special interest from a scientific point of view only."

This classification has no morphological basis and is devoid of technical significance. The sentence stands immediately beneath the title "The Textile Fibres of Commerce," and the reference to these "other fibres," which are, in fact, from the point of view of commerce or industry, mere lumber, introduces us to the supposed antithesis of science to commerce, which is archaic, but in these days misleading, and were better left out. The introduction, in short, prepares us for the plan actually followed in the book, which is that of alphabetical sequence of the conventional or trivial names of the fibres; perhaps the best in the absence of a positive, critical basis and consequent classification. The reader is thus prepared to find the book a non-critical compilation, and although the title suggests the subordination of the matter to commercial, that is industrial,proportions, the expert will be disappointed and the lay reader will get little instruction in the *practical science* of the subject.

Of course, be it understood, a book of 230 pages, upon such a subject, and containing 150 illustrations, mostly the original work of the author and friends, affords much interesting reading. This interest belongs to the subject, which is fascinating from whatever point of view it may be handled. We have no wish to depreciate the author's evident aim to popularise the subject; on the contrary, we wish for the book a successful run, and that a second edition may see a considerable improvement in the matter. But as we take the request in the preface for "any suggestions that will enable me to add to the utility of this work" as an honest invitation to the critic, we feel we should be wanting in honesty and in a duty to the technical public if we shirked the task of pointing out by a few examples the author's want of precision in handling fundamental questions. We cite first the introductory sentence of the section "Vegetable Fibres," p. 3, "Physical and Chemical Properties," which reads, "The principal vegetable fibres are plumose and bast. Both are used for spinning and weaving, and their prices fluctuate in accordance with the quality and quantity of the annual crops. The plumose fibres are composed of cellulose."

Plumose and bast should not be coupled with the same term "fibre" unless the author intends "ultimate fibre." We take it that the spinning unit is intended, and in the case of the bast fibres the unit is a more or less complex *filament*. Fibres are not used for spinning *and* weaving; the fibres or filaments are spun into yarns and the yarns woven. It is fairly obvious that prices vary with supply and quality, but there is something to be said for demand. Why, however, interject this superficial reference to the important question of value under the heading of "Physical and Chemical Properties"?

Lastly, to describe the plumose fibres as "composed of cellulose" is misleading. In the cotton substance the non-cellulose, it is true, is small in proportion, but the composition of the *eriodendron floss*, as of other seed hairs, is widely divergent.

Later in the section we find the bast fibres described as made up of cells of which the "walls are composed of more or less thickened lignin or woody material." This is quite inaccurate in regard to the most important of them, viz. flax, hemp and rhea.

Again, the "good commercial qualities" of the fibro-vascular bundles of monocotyledons "depends upon their moderate length, strength, flexibility, and the number of fibre cells in each bundle." Without reference to the grammatical slip, we will fix the looseness of the phraseology by transposing the terms to another case. "The good commercial qualities of gold depend upon its moderately yellow colour, specific gravity, ductility, and the number of silver coins of equivalent value"!

We have dealt with this section on "Physical and Chemical Properties" at disproportionate length, for the author exhausts it in a single page of matter. The failure to lay a solid critical foundation by an adequate treatment of the section, of obviously fundamental import, measures the failure of the work to contribute to the systematic development of the subject.

We are bound, further, to particularise some strange inaccuracies in the information conveyed to the perhaps unsuspecting reader. Jute is described under the heading "Jute, Common," and the description contains many curious statements. Thus:—

"The fibres are several feet in length, have a satiny lustre on account of which they are sometimes used in the manufacture of the cheaper silks."

There is a popular confusion, we presume, between jute and "jute"; there is also a slang word "water" well known "in the city," but we suggest that only in the official mind of a judge of the High Court would there be any possible confusion of the material with the immaterial "water." So we venture to think that the author has served up a popular error in relation to "jute" as an industrial fact in relation to jute.

In particularising the applications of jute yarns we find,

"the backing of hearthrugs, the lining of ladies' slippers, the collars of gentlemen's coats and burlaps for bales of jute or hemp coverings."

We refer the author to Dundee for information.

Lastly, "the jute fibre readily dissolves in alkalies and mineral acids at a low temperature." The reader may correct this statement by reference to any of the standard works on cellulose chemistry.

The chemistry of the fibre substances is dealt with generally in a superficial way. The author should have been careful to avoid such statements as the following in reference to cotton (p. 91):—

"Acids have so destructive an effect upon cotton that their use in the cotton industry ought generally to be dispensed with, since alkalies such as soap . . . can be employed for scouring and cleaning cotton fibres without materially injuring them."

And again (p. 97),

"Cotton fibres have some affinity for vegetable dyestuffs such as indigo . . . but little or none for coal-tar dyes."

The section on "Cotton" otherwise contains useful information of a conventional commercial order, and as it comprises some forty-five pages is clearly the most important of the book. In the categorical description of the various cottons, the dimensions are given in inches and fractions of an inch. This in a scientific text-book is a gratuitous concession to the rigid conservatism of our industrial system. We should like to ask if the expression 1/1180 inch conveys any definite mental impression to the reader?

We briefly notice the section "Paper Fibre Plants." We all know that paper can be made from an endless variety of fibrous materials, and the author is evidently more impressed with the fact than with the advantage of using the qualifying term "commercial" as a winnow for separating the grain from the chaff. The paper-maker will find the section of little practical importance. The subsection "Woodpulp" opens with the curious sentence, "This is rather confused and mixed up with paper-making." The remainder of the section may be similarly described.

A subsection on "Woodpulp Silk" is rather out of place at the conclusion of the section on "Silk." The treatment of this highly important industry indicates that it lies outside the author's range of experience and does not invite serious criticism.

The author is entitled to the credit of having produced an interesting book on a universally attractive subject. That it does not take the place of a standard text-book of critical importance is due to the fact that he has not sufficiently grasped the trend of the progressive scientific movement which underlies the many-sided "commercial" developments of the fibre industries.

THE FISHES OF THE CONGO BASIN.

Les Poissons du Bassin du Congo. Par G. A. Boulenger. Pp. lxii + 532. (Bruxelles: Publication de l'État Indépendant du Congo, 1901.)

IT is a striking proof of the high estimation in which science is held by the authorities of the Congo Free State that they have devoted so much expense to the publication of the beautiful volume now before us, and it is also fortunate for science that the material was placed in the hands of so highly competent an ichthyologist as

Mr. Boulenger. Already a lavishly illustrated quarto volume ("Annales du Musée du Congo") had been issued containing descriptions and figures, by the same author, of new genera and species of fishes recently discovered in the Congo, and now comes the present work, the twenty-five plates of which are "half-tone" reproductions of the lithographs illustrating the descriptions in the "Annales."

This is the first work dealing with a group of animals over the whole extent of the Congo Basin, *i.e.* including Lake Tanganyika. It commences with an introduction divided into six parts, namely, (1) general characters of the fresh-water fishes of Africa, (2) distribution of fishes in the Congo Basin, (3) fisheries and methods of capture, (4) methods of preservation and transport of fishes for scientific purposes, (5) terminology used in scientific descriptions of fishes, (6) list of previous writings specially dealing with the fishes of the Congo Basin.

A few years ago, about 90 species of fishes were known from the Congo Basin, but in the present work the list is swelled to no less than 320, 78 of which are confined to Lake Tanganyika. The families most abundantly represented are Mormyridæ, Characinidæ, Siluridæ and Cichlidæ, the name for the last-mentioned family being for good reasons adopted in place of the better-known "Chromidæ."

I am glad to see that, in spite of Cope's dictum, Mr. Boulenger still considers the Lampreys to be "fishes," as he divides the class into three subclasses—Cyclostomi, Chondropterygii and Teleostomi. Only the last is represented in the fish-fauna of the Congo Basin.

The Teleostomi include here the Crossopterygii, the Dipneusti (the usual name "Dipnoi" is rejected on account of its having been originally used to designate the Batrachia) and the Teleostei. Our author seems inclined to retain the "Ganoids" (= Acipenseroidei and Lepidosteoidei) as a distinct order, but as none of these inhabit the basin of the Congo, the question is not gone into in a detailed manner. As to the Crossopterygii, Mr. Boulenger admits only two primary divisions, the extinct Osteolepida and the modern Cladistia, represented in African rivers by the singular though well-known family Polypteridæ, of which five species of Polypterus, three being new additions, and one of Calamichthys are here chronicled. As regards the Dipneusti, in the course of some interesting remarks on vertebrate limb theories, the author adopts Dollo's view as to their probable derivation from the Crossopterygii, the corollary to which, as the present writer has also pointed out, is that the "archipterygial" form of limb must have been diphyletically realised, on the one hand, by the Pleuracanthid Selachii, and on the other by the Holoptychii and the lung-fishes. An interesting new species of Protopterus (*P. Dolloi*) is here described and figured.

Proceeding to the ordinary bony fishes or "Teleostei," we may note in the first suborder, that of the Malacopterygii, the extraordinary variety of form among the Mormyridæ, even within the limits of one genus, as in the case of *Mormyrops curtus* and *M. attenuatus* (plate iii). Sagemahl is followed in the association of the four families of Characinidæ, Cyprinidæ, Siluridæ and Gymnotidæ in one group or suborder of Ostariophysi, the essential characteristic of which is the presence of the Weberian ossicles, by which the swim bladder is brought into relation with the ear. The Cyprinodonts, of which the region produces four species all belonging to the genus Haplochilus, are included with the Esocidæ, Dalliidæ and Amblyopsidæ in a third suborder, that of the Haplomi. A fourth is formed by the Percesoces (the Müllerian "Pharyngognathi" being entirely abandoned), and which includes, not merely the Scomberesocidæ, but also the Ammodytidæ, Atherinidæ, Mugilidæ, Polynemidæ, Sphyrænidæ, Ophiocephalidæ and Anabantidæ. Coming now to the fifth suborder of Teleostei, that of the Acanthopterygii, we find that, with the exception of a few Serranidæ, Sciænidæ and Pristipomatidæ, it is entirely represented by twenty-four genera and eighty-seven species of one family, that of the Cichlidæ (= Chromidæ of Günther). This family, which was also included in the "Pharyngognathi" of the Müllerian system, is here considered as closely allied to the Perches, in spite of the fusion of the inferior pharyngeal bones. The diversity of genera of this family in Lake Tanganyika is worthy of notice. The volume finishes with a description of eleven species of Mastacembelus (suborder Opisthomi) and one of Tetrodon (suborder Plectognathi).

In conclusion, it may be said that the talented author is to be congratulated on the interesting work he has produced, and the zoological public in having, in so compact a form, a guide to a general knowledge of the fresh-water fish-fauna of so large a portion of the African continent, interspersed with many valuable remarks bearing on the subject from a morphological as well as systematic standpoint. R. H. T.

APPLIED MECHANICS.

The Roorkee Manual of Applied Mechanics, Stability of Structures, and the Graphic Determination of Lines of Resistance. Vol. ii. By Lieut.-Colonel J. H. C. Harrison, C.E., late Assistant Principal, Thomason Civil Engineering College, Roorkee. Pp. viii + 318 + 70. (Roorkee: Printed at Thomason Civil Engineering College Press.)

THIS "Manual of Applied Mechanics" is primarily intended for the use of students of the Thomason Civil Engineering College, Roorkee, North-West Provinces, India. It forms an extension of vol. i.; the latter was originally prepared by Lieut.-Colonel A. Cunningham, R.E., and was revised by the present author in 1895.

Vol. i. does not include important subjects such as the stability of block-work, the design of retaining walls, abutments, masonry arches, earthwork, foundations, &c. These omissions have been met by the issue of vol. ii. Moreover, the treatment in vol. i. is mainly analytical, whereas in vol. ii. graphical methods have been developed and largely employed; so that the two volumes together now form a very complete treatise on the principles of mechanics as applied to roofs, girders, bridges, foundations and allied structures.

In the first part of the volume under review the author describes the plotting of vector and link polygons for a general system of forces in one plane. Then, in reference to various types of structures, such as beams, cantilevers, block-work, suspension chains, and arches he develops the properties of these polygons and shows how, by their use, the shearing and bending actions, lines of resistance, &c., due to given loads may be determined. The drawing of link polygons so as to lie within given loaded arch rings is explained, and applied to the determination of the so-called line of least resistance of a masonry arch. The deflections of beams are next considered, and the link polygon method is extended and applied to the plotting of the elastic curves of loaded beams, including continuous beams. The latter were treated in vol. i. by the aid of the theorem of three moments. The student has thus the advantage of a comparison of the two methods.

Nearly a fourth part of the text is thus occupied in establishing the fundamental properties of the link and vector polygons, and then the author, in the second part, which comprises the remainder of the work, and is divided into three sections, proceeds to the practical applications.

Section i. deals with the stability and design of tall chimneys, buttresses, and various forms of cranes.

In Section ii. the subject of earth pressure is very fully considered, and examples are given of the design of retaining walls to resist the pressure of earth, and of masonry dams for reservoirs.

"Structures that span an interval" is the heading to the concluding Section iii.; and here the author treats very fully of masonry arches, fixed and continuous girders, cantilever bridges, stiffened suspension bridges, hinged metal arches, &c.

In an appendix a partial reprint is given of a paper by Colonel A. Cunningham on well foundations, which should prove of special interest to students and engineers in India, where, in spanning many of the rivers, the foundations have to be laid in quicksand.

It seems an unfortunate omission that in so excellent a treatise no reference is made to the application of the strain-energy method and the principle of least work to calculations on the deflections and stresses in braced frames, structures with redundant members, arched ribs, &c.; but otherwise the treatment is quite up to date. As regards practical construction, information is given as to the design of many details; and some examples of complete designs are fully worked out, and illustrated by drawings, taken principally, by permission, from Colonels Wray and Seddon's "Instruction in Construction." There are numerous folding plates, facilitating reference and allowing the figures to be drawn to a large scale.

The treatise can be recommended as a useful book of reference for engineers in the pursuit of their profession. Students who master the details of both volumes should, in the subjects of which they treat, be well equipped for their duties of after life.

OUR BOOK SHELF.

Ordnance Survey of England and Wales. Scale 4 miles to 1 inch, or 1:253,440. Sheet iv. Price 1*s.* 6*d.*

THIS sheet is a specimen of the new quarter-inch map of the British Isles which is being issued by the Ordnance Survey at Southampton, and we have pleasure in recognising in it many marks of the vitality of the Survey and of its power of employing the most modern methods to meet new requirements. The old quarter-inch map of Ireland in four huge sheets was a masterpiece of engraving and of printing directly from the plate; the old quarter-inch map of Scotland was a somewhat hapless attempt to show rivers in blue on an outline very sketchily printed from transfers in black, while the old quarter-inch map of England was a clear outline with fine lettering but little detail, the antiquity of which was thrown into painful relief by the insertion of railways up to a modern date. The new quarter-inch map of Great Britain, now in course of publication, is up to date in all particulars, and beautiful as well as accurate. The sheets are of convenient size (24 in. × 16 in.), the edges graduated to single minutes of latitude and longitude, with the meridians and parallels for each 20′ drawn clearly across the map, thus greatly facilitating the plotting of any distribution which has been worked out on maps of a larger scale, an advantage which will appeal to every geographical worker. The names and general detail are printed in black, the size of the lettering nicely graduated to show relative importance, and the style of execution is worthy of the best traditions of the old one-inch map. Railways are shown in a strong black line, county boundaries in a distinct dotted line, and roads of three classes are distinguished, the first class having the usual indication as to fencing and being coloured solid brown. Rivers and other water surfaces are given in blue, and when the altitudes marked on in bold black figures are considered the surface would appear to be so fully occupied that nothing could be added. Here, however, the chief novelty and beauty of the map appears. The configuration of the country is shown by a hill shading so expressive and unobtrusive that it actually seems to make more room for the other features, by throwing each into its own proper place and fixing it there. The blue threads of the water-courses accentuate the valleys of the high moorlands, the roads and railways are fitted with a pictorial commentary explanatory of every curve; even the county boundaries, so arbitrary on common maps, are seen to be natural lines, now a main watershed, again a powerful river. Colonel Johnston deserves the utmost credit for his bold and successful experiment in expressing relief without the use of contours or of hachures by the half-tone photographic reproduction of washes of colour. The hill-work is printed in brown, with which the blue of the water and the black of the names and railways contrast equally, and even the green with which extensive woodlands are shown stands out well.

The technical production leaves nothing to be desired, and we confidently place this map before any other in the world on the same scale for beauty of finish, accuracy of execution and sound judgment in the selection of features and names. It will be invaluable for mapping the distribution of phenomena in many branches of science, and welcome also to the tourist and motorist.

A Manual of Elementary Practical Physics. By Julius Hortvet, B.S. Second edition. (Minneapolis: H. W. Wilson, 1902.)

"LIFE is not long enough to admit of a *rediscovery* of the fundamental laws of physics. Besides . . . some of the laws were not discovered through experiment at all, but, on the contrary, were obtained by pure reasoning and afterwards verified by experiment."

This quotation will show that the author is not an adherent of the out-and-out heuristic school. But while it is not expected that a pupil shall go through the necessarily slow process of acquiring *all* his knowledge by his own investigations, he is expected to think for himself while the chain of reasoning to be followed and the conclusions to be drawn are indicated by questions which the pupil has to answer. While in sympathy, in the main, with this method, we do not think that the questions are always very happily chosen. Thus after experiments on the bending of a lath and the stretching of a spiral spring occur the following:—"What quantities included among the above results are stresses and what are strains? State the relation between the elongation of the spiral and the stretching force. Does it appear that the elasticity of the spiral is perfect? State the relation between the force of elasticity and the elongation; also the relation between the elasticity of the spiral and the stretching force. State the relation between the strain and the stress."

We like better the instruction given in regard to the performance of the selected experiments, much of which appears excellent and should prove very useful to the teacher. It is a school-book, and we therefore notice with pleasure an adequate paragraph on "significant figures" and another on the plotting of curves. The book, although a second edition, is by no means free from mistakes and obscurities, some of which will be briefly mentioned. The standard metre is not the one preserved in the Archives of Paris, but one of those at the International Bureau at Sèvres. In connection with the barometer, "The same rise in temperature has caused the metal scale and tube to expand so that the observed height is too small." The expansion of the tube does not matter. On p. 136 we find, "Heat is a physical quantity in the same sense that force is a quantity," while on p. 73 it is stated that "force is not in itself a physical entity." In the former, did the author mean "energy" instead of force? The signs in the formulæ for lenses on p. 185 are very confused. "It is important that the principal axis of the lens should lie parallel with the line joining the centres of object and image, and be as near to that line as possible" (p. 186). Page 193, explanatory of electric capacity, is bad; while in the same chapter the phrase "touch B to bring its charge to zero" occurs twice, when potential, not charge, is meant. Lines of magnetic force are said on p. 197 to form closed circuits through a magnet, although such a line has been defined as giving the direction in which a north pole would be urged.

Such statements as these will mislead a teacher who is not very clear himself, and work the usual havoc. But a good man will receive a large number of useful hints from the book, and to such we commend it.

A. W. P.

The Journal of the Iron and Steel Institute General Index. Vols. xxxvi.–lviii., 1890–1900. Edited by Bennett H. Brough, Secretary. Pp. 511. (London: E. and F. N. Spon, Ltd., 1902.)

IT is impossible to over-estimate the value of collective indexes to the transactions of scientific societies as an aid to research. The new general index to the twenty-three octavo volumes of the *Journal* of the Iron and Steel Institute published during the years 1890 to 1900 inclusive is of special value, inasmuch as it contains references, not only to the authors and subjects of papers contributed to the Institute, but also to those of papers relating to iron and steel and cognate subjects published in other journals at home and abroad of which abstracts have been printed by the Institute. These abstracts are systematically arranged and constitute a valuable feature of the Institute's *Journal.* They indicate the great amount of activity at present exhibited in research and investigation connected with iron and steel. In 1900 no less than 1507 papers dealing with iron and steel, written in various languages, were abstracted. The general index furnishes, therefore, a useful means of reference to the whole field of recent literature of iron and steel. The volume also contains an interesting introduction tracing the history of the development of the Institute. From its foundation in 1869 to the end of 1900 it had published 581 original memoirs, and its *Journal* had covered 29,105 pages, with 1124 plates. This introduction is illustrated by full-page portraits of the sixteen past presidents, the seventh Duke of Devonshire, Sir H. Bessemer, Sir Lowthian Bell, W. Menelaus, Sir W. Siemens, E. Williams, J. T. Smith, Sir B. Samuelson, Dr. Percy, D. Adamson, Sir J. Kitson, Sir F. A. Abel, E. Windsor Richards, Sir David Dale, E. P. Martin and Sir W. Roberts-Austen.

Zur Metaphysik des Tragischer. By L. Ziegler. Pp. ix + 104. (Leipzig: Dürr'schen Buchhandlung.) Price Mk. 1·60.

A PLEASANTLY written little pamphlet on the spirit of tragedy and its philosophical implications. Mr. Ziegler's main contention is that the object of tragedy is to exhibit the absolute domination of the whole personality of the tragic hero by a single impulse or purpose. The tragic catastrophe affords, as it were, an ocular demonstration of the "illogicality" or "guilt" of any finite purpose which sets itself up against the totality of the world-process. This thought is then affiliated by the writer to the central idea of von Hartmann's doctrine of the unconscious, the "redemption" of the "cosmos" from itself. As in duty bound, Mr. Ziegler exhibits all the intellectual prejudices of the sentimental-romantic school to which he belongs. He is, of course, anti-semitic, and is quite sure that "we Germans" are the metaphysical salt of a degenerate world. Also he prefers Richard Wagner to Shakespeare as an exponent of the tragic idea. From his somewhat sentimental point of view he has some interesting criticisms of ancient and modern tragedy. This is not the place to discuss his theory in detail, but one question may perhaps be put to him. On his view, so long as the tragic hero wills something passionately, it must be a matter of indifference what he wills. Richard III. or, for the matter of that, Bluebeard is as good a hero as Antigone or Othello. Now does not this position, to say the least of it, require some substantiation? With more reverent study of the great masters of tragedy and less rhetoric about the defects of the Jews and the superhuman excellences of the German genius, he may in future make a more valuable contribution to æsthetic theory.

A. E. T.

Hygiene for Students. By Edward F. Willoughby, M.D.Lond. Pp. xx + 563. (London: Macmillan and Co., 1901.) Price 4*s.* 6*d.*

THIS book, which is a fourth edition of the "Principles of Hygiene," although designed for the examinations of the Board of Education, covers a wide field, and should be of considerable value to medical practitioners and others who wish to gain a general knowledge of, without going deeply into, the subject. An excellent account is given of various dietetic substances, wines, tea, coffee, bread, meat, butter, &c., their actions, uses and adulterations. Some good advice is given respecting sleep and its attainment, but the suggestion that 5–10 grains of chloral may be taken in extreme cases of insomnia is decidedly one that should have been omitted. Ventilation and heating are dealt with more fully than is usual in books of the size; and there is a good account of drainage and sanitary appliances. Chemical methods for the disposal of sewage are condemned, while a concise account of the various bacterial systems is given. The author adopts a classification of his own of the specific infective diseases, which has many points to recommend it; and the information given seems to be well up to date, *e.g.* the transmission of malaria and of yellow fever by the mosquito. Altogether, the book is one which may be recommended, not only to the beginner, but also to the advanced student, for much information is introduced which is usually only met with in the larger text-books.

R. T. H.

LETTERS TO THE EDITOR.

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

A Simple Telephonic Receiver for Wireless Telegraphy.

WHILST engaged in some testing experiments with an installation for wireless telegraphy (Popoff system) between the Hook of Holland and the Government lightship, lying at a distance of 16 km. from shore, it occurred to me to try telephonic communication. As the necessary apparatus, now constructed by different companies, could not be procured without much delay, I made myself a most simple arrangement, yet yielding excellent results, an account of which may interest those occupied in similar experiments.

I fixed two parallel pieces of carbon (as used in an ordinary arc lamp) having a length of 5 cm. on a square piece of wood, and made with it a circuit including a couple of dry elements (small size) and an Ader telephone; the circuit was completed by placing three or four common sewing needles loosely in transversal direction on the carbon rods. The apparatus is ready for use when the insulated wire of the signal mast (antenna) is joined to one carbon and the other is connected to the earth conductor. The letters from the Morse alphabet are very distinctly heard by this most simple device as shorter and longer taps in the telephone, and at the given distance the telegrams were easily read by sound, by a trained operator, as they were sent from the ship, and more quickly, of course, than they could be delivered by the usual coherer arrangement combined to the Morse writer; besides, it does not require special care to keep it in working condition. Yet it is sensitive enough to make audible the peculiar noise which accompanies the motion of the interrupter combined with the induction coil when it is operated by hand to produce the spark.

I believe that such a receiver may prove very useful for temporary installations of wireless telegraphy, as any one may carry it, along with all its accessories, in his pocket and put it at once in action when an insulated wire can be fixed to some elevated post, earth connections being always at hand.

I also investigated this arrangement in my laboratory with the view to ascertain whether it is really auto-decohering, as has been claimed recently for circuits where a telephone is used and carbon as coherer substance. Indeed, it seems that no tapping or any other arrangement is required to keep the telephone in good receiving condition. But when I substituted a sensible aperiodic galvanometer (Weston's construction) for the telephone, and operated with a small induction coil and Leyden jar (spark 3 mm.) in an adjacent room, every discharge produced a deflection of the needle, which did not return to its former position, unless a slight tapping was applied near the carbons, otherwise each new spark increased the deflection obtained by the former. It may be that the self-induction of the coil of the telephone is sufficient for decohering, which factor is not so active when a galvanometer is substituted.

I examined other substances than the steel needles, namely, copper, nickel, platinum, carbon, this also in powder (as used in the Mix and Genest telephone), and they all gave the same result, and this was obtained in the best way when, before the sparking of the coil, the transverse wire, by slightly tapping, had obtained a contact sufficient to transmit a small portion of the circuit current. But I observed that sometimes with platinum, and also with carbon, the deflection was reduced to zero, when the sparks set in, indicating that the resistance was increased by the electric waves, instead of diminishing, as was usually the case.

I found that a certain pressure exerted on the transverse wire, lying on the carbons, did not prevent the influence of the electric waves on the contact surfaces. When a load of 1·5 kg. and even of 5 kg. was placed on the needles (protected from immediately touching them by a glass plate), the deflection of the galvanometer set as well in and the telephone answered as distinctly to the sparks, produced in another room, as before.

It is obvious that the described arrangement proves also to be a very delicate microphone, but a slight pressure applied in the same way on the transverse wires makes it directly insensible to sound impulses, as was to be expected.

The Hague, July. L. BLEEKRODE.

The Future of the Victoria University.

PROF. SCHUSTER (p. 319) does not challenge the accuracy of my statements and I have nothing to alter in them. I have enjoyed reading his playful comments, but I have no desire to enter upon a mere dialectic contest with him, especially if it is to be fought with dynamical metaphors. I only wish now to disavow the predilection for federal universities, which Prof. Schuster artfully attributes to me. I have certainly acquired belief in one existing federal university which includes Lancashire and Yorkshire, but if that "experiment" is to fail, I do not see that I should necessarily favour another of the same kind. I must therefore decline with thanks the consolation that is offered me in the contingent possibility of my being able to take part in a federal university for Yorkshire. The immediate need of those who are or may be charged with university organisation seems to me to be an authoritative and impartial pronouncement on the causes which are alleged to warrant the disruption of the Victoria University. This is what I await before agreeing to any fresh experiment. ARTHUR SMITHELLS.

August 1.

M. Faye and the Paris Observatory.

I THINK the addition of the following to the excellent article on Hervé Faye in NATURE of July 17 (p. 277) is of interest. I had the facts from Le Verrier and Faye; they have not been reported in the speeches delivered, and should not be lost to history.

It is known that one of the great things done by Le Verrier was the creation of the Central Bureau of Meteorology, as part of the Paris Observatory. When the celebrated astronomer was dismissed, in 1870, by the Emperor, no change took place in the organisation of this establishment. When Le Verrier was recalled, in 1872, after Delaunay's accidental death, he filled, as in former times, the double position of head of French astronomy and of meteorology. But he was told that steps were being taken by the Administration to form a Central Bureau, independent of the Observatory, when he should have breathed his last. This idea grieved Le Verrier; he complained bitterly of it to his friends and to the Academy.

When Le Verrier died, M. Yvon Villarceau was appointed intermediate director, and filled this office for some months. M. Bardoux, a member of the Senate, sent a message to the Academy of Sciences asking its opinion on the idea of creating an independent "Météorologie." The question was warmly discussed in secret session, and M. Faye, like many others, raised objections. The Academy accepted their opinion, and answered in the negative to the official proposition. As the advice of the Academy was not binding, M. Bardoux had a right to disregard it, which he did. The reputation of M. Faye was such that he was generally considered as being the only possible successor of Le Verrier. M. Bardoux advised M. Faye to accept the directorship of French astronomy, as meteorology would henceforth form a separate department. M. Faye thanked M. Bardoux, but declined under such conditions.

WILFRED DE FONVIELLE.

Electrical Resistance of Iron at very Low Temperatures.

OWING to the kindness of Dr. M. W. Travers in providing me with some liquid hydrogen, I have recently been able to observe the resistance of a specimen of iron wire at a temperature of about 20° absolute. The specimen was the same that had been used in previous experiments on resistance between 1100° and −200°, and the result of continuing the resistance-temperature curve is of considerable interest. In two papers on this subject Profs. Fleming and Dewar reach the conclusion that the resistance of pure metals tends to vanish at the absolute zero, but that the presence of impurity in the specimen reduces the rate of decrease of resistance with temperature, and that this behaviour may even afford a test of the purity of a conductor. This bears out a remark made by M. Edmund Van Aubel (*Annales de Chimie et de Physique*, 1899) that the purity of bismuth can be gauged by the variation of its electrical resistance between 0° and 30°.

The temperature coefficient of bismuth is abnormal when the element is in certain physical conditions, its resistance increasing with fall of temperature in more than one position over the range indicated, a behaviour which is less surprising if bismuth really contains a small percentage of polonium. An observation of resistance at the temperature of liquid hydrogen was made by Dewar on platinum, and he found that the resistance decreased to a certain value and then became constant. Thus from this result and from the behaviour of bismuth it is not altogether unexpected that a rather impure specimen of iron should show a definite turning power.

The present experiments, so far as they go, show that the resistance of iron at the temperature of -253° is actually greater than that at -191° (liquid air), a turning point on the curve occurring just below -200°. Several readings were taken of the resistance of the iron spiral when immersed in liquid hydrogen, and the readings in liquid air were consistent with my previous results. But the observations lack confirmation, and I am induced to publish them owing to the small chance of getting any more liquid hydrogen until next year. E. PHILIP HARRISON.

University College, London, July 31.

Retention of Leaves by Deciduous Trees.

I HAVE read with much interest the various communications in NATURE on this subject, as the phenomenon was the subject of much conjecture to me last winter in Northumberland. In one particular instance which I had constant opportunity of observing, the cause of the retention of the leaves could hardly have been "protection," as the beech hedge in question was in a very exposed, though by no means an elevated, situation. The hedge was a high one, probably 12 or 15 feet high, and formed a protection to the garden to the south or south-east of it, and in spite of the severe winds to which it was exposed it retained its leaves long after those of the beech trees of the neighbourhood had fallen.

I am inclined to think that it is much more probable that the frost theory brought forward by "P. T." in NATURE of May 15 is the true solution of the phenomenon than that the retention is a "protective device."

It would be interesting to know whether "P. T." or any other readers of NATURE can produce any further proof of early frosts causing the premature drying up of the leaves in the case of beech hedges and young small trees. If, as "P. T." suggests, the early freezing prevents the formation of the abscission layer of cork at the base of the petiole, it should also cause the leaves of hedges and small trees to display their autumn tints, or at least to show signs of drying up earlier than the leaves of the larger trees.

If this can be shown to be generally the case where the leaves are retained, I think "P. T.'s" theory would be considerably strengthened. A. F. G.

Henzada, July 1.

Campanulate Foxgloves.

IN the issue of NATURE for July 24 (p. 306) is a paragraph which is somewhat misleading. It is distinctly stated therein that "the terminal flower of each inflorescence was not a foxglove blossom, but a Canterbury bell (Campanula)," and again, "the combination of two flowers other than the foxglove and Campanula, if it occurs, would, however, be worth recording." There is no telling what hybridisers may do in the future, but it is quite certain they have not yet succeeded in crossing the foxglove with a Campanula, nor does it seem likely they will ever accomplish such a feat. Bigeneric hybrids (if they are really bigeneric) are not uncommon nowadays, but the union is always between nearly allied genera, not between groups so widely different one from the other as the foxglove and the Canterbury bell. The confluence of several of the uppermost flowers of the foxglove into a large cup-shaped blossom is not uncommon. Indeed, the peculiarity is so far "fixed" that a large percentage of the seeds from this form may now be relied on to "come true." Is this a case of the inheritance of an acquired character?

The synanthic condition of the foxglove flowers is mentioned in my "Vegetable Teratology," p. 40, or p. 59 of the German editions, and has repeatedly been recorded, but I am not aware that the cause of the deviation has been ascertained.

MAXWELL T. MASTERS.

Forestry.

IN my paper on forestry which appeared in NATURE of July 17 (p. 283) I was wrong in stating that *cueilletes* means "production of all kinds from baskets and fishing rods to sponges and caviare." The term means articles of forest produce, collected and utilised, though not specially made the object of the working of the forest.

Fruits and seeds, grasses, flowers, bark, medicinal products, and so on, all belong to *cueilletes*.

This correction is due to Mr. J. S. Gamble, F.R.S., who wrote the article in the Royal Scottish Arboricultural Society *Proceedings*, which I noticed in the paper referred to.

Coopers Hill, Englefield Green, Surrey. W. R. FISHER.

THE FORTHCOMING MEETING OF THE BRITISH ASSOCIATION AT BELFAST.

SECTIONAL ARRANGEMENTS.

THOUGH several of the sections of the British Association have not completed their programmes, it is possible to make a preliminary statement of some of the subjects to be brought before the Belfast meeting. Up to the time of going to press, the following particulars of sectional arrangements have reached us.

In Section A (Physics) there is to be a department in astronomy and cosmical physics, to be presided over by Prof. Schuster. To this department papers on the work on Eros, on the Moon and on Nova Persei will be presented, and some discussion on points connected with the nebular theory will, it is hoped, take place. Photographs from Yerkes Observatory will probably be shown, and several seismological communications will be made. In the section itself, Lord Rayleigh will probably raise the question of the conservation of weight in chemical reactions; Prof. Trouton will describe his experiments to detect the rotation of the ether with the earth, and Dr. Larmor will have something to say on the temperature of radiant energy. Belfast will be represented in the programme, Profs. Everett, Morton and Dixon having several communications to make.

The presidential address in Section C (Geology), by General C. A. McMahon, F.R.S., will deal with the general principles of rock metamorphism. Among the papers received or promised for the section are the following:—(1) "The Geology of the District around Belfast, including the Mourne Mountains"; (2) lecture on "The Structure of Ireland," by Prof. Grenville A. J. Cole; on "The Viscous Fusion of Rock-forming Minerals," by Prof. J. Joly, F.R.S.; "List of Minerals known to occur in Ireland," by Mr. H. J. Seymour; note on "The Scenery of Ceylon," by Mr. A. K. Coomaraswamy; on "A Lower Carboniferous Fish-fauna from Victoria, Australia," by Dr. A. Smith Woodward, F.R.S.; on "The Graptolites of the Belfast District," by Mr. R. Clark; on "The Valleys at the Head of the Hardanger Fjord, Norway," by Mr. H. W. Monckton; on "The Marine Fauna of the Boulder Clay," by Mr. Joseph Wright; on "The Original Form of Sedimentary Deposits," by Rev. J. F. Blake; on "A Stage in the Evolution of the Brittle Stars," by Prof. W. J. Sollas, F.R.S.; on "The Fishes of the Lower Devonian 'Roofing Slate' of Gemünden, Germany," by Dr. R. H. Traquair, F.R.S.

Prof. Howes is president of Section D (Zoology) this year, and it is believed that he will devote his address to a general consideration of the importance of the morphological method in zoology. As regards the subsequent work of the section, several papers of a morphological and more or less technical character have already been promised. The president will show, on behalf of Dr. Hill, an interesting series of photographs of segmenting eggs and other early stages in the development of Dasyurus. Prof. Johnson Symington will read a paper on the "Cetacean Larynx." Prof. MacBride will describe the development of Echinus, and Mr. Bles, whose exhibit of living larvæ of Xenopus (Dactylethra) excited so much interest at the Royal Society's soirée recently, will give a general account of the development of this interesting frog. Mr. Graham Kerr will describe the result of his investigations on the early development of nerve and muscle in Lepidosiren.

It is hoped that Prof. Herdman will be able to contribute accounts illustrated by lantern of his recent experiences of "Dredging in the Indian Ocean" and "Life and Work on the Pearl-oyster Banks of the Gulf of Manaar." Several other papers from the Liverpool School are expected—by Mr. A. T. Watson, on a very interesting defensive mechanism which he has discovered in certain Onuphid worms; by Mr. I. C. Thompson, on Indian Ocean Copepods collected by Prof. Herdman; and by Mr. H. C. Robinson, on his recent journeys in the East. Mr. J. Stanley Gardiner will read a paper on the "Bionomics of a Coral Reef."

The International Fisheries Investigation scheme, the inauguration of which is exciting so much interest at present, will form the subject of papers by Prof. McIntosh and Mr. Garstang. Of similarly economic interest will be Dr. J. L. Jameson's account of his reinvestigation of the problem of pearl formation. Mr. J. Stuart Thomson will give an account of his recent researches on the scales of marine fishes as an index of age.

Prof. Cossar Ewart will communicate the results of his recent experiments upon intercrossing of dogs. Prof. Weldon, in one of the evening lectures, will deal with heredity. This subject is so much "in the air" at present that it is to be hoped that some further communications dealing with it may be presented to the section. In regard to faunological matters, Dr. Scharff will read a paper on the "Atlantis Problem," Mr. Carpenter on the "Insect Fauna of Irish Caves," and Mr. Steel will make an interesting exhibit of Australian specimens.

Among the papers which, it has been arranged, will be read in Section E (Geography) are the following:—Dr. H. R. Mill, on "Antarctic Expeditions"; Dr. J. Milne, F.R.S., on "World-shaking Earthquakes in relation to Volcanic Eruptions in the West Indies"; on "The Jordan Valley" and on "Petra," by Prof. Libbey, of Princeton University, N.J.; Prof. Johnson, Dublin, on "Peat"; Mr. C. R. Beazley, on "Mythical Islands to the West of Ireland"; Mr. R. L. Praeger, of the National Library of Ireland, on "Geographical Plant Groups in the Irish Flora"; the Rev. W. S. Green, on "Rockall and Porcupine Bank off the West of Ireland"; Mr. J. Porter, on "The Cork Valleys"; Mr. R. B. Buckley, C.S.I., on "Colonisation and Irrigation in Uganda and the British East Africa Protectorate"; Captain Ryder, R.E., on "Surveys in Yünnan"; and Mr. C. H. Hawes, on "The Island of Sakhalin and its Inhabitants." The general subject of the presidential address by Sir Thomas H. Holdich will be "The Necessity for the Application of more Scientific Methods to Geographical Exploration."

The president of the Engineering Section is Prof. John Perry, F.R.S., whose presidential address is looked forward to with interest. In this section it is expected that an important report will be presented by the Committee on Road Traction. The committee, the secretary of which is Prof. H. S. Hele Shaw, was appointed two years ago to investigate certain questions connected with the propulsion of vehicles on roads. The introduction of motor cars has made these problems of great importance, and one easily realises that much has to be done, remembering that scientific engineering was born long after the railways had absorbed all important traffic from the roads. The Screw Gauge Committee reported last year that it was transferring its work to the National Physical Laboratory, and the progress of this will probably be reported this year. Among the papers to be read are several on Irish water questions, on problems connected with steam raising, on electrical and surveying apparatus and on some subjects of mechanical detail.

The president of Section K (Botany), Prof. J. R. Green, F.R.S., will deal in his address with the present position of research in vegetable physiology and its importance in connection with agriculture. He will give a general account of some of the more important problems in this department of botany, and will endeavour to indicate certain lines of research which may be expected to have important developments in the future. The work of the section will include papers on "The Morphology and Past History of the Araucarieæ," by Mr. A. C. Seward, F.R.S., and Miss Sybille Ford; on "Internodes and their relation to Morphological Problems," by Prof. Percy Groom; on "The Dorsiventrality of the Podostomaceæ," by Mr. J. C. Willis; on "The Function of the Nucleolus" and on "The Nucleus of the Cyanophyceæ," by Mr. Harold Wager; on "Sex in the Genus Diospyros" and on "Foliar Periodicity in Ceylon Trees," by Mr. H. Wright; and on "Fossil Nipa Seeds from Belgium," by Mr. Seward and Mr. Arber. Papers will also be read by Prof. Oliver and Miss Chick, Dr. Dixon, Miss Matthaei, Miss Bateson, Mr. Worsdell, Prof. Bottomley and others, and Mr. Thomas Steel will exhibit some characteristic Australian plants.

The president of Section L (Educational Science), Prof. Henry E. Armstrong, F.R.S., will deliver an address on the morning of Thursday, September 11. The subjects to be brought forward in papers, addresses or reports with a view to discussion are:—"Recent Reforms in Irish Education, Primary and Secondary, with a view to their Coordination," by Dr. W. J. M. Starkie; "Report on the Teaching of Mathematics"; Irish Educational Work: (1) "Intermediate Education in Ireland," by Mr. R. M. Jones; (2) "The Introduction of Practical Instruction into Irish National Schools," by Mr. W. Mayhowe Heller; "Technical Instruction in Relation to Industrial Development in Ireland," by the Right Hon. Horace Plunket; "Report on Teaching of Science in Elementary Schools"; "The Training of Teachers," by Prof. Withers, Miss Walter and others; "Report on the Conditions of Health essential to the carrying on of the Work of Instruction in Schools"; "The Subjects to be Taught as 'Science' in Schools and the Order in which they should be Taken," by Dr. C. W. Kimmins; papers on "Educational Experiments"; "The Teaching of English," by Mr. P. J. Hartog, Canon Lyttelton and others; joint discussion with Section G on "The Training of Engineers"; and "Interim Report on Examinations."

The Belfast Harbour Commissioners have offered to lend their steamer *Musgrave* to the local committee for the use of members of the Association for Harbour and Lough trips on three days during the meeting, and it was suggested that on one of these days a special visit of the Engineering Section might be made to the Harbour Works. Supplementary excursions are being arranged by the Belfast Naturalists' Field Club, consisting of short trips in the neighbourhood in the afternoons during the meeting, and also longer excursions for the Thursday after the meeting. Ample information respecting all these will be obtainable in the reception room. On Thursday, September 11, the Lord Mayor of Belfast, Sir Daniel Dixon, D.L., will invite members, associates and holders of ladies' tickets to a reception in the exhibition hall near Queen's College. On Friday, September 12, the Earl of Shaftesbury invites members, associates and holders of ladies' tickets to a garden party in the grounds of Belfast Castle at the foot of Cave Hill at three p.m. (limited to 600). On Saturday evening, September 13, Major Ritchie and Miss Ritchie will invite 150 members to a reception at the Grove, at nine p.m. A list of lodgings and hotel accommodation has been prepared and may be obtained on application.

THE FIRST MEETING OF THE INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA.

AT the conference which was held at Stockholm in June, 1899, having for its object the promotion of international cooperation in studying the physical and biological conditions of the seas bordering Europe, programmes were discussed and formulated, which were revised at the second conference, held in Christiania, in May, 1901, when a scheme for the coordination of the proposed work was provisionally agreed to. This scheme contemplated the creation of an International Council nominated by the Governments of the countries interested, which should meet periodically and organise and direct the proposed work, utilising for this purpose funds to be placed at its disposal by the Governments in question.

The question having been considered by all the maritime countries of northern Europe, all except France decided to participate, in most cases, however, for a few years only, and with conditions limiting the application of the funds which were voted to researches likely to produce practical results beneficial to fisheries at an early date.

The first meeting of the International Council took place in Copenhagen on July 22, when the following delegates and experts took part:—Great Britain, Sir Colin Scott Moncrieff and Prof. D'Arcy Thompson, with Dr. H. R. Mill and Mr. W. Garstang as experts; Denmark, Captain Drechsel and Dr. M. Knudsen, with Dr. C. G. J. Petersen and Dr. Ostenfeld as experts; Holland, Dr. P. P. C. Hoek; Finland, Prof. Homén and Dr. Nordqvist; Germany, Dr. Herwig and Prof. Krümmel; Norway, Prof. F. Nansen and Dr. J. Hjort, with Mr. Schweigaard as secretary; Russia, Dr. Knipovich; Sweden, Prof. O. Pettersson and Dr. Trybom, with Prof. P. T. Cleve as expert. The Council was received at the opening meeting by the Prime Minister, M. Deuntzer, who welcomed the delegates to Copenhagen and explained that the Belgian Government, while not sending a delegate on this occasion, had not dissociated itself from the work. The King of Denmark received the delegates on a later occasion, and the Prime Minister and the Minister of Agriculture gave dinners in their honour. The meetings took place in the Foreign Office, and every possible facility was afforded for carrying out the work for which the Council had assembled.

At the first sitting the Council was constituted. Dr. Herwig, of Hanover, the head of the German Sea-Fisheries Association, was elected president; Dr. Otto Pettersson, of Stockholm, vice-president; and Dr. P. P. C. Hoek, of The Helder, in Holland, was appointed general secretary, in accordance with the suggestions of the Christiania conference.

The second sitting was occupied in discussions as to the management of the business of the Council, and two committees, each consisting of one delegate from each country represented, were appointed to draw up definite proposals as to the oceanographical and biological work of the Council. The third sitting received the reports of these committees and adopted them after discussion.

The scheme of biological work has been considerably modified on account of the conditions imposed by most of the Governments in giving funds for the international cooperation. Practical results of direct value to the fisheries are sought for, and the money has been given definitely for that purpose, thus preventing the institution of researches of a purely scientific aim the results from which might not directly and rapidly lead to the benefit of fisheries.

It was decided to undertake at once the systematic study of two problems of immediate practical importance—the migrations of the most important food-fishes of the North Sea, especially the cod and herring; and the question of over-fishing in those parts of the North Sea, Skagerrak and Kattegat most frequented by trawlers, with special reference to the plaice, the sole and other flatfish, and to the haddock. Each problem is to be studied by international observations directed by an international committee under a chairman or convener nominated by the Council. The committee on fish migration consists of one representative each of Germany, Denmark, Norway, Sweden, Finland and Russia, and two of Great Britain (for England and Scotland); the convener of this committee is Dr. Johan Hjort, of the Norwegian Fisheries Department. The committee on over-fishing consists of one representative each of Germany, Denmark, Sweden and the Netherlands, and two of Great Britain (for England and Scotland), to whom will be added eventually one of Belgium. The convener of this committee is Mr. W. Garstang, of the Marine Biological Association.

A third committee for the investigation of the Baltic was also appointed, consisting of one representative each of Germany, Denmark, Sweden and Finland, with Dr. Nordqvist as convener.

The "hydrographical," or, as we would rather term it, the purely oceanographical work of the international cooperation is to be carried out by means of the steamers provided by the participating States in accordance with the provisions of the Christiania programme. The representatives of the various countries handed in provisional schemes authorised by their Governments, the British scheme including two areas for research—the English Channel west of the Isle of Wight and the Færoe-Shetland Channel. The Dutch area includes the southern and the German area the northern half of the North Sea; the Danes undertake observations between Færoe and Iceland, the Norwegians observations in the western North Atlantic off the coast of Norway, and the Russians in the Arctic Sea. It is hoped that Belgium may undertake the eastern part of the English Channel. The countries possessing a coast-line on the Baltic divide that sea between them. The essential feature of the physical work consists of a simultaneous quarterly cruise by all the ships, employing instruments and methods of higher precision than have hitherto been thought necessary, and determining the horizontal and vertical distribution of temperature, salinity, dissolved gases and also of plankton. This does not, however, exhaust the programme, which provides for securing an extensive series of surface observations, and samples from regular liners crossing the North Sea and the Atlantic, and also aims at utilising lightships and coast-stations for regular observations at frequent intervals, in order to connect the various periodical cruises and so enable a continuous record of the march of seasonal change to be kept.

The International Council will conduct its work through the Central Bureau, which has now been established in Copenhagen, and the International Laboratory, to be opened in Christiania. The Bureau consists of the president, vice-president and general secretary of the Council, with the addition of Captain Drechsel, one of the Danish delegates, as an honorary member. It will exercise the executive authority of the Council, calling the annual or extraordinary meetings when required and keeping up communication with the various national organisations through the secretary, Dr. Hoek. The chief assistant in the Bureau is Dr. Martin Knudsen, lecturer on physics in the Polytechnic Institute of Copenhagen.

The International Laboratory at Christiania will be opened under Dr. Nansen, as honorary director, in the month of October, and Dr. Walfrid Ekman, of Stockholm, has been appointed first assistant, specially charged with the purely physical work; a second assistant for chemical work will be selected by Dr. Nansen at an early date. The work of the Laboratory, as defined in the Christiania programme, includes the instruction of observers, the verification of instruments, the preparation and distribution of standard sea-water for controlling analyses, and experiments with new apparatus.

As in all international undertakings, concessions have had to be made on all sides; but the proceedings at the Council were always harmonious, and there is good reason to expect that the various national organisations will cooperate heartily to obtain results which at the end of a few years may justify the experiment to the practical man engaged in fisheries as well as to the man of science.

H. R. M.

POLYNESIAN POLITICS AND ANTHROPOLOGY.[1]

IN the course of a long residence in the South Pacific as a British official, Mr. Basil Thomson has from time to time published several amusing and instructive works, illustrative of native life and thought and the problems with which a civilised Government has to deal. Not the least instructive, or the least amusing, of these was "The Diversions of a Prime Minister," issued in 1894. There the author recounted the difficulties which beset him in repairing the evils of the misgovernment of the Tonga Islands by Mr. Baker, formerly a Wesleyan missionary, and afterwards, as prime minister of the king, practically despot of the islands. The present volume narrates his experiences as commissioner for the purpose of taking over the suzerainty of Savage Island and Tonga consequent on the Samoa Convention with Germany, whereby these islands were assigned to Great Britain. So far as regards Tonga, therefore, it is a sort of sequel to the former work. The more important part of the book, however, and, to those who are interested in the well-being of the Pacific Islanders, the more pleasant part, is that which concerns the visit to Savage Island. The sovereignty of that island had been offered to Queen Victoria in 1887, and a protectorate so long ago as 1859. The island had been Christianised by the London Missionary Society, of whose missionaries, and particularly of Mr. Lawes, the resident missionary at the time of the proclamation, Mr. Thomson speaks in the highest terms. The natives were accordingly well-disposed towards the object of the visit; and the ceremony of proclamation of British supremacy was performed, and the protectorate flag hoisted, after the signature of a formal treaty, in the presence of a general assembly of the people, with their full assent.

Mr. Thomson took the opportunity of his visit to make inquiries into the history, customs and racial affinities of the natives. This was partly a business inquiry, for on coming under British rule certain changes in the law, particularly in the penal code, were requisite. It is only one example of the intimate connection between anthropological study and the practical politics of the widely extended British Empire. Fortunate it was for the Savage Islanders that an official so experienced in the ways of the Polynesian and Melanesian races, and so sympathetic, was found to undertake these delicate duties.

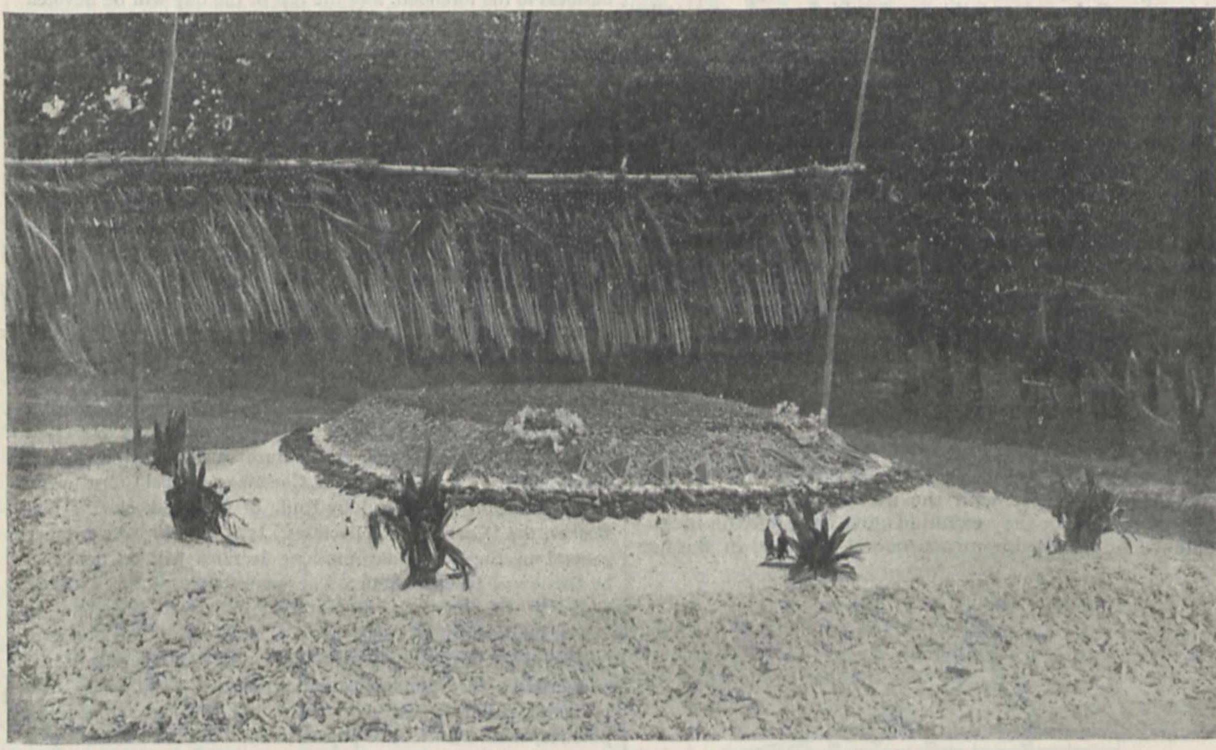


FIG. 1.—A grave in Tonga.

To enumerate the various subjects of scientific interest briefly discussed by Mr. Thomson would be to make a pretty long list. It must suffice to mention only three or four. The first is the physical and mental characteristics of the Niuéans. Polynesians they are, but Polynesians with a dash of alien blood which has rendered them less indolent, more alert and enterprising, than others of Polynesian race. Another subject is that of the historical value of tradition. The author cites a Niuéan tradition of a Tongan invasion, and sets beside it the Tongan account of apparently the same event, as well as an

[1] "Savage Island: an Account of a Sojourn in Niué and Tonga." By Basil Thomson. Pp. viii + 234. Illustrated. 7s. 6d. net. (London: John Murray.)

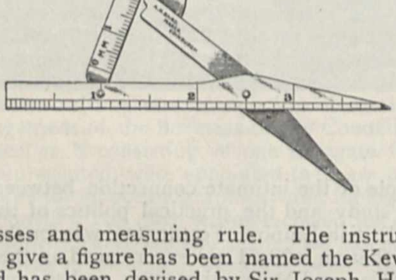
independent tradition of the Futuna islanders of an incident said by the Tongans to have occurred on that island during the same expedition. Whatever a critical examination of these traditions may yield, there is one caution to be observed. The Polynesians have an unusual facility for the preservation of quasi-historical memories. Their genealogies go back for many more generations than those of most other savages: and it is impossible to generalise from their example as to the historical value of the traditions of other races. Even their retention of the memory of events is capricious. The Niuéans have preserved a mimicry of the rite of circumcision, which renders it obvious that they once practised the rite in real earnest, like other South Sea islanders; but they have no tradition of how, or why, or when they abandoned it. The ceremony in question is curious, and, as Mr. Thomson says, probably unique. It is worth further inquiry. Lastly, the sacredness of animals, which is here noticed as a suggestion of totemism, is a clue to be followed up. There is nothing in the information given by Mr. Thomson pointing directly to totemism. But the wish, at which he hints, that Polynesian folklore should be systematically collected in all the islands, and compared, is one that every anthropologist will echo. If this were done, whether totemism were discovered or not, much would be discovered of importance to science, and something perhaps of not a little utility for the administration by European Powers of those outlying portions of their Empires.

The book is written with Mr. Thomson's accustomed gaiety. It contains a number of plates from photographs, of which the one here reproduced, by the courtesy of the publisher, shows a Tongan grave-mound of coral, white sand and polished black pebbles, together with the garlands worn by friends and suspended above it as a mark of their affection. Is the word "surplus" on p. 163 a misprint, or a joke?

E. SIDNEY HARTLAND.

KEW MICROMETER.

ALL botanists, entomologists and others who have to deal frequently with the minute measurements of parts of the object they examine must have felt the inconvenience of the double measurement involved in the use



of compasses and measuring rule. The instrument of which we give a figure has been named the Kew Micrometer, and has been devised by Sir Joseph Hooker to remove this inconvenience.

The construction will be evident on reference to the figure. By a simple adjustment of a scale to one arm of the micrometer, the length of an object is recorded up to a fraction and can be read off at leisure. One side of the scale is graduated to millimetres, the other to inches. For work under a microscope there is great advantage in the use of an instrument of this kind, for a measurement may be recorded and a dissection proceeded with without lifting the eye from the eyepiece of the instrument. Another useful feature of the micrometer is that the graduation to inches and millimetres on opposite sides of the scale furnishes a ready means of turning the one scale into the other without calculation, and this is a matter of some moment at the present time, when the two scales are in use in several countries. The length of the arm of the micrometer is exactly four inches, and this is graduated to tenths of inches and can therefore be used for larger measurements.

The instrument is a small and handy one, and can be easily carried in a sheath in the waistcoat pocket; it supplies a real want. Mr. Baird, scientific instrument maker in Edinburgh, is the maker of the instrument.

NOTES.

THE preliminary programme of the meeting of the German Association of Naturalists and Physicians to be held at Carlsbad in September has been prepared. On Sunday, September 21, the various committees will meet to transact the preliminary business in the forenoon, and the rest of the day will be devoted to social gatherings. Of the seventy-four meetings this will be the second visit paid to Carlsbad, the first occasion having been forty years ago. Prof. Dr. Heubner, of Berlin, is the president for this year, with Prof. Dr. van 't Hoff, of Charlottenburg, and Prof. Dr. Chiari, of Prague, as vice-presidents. On September 22 the work of the meeting will commence after an address of welcome to the general body, when Hoffmeister, of Strasburg, will deliver an address "On the Molecular Construction of White of Egg"; Weber, of Amsterdam, on "The Early History of the Malay Archipelago"; and Voller, of Hamburg, on "The Origin and System of Wireless Telegraphy." In connection with the last-mentioned, there will be during the week opportunities for the members to study the Slaby and Braun system, practical illustrations of which will be supplied by the General Electrical Co., of Berlin, and the Wireless Telegraphy Co. (Braun and Siemens-Halske system), of Berlin. On Wednesday morning the sections again unite to be addressed by Suess, of Vienna, "On the Nature of Hot Springs"; by Meyerhoffer, of Berlin, on "The Chemico-physical Constituents of Medical Springs"; and by Ruff, of Carlsbad, on "David Becher, the 'Carlsbad Hippocrates,' 1725–1792." At another general meeting on Friday morning lectures will be delivered by Baron von Eiselsberg on "The Importance of the Thyroid Gland in the Economy of Nature"; by von Wettstein on "Neo-Lamarckisms"; and by von Miller on "The Forces of Nature in the Service of Electricity." At the meetings of the 28 sections, the communications promised cover every field of investigation in natural science and medical and surgical practice, some hundreds of papers in all. On the scientific side they range up to 18 in the mathematical, astronomical and geodesy section, and 29 in the chemistry section, while on the medical side they range up to 60 in the surgical section. The closing meeting will be on Friday, September 25. Everything is being done by the ten local sub-committees to render the week a pleasant one for visitors, the Entertainments Committee having made a complete arrangement of concerts, theatricals, dinners and excursions to occupy the whole of the spare time.

PROF. D. J. CUNNINGHAM, F.R.S., has accepted the invitation of the Anthropological Institute of Great Britain and Ireland to deliver the third annual Huxley memorial lecture, the date fixed being October 21. He has chosen for his subject "Right-Handedness and Left-Brainedness."

THE San Francisco correspondent of the *Daily Mail* reports that the people of Santa Barbara, a county of southern California, are terror-stricken owing to the increasing frequency and severity of the earthquake shocks, of which there were seventyfive from July 27–31. The most destructive was that at the town of Los Alamos, at 1.20 a.m. on July 31. All the brick buildings were thrown to the ground, but the frame buildings generally escaped serious injury except to their windows. Not a chimney has been left standing. The shock lasted thirty seconds, and seems to have had a spiral motion. Goods were hurled from the shelves of the stores and piled in the middle of the rooms; even heavy desks were tossed about. The inhabitants ran into the streets in a panic, for in the morning between 7.25 and 7.30 there were three additional shocks, and just before nine two more. It is also reported that there were four severe shocks of earthquake in Los Alamos Valley on August 1. Several buildings which had survived the earlier shocks were badly cracked, and an immense structure near Los Alamos was turned partly round on its foundations. The earth continues to tremble at intervals, and the countryside is said to be changing appearance. A Reuter telegram from Leiria, Portugal, states that a violent earthquake shock was felt there at midnight on August 3 and was renewed at 6.45 a.m. on August 4. One shock was felt throughout the centre of Portugal and on the seaboard. The Central Meteorological Bureau of Italy announces that a severe earthquake shock was felt at Carrara at 11.35 p.m. on Monday, August 4. It was followed by two more shocks. Another earthquake shock is reported from Massa. The seismographs at Siena, Florence, Padua, Rome and Rocca di Papa also registered disturbances.

IN the House of Commons on Monday, the decision to close the observatories at Ben Nevis and Fort William was again brought forward, and the First Lord of the Treasury was asked whether he would order an inquiry to be made into the distribution by the Meteorological Council of the annual grant of 15,300*l.*, so as to secure that an adequate allowance be made to these observatories. In his reply, Mr. Balfour referred to an inquiry held about twenty years ago, at the close of which the committee recommended that the inquiry should be repeated from time to time, a recommendation that has not been followed. In the circumstances he thought it would be right to have an investigation and to repeat it from time to time. This would involve no slur or slight on the scientific committee which allocates the funds.

A COPY of the remarks made upon the subject of the Ben Nevis observatories by Sir Arthur Mitchell, honorary secretary of the Scottish Meteorological Society and of the directors of the Ben Nevis observatories, at the meeting of the Society on July 23, has been received. It is pointed out in this statement that the importance of observations at a high level is emphatically and increasingly recognised in the countries of Europe and in the United States of America. Both the high- and low-level observatories at Ben Nevis have been, all through their existence, under the sole management and control of the directors, by whom they were erected and to whom they belong. Having high-level observations to compare with suitably associated observations at sea level has a direct bearing on the study of meteorology broadly; but it is also and everywhere held that the possession of such observations may be reasonably expected to assist directly in weather forecasting. The directors started in 1883 with the intention of performing a big and costly experiment in atmospheric physics, which, in their opinion, ought to cover a sun-spot period, that is, from eleven to twelve years. This experiment they have been able to complete by the aid of public generosity. For the first seven years after 1883, when the observatory at the top of Ben Nevis was opened, there were no hourly observations at sea level for purposes of comparison, so that the experiment began in a complete form only twelve years ago, in 1890, when the low-level observatory at Fort-William was also opened.

THE Museum of Practical Geology, Jermyn Street, will be closed as usual from to-morrow evening, August 8, until the morning of September 10.

THE Reale Accademia dei Lincei has conferred on Mr. Marconi a special prize of ten thousand francs under the Santoro foundation in recognition of his work in connection with wireless telegraphy.

THE Bisset Hawkins gold medal of the Royal College of Physicians of London has been awarded to Dr. W. H. Power, F.R.S., principal medical officer to the Local Government Board. The medal was instituted in 1896 with the object of perpetuating the memory of the late Dr. Francis Bisset Hawkins, and is bestowed triennially on some duly qualified medical practitioner who has, during the preceding ten years, done good work in advancing sanitary science or in promoting public health. Dr. David Ferrier, F.R.S., will deliver the Harveian oration of the College on St. Luke's day, October 18. The Bradshaw lecture will be delivered in November by Dr. C. J. Cullingworth. Dr. A. S. F. Grünbaum has been appointed Goulstonian Lecturer and Dr. T. R. Glynn Lumleian lecturer for 1903, and Dr. J. R. Bradford the Croonian lecturer for 1904.

ON Friday last Sir Alfred Jones, chairman of the Liverpool School of Tropical Medicine, entertained at dinner the Duke of Northumberland and the Tropical Diseases Section of the British Medical Association, at the Adelphi Hotel, Liverpool. In proposing the health of the Duke of Northumberland, Sir Alfred Jones mentioned that a friend had given a donation of 25,000*l.* for the study of tropical medicine at the Liverpool School, and through the energy and perseverance of Prof. Boyce the School was being endowed with 10,000*l.* The Duke of Northumberland, in replying, said that he had been impressed with the importance of the efforts which were being made in the direction ot ameliorating the conditions of tropical existence. In responding to the toast "Tropical Medicine," Sir W. Kynsey said it seemed extraordinary that in a wealthy country like England it was impossible to get a penny from Government for these schools, which had been entirely dependent upon private benevolence.

THE steamer *America*, with the whole of the Baldwin-Ziegler Arctic expedition, arrived on August 1 at Honningsvaag, in Northern Norway, and then proceeded to Tromsoe. Mr. Evelyn B. Baldwin, the leader of the expedition, reports as follows to Reuter's Agency:—"This year's work has been successful. An enormous depot of condensed foods has been established by sledge on Rudolf Land within sight of the Italian expedition's headquarters. A second depot has been formed in lat. 81 33, and a third depot at Kane Lodge, Greely Island, which has been newly charted as near the 81st degree of latitude. These large depots, together with the houses and stores left at Camp Ziegler, as well as provisions for the five ponies and 150 good dogs now on board, besides the pack itself, will afford means for a large Polar dash party next year. The fact that all the channels through Franz Josef Land remained blocked by ice during the autumn of 1901 prevented the establishment of depots by steamer last year. The breaking up of the ice early in June compelled us to use our reserve supply of coal, and hence our departure from Camp Ziegler on July 1 in order not to imperil the expedition. We dispatched 15 balloons with 300 messages in June. We have obtained the first moving pictures of Arctic life. We discovered Nansen's hut, recovering the original document left there and securing paintings of the hut. We have also secured marine collections for the National Museum, new charts, &c. Thirty men, with 13 ponies, 170 dogs and 60 sledges, were employed in field work from January 21 to May 21, this severe work resulting in the destruction of the sledges; this and the depletion of the food for the ponies and the dogs rendered a return imperative."

IN a paper read at the International Navigation Congress recently held at Dusseldorf, Mr. Gordon C. Thomas, C.E., gives a description of a novel kind of canal lift which he has recently constructed at Foxton, on the Grand Junction Canal, one of the most important arterial waterways in this country. At Foxton there is a rise of 75 feet, which used to be overcome by a flight of 10 locks, which could only take barges carrying 33 tons. The time occupied in passing a boat through these locks was 75 minutes, and 30,000 gallons of water were used for the purpose at each lockage. The increasing traffic necessitated some better means of raising and lowering the barges and decreasing the quantity of water required. For this purpose Mr. Thomas has recently constructed for the Canal Company a new system of elevation at a cost of 40,000*l.*, by means of which the time occupied in raising and lowering the boats has been decreased to twelve minutes for one boat ascending and another descending as compared with an hour and a quarter for the passage of a single boat, the quantity of water used being only one-tenth of that required when the locks are used. The lift consists of an inclined plane connected with the higher and lower levels of the canal at an angle of 1 in 4. On this incline two docks, or iron troughs, 80 feet long, 15 feet wide and 5 feet deep are hauled up and down, the barges being first floated into or out of the docks from the canal, the ends of which are closed by gates made watertight. The troughs are hauled up sideways and the wheels on which they rest are so adjusted that the water in them always remains level. As one trough is drawn up, either loaded with a boat or empty, except as to the water, the other descends. This lift is capable of passing 200 canal boats in twelve hours, and can be managed by three men.

SIGNOR FILIPPO EREDIA has published in the *Atti* of the Royal Academy of Acireale some interesting statistics in regard to the rainfall of Sicily during the period 1880-1900. Considering the following ten stations, Palermo, Termini, Messina, Riposto, Catania, Syracuse, Mineo, Girgenti, Caltanisetta and Trapani, it is found that if the twelve months of the year be arranged in descending order of their average rainfalls, the five least rainy months at each station occur in the order September, May, August, June, July. The most rainy month is November for Messina, Riposto, Catania and Trapani, and December for the other stations. The next in order is December for Messina and Trapani, November for Syracuse, Termini and Girgenti, and January for the other stations. October occurs fourth on the list for Palermo, Termini, Girgenti and Syracuse; it is the third for Messina and Trapani, fifth for Riposto and Catania, and still lower down for Mineo and Caltanisetta. February is fifth on the list for Palermo, Termini, Messina, Trapani and Syracuse, fourth for Catania, Mineo and Caltanisetta and third for Riposto. Finally, March and April occupy the sixth and seventh places at all stations except Girgenti, Mineo and Caltanisetta.

THE director of the International Bureau of Weights and Measures, at Paris, has recently issued a further volume of he *Travaux et Mémoires* of the Bureau (vol. xii., 338 pp.; Paris: Gauthier-Villars.) This volume deals with (1) the determination in 1894-5 of the length of the yard in terms of the metre; (2) with the verification in 1890-7 of standard end-measures (mètres à bouts); and (3) with a comparison of platinum and gas thermometers. The volume also contains a reprint of the "Compte rendus des Séances" of the three general conferences on weights and measures which were held at Paris in 1889, 1895 and 1901, to the last of which reference has been recently made in our columns. The comparisons of the yard and metre, and the verification of the end-metres (1) (2), are now almost ancient history, and the important results obtained in 1895 and 1897 have been duly recognised in this country. A full and interesting report is made on the comparisons of platinum, gas and mercurial thermometers by Dr. J. A. Harker and Dr. P. Chappuis (3). The results of their researches have, however, been already published in London (*Phil. Trans.* Roy. Soc., vol. cxciv. pp. 37-134, 1900). Prof. Callendar's method of measuring temperatures based on the determination of the electrical resistance of a platinum wire, has been extended to a comparison at the Bureau of the platinum thermometer with the nitrogen thermometer (now adopted as the international standard thermometer) at temperatures varying from 80° to 460° C. A comparison was also made between the platinum and the mercurial thermometers at lower temperatures, all the comparisons having been made under the direction of Dr. Benoit. These comparisons were originally proposed by the Kew Observatory Committee, and the numerous formulæ as well as the results are clearly set out in appendices to the report.

THE explosion of a charge of about ten tons of gunpowder in connection with blasting operations in the granite quarries near Baveno (Lago Maggiore) has afforded Dr. Emilio Oddone an opportunity for making a series of observations of interest in connection with seismology, and the results are described in a paper communicated to the Istituto Lombardo in May last. The charge was fired on October 30, 1901, and Dr. Oddone made observations in a hut distant about 1¼ kilometres to the north of the mines, using a seismometer for horizontal motions, an apparatus for determining the relative motion in a radial direction of two points three metres distant, a variometer for the aërial disturbances, an aneroid and a chronometer. To calculate the velocity of propagation, observations were made at 7, 10 and 20 kilometres, and also with the instruments at Pavia, Milan, Turin and Padua. The indications of the seismograph showed initially a solitary wave of amplitude 0·1 millimetre, but in consequence of the rock subsequently breaking off in five pieces this was followed by subsidiary waves. The variometer indicated an instantaneous variation of atmospheric pressure of about 1/24 millimetre of mercury. The distant observations gave negative results; at Baveno, 7 kilometres distant, no earth tremors were noticed, and even the sound of the explosion hardly reached 15 kilometres. A calculation of the total energy dissipated by the waves across a hemispherical surface of radius 1500 metres about the hypocentre gives $1{\cdot}4 \times 10^7$ kilogrammetres, the total energy set free by the combustion of the powder being $2{\cdot}584 \times 10^9$ kilogrammetres. It appears, however, probable that about 92 per cent. of the elastic energy was absorbed at a distance of 1500 metres, and this absorption Dr. Oddone attributes to the viscosity of the granite. The same cause accounts for the absence of any observed earth tremors at the distant stations, which made it impossible to calculate the velocity of wave propagation. At the same time, an explosion high up on a mountain at the side of a deep lake hardly appears to be favourably placed for sending earth-tremors to a long distance.

A BEAUTIFULLY illustrated pamphlet, by Mr. C. Dixon, issued by Ross, Ltd., of New Bond Street, describes the advantages of Ross's prism field-glasses to the out-of-doors naturalist.

NUMBER ix. of the L.M.B.C. *Memoirs*, by Mr. O. V. Darbishire, is devoted to a full account of the natural history of Chondrus, or "Irish moss." At the conclusion of his memoir the author deplores the want of a thoroughly trustworthy and up-to-date work on British sea-weeds.

THE August number of the *Contemporary Review* contains an interesting article on bird-life by Mr. Digby Pigott, in which the author draws special attention to the beautiful preparations in the Natural History Museum illustrative of the arrangement of the feathers in the wing.

THE *Journal* of the Straits Branch of the Royal Asiatic Society for January contains a long paper on Sarawak Hymenoptera, by Mr. P. Cameron, largely based on the collection made by Mr. R. Shelford. Since the report in 1857 on Dr. Wallace's collection very little work has been done on this subject, and the author is enabled to record a number of new generic and specific types.

THE contents of the July number of the *American Naturalist* include a paper on the gastrulation of the egg of the toad *Bufo lentiginosus*, by Miss H. D. King, and another, by Mr. W. A. Hilton, on the sense-hairs of caterpillars. In the latter the author states that the majority of the body-hairs of these larvæ are sensory, and that almost the only mode in which sensory nerves terminate on the bodies of insects is by means of hairs.

IN the July issue of the *Journal of Anatomy and Physiology*, Dr. H. W. M. Tims discusses the intricate question of the homology of certain deciduous and permanent cheek-teeth in mammals, in the course of which he disputes the view that the functional teeth of marsupials belong to the deciduous series. In the same number Mr. Elliot Smith describes the manner in which the desiccated brain is preserved in many Egyptian human skulls, other than those of mummies, and Prof. F. G. Parsons figures some of the leading modifications of the aortic arch in mammals.

THREE interesting instances of abnormality in mammals are recorded in journals received during the past week. In the *American Naturalist* for July Mr. F. Howe discusses the nature of the polydactylism in a breed of cats kept at Cambridge, Mass. It is concluded that the polydactylism lends no support to the theory of reversion to a six- or seven-toed ancestral type, the only definite statement possible being that three digits are developed where there are normally but two. In the *Journal of Anatomy and Physiology* for the same month Prof. O. C. Bradley records the occurrence of seven cheek-teeth, exclusive of the deciduous first premolar, in a horse, while Mr. Elliot Smith mentions an ancient Egyptian skull with an additional incisor. Mr. Smith, from his specimen, suggests that the missing incisor in man is *i.* 1, and not *i.* 2, as Tomes believes to be the case. It may be pointed out that Lydekker suggested the missing tooth to be *i.* 2 in 1884, or fourteen years earlier than the work of Tomes cited by the author.

AT the conclusion of some notes in the *Proceedings* of the Philadelphia Academy on the so-called flying-lemur (*Galeopithecus volans*), a creature usually regarded by naturalists as an aberrant member of the Insectivora, Dr. H. C. Chapman sums up as follows :—"It appears, at least in the judgment of the author, that Galeopithecus cannot be regarded as being either a lemur, or insectivore or bat, but that it stands alone, the sole representative of an ancient order, Galeopithecidæ, as Hyrax does of Hyracoidea. While Galeopithecus is but remotely related to the Lemuroidea and Insectivora, it is so closely related to Chiroptera, more particularly in regard to the structure of its patagium, brain, alimentary canal, genito-urinal apparatus, &c., that there can be but little doubt that the Chiroptera are the descendants of Galeopithecus, or more probable that both are the descendants of a Galeopithecus-like ancestor."

IN a valuable series of observations on living brachiopods contributed to the *Memoirs* of the Boston Natural History Society (vol. v. No. 8), Prof. E. S. Morse quotes with approbation a note from NATURE of July 13, 1899, based on Prof. J. A. Thomson's inaugural address at Aberdeen, on the importance of "nature-study," and he gives as one of the reasons for publishing his observations, which were made twenty years ago, our lack of knowledge of the habits of living brachiopods. It is not that these animals cannot be easily kept in confinement, as Prof. Morse states that in the middle of summer he transported a series of specimens a distance of 700 miles in a small bowl. In this connection it is interesting to note that from its vitality in such unfavourable circumstances Prof. Morse was led to suggest that the long persistence of Lingula might be accounted for. A few weeks ago we chronicled the very same suggestion made by Mr. N. Yatsu, of Tokio. The memoir is illustrated by twenty beautifully executed plates, of which the first is coloured.

WE have received the Report of the American Museum of Natural History for 1901, containing a full account of the rapid progress made by that institution and of the various expeditions which have been equipped by private persons for its enrichment. Among the latter is the Jesup expedition to the North Pacific, which has resulted in the acquisition of a mass of material illustrating the life of the Chukchi's of the extreme north-east of Siberia. The cost of publishing the results of this and other expeditions has become a somewhat serious difficulty. "It does not seem proper," says the Report, "to ask those who have generously placed parties in the field also to provide the funds for publishing the scientific results of their investigations; on the other hand, the general funds of the Museum are not sufficient to meet the obligation." As usual, the Report is well illustrated. A plate of the new "auditorium," with its benches crowded with attentive listeners, illustrates a phase of museum development unknown in our own metropolis. Among other illustrations is one of a group of guillemots and gulls mounted in the Museum in imitation of their natural surroundings. A second displays a remarkably fine skeleton of a fish-lizard (Ichthyosaurus) containing numerous young skeletons within the ribs, recently acquired by exchange with the Stuttgart Museum. Other plates are devoted to ethnographical specimens.

A FORTNIGHT'S cruise in the North Sea was made recently by the Norwegian Government's research steamer *Michael Sars*. The first week was spent in a series of studies on the distribution of animal life at various depths on "Storeggen" and "Shetlandseggen," which are great submarine ridges with sloping sides. With a 50-feet trawl dredgings were made down to a depth of 600 fathoms to ascertain the distribution at various depths of the fishes used for food. A sharply defined boundary manifested itself between the distribution of the food-fishes and the deep-sea forms of life, and this boundary coincides with a rapid transition from water of a higher temperature to water just above or at the freezing point. This boundary occurs on the slope of the Shetland ridge, at a depth of between 275 and 300 fathoms. A series of studies was next undertaken on the steep north-east slope of the Faero bank. Here, so far as is known, no accurate soundings had been previously taken and no fishing carried on either here or upon the great ridge or upon the Shetland ridge. A series of soundings was made, which do not correspond with those given on the British charts. Experimental fishings were carried on for three days with most satisfactory results; nine lines were cast, with a total of 5500 hooks attached to them, of which 660 were halibut hooks; and the catches consisted of 117 halibut weighing more than 5000 kilos., 300 large cod, 500 brosme, 10 common ling and 80 blue ling. This result is of interest, as it points to a new and important area for sea-fishery and to the existence of large quantities of halibut at a time of the year when it is not to be found on the great bank or ridge on the coast of Norway, and the same applies to the cod also. Both cod and halibut had herrings in their stomachs, although the catch was made at a depth of 200 fathoms. The work was carried out under the personal supervision of Dr. Johan Hjort.

ATTENTION was directed in NATURE for April 3 to a memoir by Prof. Yoshiwara on the geology of the Japanese islands which form the "Riukiu Curve." We have since received a report on the fossils of these islands and of Formosa, by Mr. R. B. Newton and Mr. R. Holland (*Journ.* Coll. Science, Tokyo, Japan, vol. xvii. 1902). The specimens comprise many examples of Orbitoides and other foraminifera, together with one or two species of Cellepora and one nullipore. They occur in the Orbitoidal-limestone of Miocene age, and in the raised coral-reef formations which belong to some part of the post-Pliocene series.

A SECOND and enlarged edition o of the "Hand-List of Herbaceous Plants" cultivated in the Royal Botanic Gardens at Kew has been issued. In the preface it is pointed out that no substitute for the "Students' Garden"—the site of which was required for the new wing of the herbarium—is contemplated, more especially since the Botanic Gardens at Chelsea have been reconstituted under the auspices of the Charity Commissioners to serve a similar purpose. A new feature in this edition is a reference to works in which figures of the species may be found.

OF the various subjects reviewed by Mr. J. H. Maiden in his presidential address to the Linnean Society of New South Wales, the forestry question and a botanical survey of the country are topics on which the opinion expressed is that of an indefatigable worker and a practical expert. In connection with the State management of forests, Mr. Maiden directs attention to the importance of conserving areas which are not suited to agriculture, and to the necessity for planting trees to check the sand-drifts and to provide shade on the arid western plains. The object of the botanical survey would be to summarise existing records and extend them. In order to institute a survey which shall be carried on by independent workers, the delimitation of the country into areas, whether known as *domaines* or *counties*, is essential; otherwise a definite basis for concerted action is wanting. A tentative scheme of botanical counties is outlined in a chart which accompanies the paper.

WE have received two papers dealing with insects harmful to agriculture, horticulture, &c., the one, by Mr. G. H. Carpenter, on injurious insects observed in Ireland in 1901 (*Economic Proceedings* of the Royal Dublin Society, vol. i. part 3, No. 5), the other by Signor A. Berlese, entitled "Importanza nella Economia Agraria degli Insetti Endofagi," published in *Bolletino* No. 4 of the Royal College of Agriculture of Portici, Sicily. In the former Mr. Carpenter states that entomologists appear to have paid scarcely any attention to the maggots of flies which infest the bodies of live sheep, and he has therefore considered it advisable to describe in some detail the life-history of the sheep-fly (*Lucilia sericata*). It is somewhat remarkable that this infestation seems to be mainly confined to Great Britain and Ireland, having been recognised on the continent only in France and Holland; in the latter case, at any rate, there is good reason to believe that it was introduced from England. The author also records the occurrence of a "plague" of black ants of the Tropical American species *Iridomyrmex humilis* near Belfast in 1900. In the second communication Signor Berlese describes, with figures, the life-history of a number of deleterious insects met with in Sicily.

THE Maidu stock of north-eastern California contains some very primitive tribes, who, in their lack of clan organisation or totemic grouping, practical absence of clothing and other negative characteristics, recall the Seri Indians of the Gulf of California as set forth in the elaborate study by Dr. W. J. McGee (Seventh Annual Report of the Bureau of American Ethnology). Mr. Rowland B. Dixon, when on the Huntingdon California Expedition, made a large collection of Maidu myths, which he has recently published in the *Bulletin* of the American Museum of Natural History (vol. xvii. 1902, p. 33). The time has not yet come when these myths can be made to yield general conclusions, more field-work being necessary in other districts. When such material is available it will probably enable us to trace more accurately the lines of migration and the mutual relationships of the great mass of stocks scattered along the Pacific coast from the Columbia River to Mexico. These myths are beast-tales with, or without, a human element. The coyote is very prominent; he seems to be generally inimical to mankind, and appears often as a buffoon and trickster, who comes out of his adventures in a sorry plight.

GERMAN translations of Faraday's papers on experimental investigations in electricity, from the *Philosophical Transactions* of 1835 and 1838, are given in Nos. 126 and 128 of Ostwald's admirable series of scientific classics published by Mr. W. Engelmann, Leipzig. Dr. A. J. v. Oettingen is the editor of the volumes, and contributes a few remarks upon them. No. 125 of the same series, edited by Dr. F. G. Donnan, contains translations of John Mayow's papers on nitre, combustion and respiration, and No. 124 papers on thermodynamics by von Helmholtz, edited by Prof. Max Planck.

THE additions to the Zoological Society's Gardens during the past week include two Green Monkeys (*Cercopithecus callitrichus*) from West Africa, presented by Captain Hugo B. Burnaby; a Common Otter (*Lutra vulgaris*) British, presented by Mr. W. Radcliffe Saunders; a Common Seal (*Phoca vitulina*) from British Seas, presented by Mr. H. C. Rouch; three Mauge's Dasyures (*Dasyurus viverrinus*) from Australia, presented by Mr. Paris K. S. Foot; eight Rufous Tinamous (*Rhynchotus rufescens*) from Brazil, presented by Colonel Sir Thomas Hungerford Holdich; a Common Mynah (*Acridotheres tristis*) from India, presented by Mrs. Hope Robinson; a Greater Black-backed Gull (*Larus marinus*) European, presented by Mrs. V. H. Veley; a Yellow-eyed Babbler (*Pyctorhis sinensis*), two Striated Babblers (*Argya earlii*), two Himalayan Black Bulbuls (*Hypsiptes psaroides*), three Rufous-bellied Bulbuls (*Hypsiptes maclellandi*), a Verditer Flycatcher (*Stoparola melanops*) from British India, presented by Mr. E. W. Harper; a Rough-scaled Lizard (*Zonurus cordylus*), a Spotted Gecko (*Pachydactylus maculatus*) from South Africa, presented by Mr. R. Broome; six Menopomas (*Crypotobranchus alleghaniensis*), four Menobranchs (*Necturus maculatus*), a Blue Lizard (*Gerrhonotus coeruleus*), a Spiny-tailed Mastigure (*Uromastix acanthinurus*), four Horned Lizards (*Phrynosoma cornutum*) from North America, deposited; a Bennett's Wallaby (*Macropus bennetti*), three Glossy Ibises (*Plegadis falcinellus*), three Jameson's Gulls (*Larus novae-hollandiae*), a Herring Gull (*Larus argentatus*) bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE SPECTROSCOPIC BINARY β CEPHEI.—In No. 5, vol. xv. of the *Astrophysical Journal*, Prof. Frost gives the results of his own and Mr. W. S. Adams's estimations of the radial velocity of β Cephei, reduced from ten spectrograms which these observers obtained between December 18, 1901, and May 24, 1902, with the Bruce spectrograph.

The results obtained by the two observers agree very well and indicate a radial velocity which varies from −20·3 to +11·3 km. It was expected that the period of variation would be found to be a long one, but two spectrograms obtained with an interval of five and a half hours show a variation in velocity of about 14 km., or nearly half of the whole range yet observed.

DOUBLE STARS.—As an extract from the *Monthly Notices* R.A.S. for May, 1902, the Rev. T. E. Espin publishes his micrometrical measures of double stars made at the Wolsingham Observatory with a $17\frac{1}{4}$-inch reflector.

The catalogue contains several records of new components, such as in Σ 59, where two new components, C and D, have been observed, and Σ 3010, where a third component has been observed for the first time. There are also several variations of distance and position angle noted, and new values given to them, *e.g.* in Σ 2708 the measures made by Mr. Espin vary considerably from those made by the discoverer of this system, Prof. Hall, but this discrepancy is accounted for by a movement of $0''.26$ towards $137^{\circ}.7$ which has been observed at Wolsingham. In regard to θ Persei (Σ 296) it is stated that the proper motion during the last 116 years has been perfectly rectilinear, all the observations being well represented by

$$\Delta = 16''.363 + 0''.029\,(t - 1866.0).$$
$$T = 297^{\circ}.162 + 0^{\circ}.075\,(t - 1866.0).$$

It has been observed that Σ 1321 is a similar system to 61 Cygni, P.M., the two components A and B both being of a reddish-yellow colour, whilst a third component, too faint to measure, was discovered on January 22, 1901.

LIGHT OF THE GALAXY AND BRIGHT STARS.—In No. 3803 of the *Astronomische Nachrichten*, Mr. C. Easton gives the results of his researches in comparing the light of the Galaxy to that of the comparatively bright stars of the Milky Way of the Northern Hemisphere.

Mr. Easton divided the galactic zone between -18° galactic latitude and $+18^{\circ}$ galactic latitude into 108 rectangles, and then, by an ingenious method, compared the light emitted from the area of each rectangle with the light emitted by the stars of the Northern Milky Way. The results show that there is a correlation and parallelism between the distribution of the galactic light and the stars of Argelander. On this basis Mr. Easton deduces that the stars in general may not simply be isolated units, but they may all belong to such agglomerations as we believe make up the Milky Way, the only real difference being in their relative distances from us; he suggests that the apparently crowded parts of the heavens, such as occur in the region of Cygnus, are parts where we get two such agglomerations at different distances, overlapping at the edges, and supports this theory by noting the fact that in such regions, both the galactic light and the brighter stars increase in density together.

PERIODICITY OF VOLCANIC ERUPTIONS AND EARTHQUAKES.—*Circular* No. 49 of the Wolsingham Observations contains a summary, by the Rev. T. E. Espin, of the results obtained by arranging and charting the data which he has collected in regard to the times of volcanic eruptions and earthquakes.

These results point to a period of between eight and nine years in the phenomena of which Mr. Espin has received the records.

This period agrees with the period of revolution of the moon's perigee, and further investigation indicates that the greatest volcanic activity takes place when the perigee occurs at its maximum northerly declination.

MINOR PLANETS.—Prof. Max Wolf records the observations, during July, of six minor planets, giving their R.A., declination and magnitude. Amongst them is a new minor planet 1902 JL, the position of which on July 9, 1902, at 12h. 13·7m. (Heidelberg mean time) was R.A. = 20h. 25·9m., Decl. = $-19^{\circ}\,58'$, and the daily movement of which is $-$ 0m.·8, $-6'$ (*Astronomische Nachrichten*, No. 3803).

PHARMACOLOGY AT THE BRITISH MEDICAL ASSOCIATION.

THE section of pharmacology at the British Medical Association at Manchester this year was distinctly active, and many interesting discussions were held and papers read. The first day's discussion was devoted to a subject of great practical value to physicians, viz. the unexpected and undesired effects of medicines. Sir Lauder Brunton introduced the discussion and his paper was full of interest. He treated at length the various factors which tend to render medicines either ineffective or productive of unusual effects. Speaking of tolerance, he instanced a case in which as much as 24 grains of morphine was used by a patient as a hypodermic injection, the ordinary dose being one-third of a grain. Taking arsenic as an example, he showed how the form in which this was given greatly influenced the results produced by it. The influence of certain remedies in producing skin rashes, especially those of the antipyrin series, was also referred to, and finally the occasionally extraordinary effects of some of the antitoxin sera; especially in this connection antistreptococcic serum was referred to as having in a few minutes produced in a patient an almost universal swelling of the subcutaneous tissues (general œdema). The varying effects of opium were, according to the lecturer, most probably to be explained by the inconstant chemical composition of this substance and its preparations.

Subsequently several papers were read. One which aroused great interest was communicated by Prof. Liebreich, of Berlin, upon the therapeutic value of alkaline waters of the Vichy type. The lecturer refused to believe that waters artificially made from the data of chemical analysis were of the same therapeutic value as the naturally occurring waters. Especially in this connection was the presence in natural waters of a substance of colloidal nature, known as glairin, of importance. In continuation, the lecturer indicated the special conditions for which Vichy waters were to be recommended. In the discussion which ensued, Prof. Tunnicliffe drew attention to the work of Nageli, Locke and others upon the physiological action of chemically unrecognisable quantities of certain substances, especially, for instance, copper, and thought that for this reason the chemical analysis of natural waters afforded, although perhaps the best available, nevertheless not entirely trustworthy data for the artificial manufacture of medicinal waters. Papers were subsequently read by Prof. Marshall, upon the action of heroine and dionine upon the circulation, and by Dr. Dixon, upon the question of injectable purgatives.

An interesting paper upon synthetic purgatives was communicated by Prof. Tunnicliffe. It appears from recent researches into the chemistry of the vegetable purgatives, especially of the rhubarb group, that the active purgative group of these substances is an anthraquinone derivative. Starting from this fact, certain artificial anthraquinone derivatives have been made in the laboratory, and one anthrapurpurin acetate has been introduced into therapeutics as a purgative. This substance is very interesting and marks a decided advance in pharmacology, since it must be regarded as the first synthetic vegetable purgative. According to Prof. Tunnicliffe, however, the phthaleins exert a purgative action, and have certain advantages over both the natural purgatives and also the artificially prepared anthraquinone derivatives. The substance of especial interest in this connection is the chemical indicator phenolphthalein, a dihydroxyphthalophenone. This substance is now to be introduced under the name purgen, and the lecturer gave an account of the results of its administration as a purgative in 1000 cases.

On Thursday the section was devoted to a discussion upon the therapeutic value of arsenic. The discussion was introduced by Dr. Ralph Stockman. The author gave the result of certain observations he had made upon the action of arsenic upon the bone marrow. These researches included microscopical examinations of the bone marrow of patients who had died in the Manchester beer-poisoning epidemic. The discussion was followed by a paper by Prof. Liebreich upon the therapeutic value of cantharidin. In this paper the author discussed the *rôle* played by the capillaries in the absorption and elimination of poisons. He ascribed to each capillary area a specific irritability. Dr. Pope subsequently read a paper upon arsenic in the treatment of chorea.

Friday was occupied by a discussion on the treatment of diphtheria. Subsequently several papers were read of considerable pharmacological interest.

In reviewing the proceedings of the section we may certainly say that it evinced a healthy activity; the material to be dealt with was in excess of the available time. The meetings were well attended by pharmacologists from England, Scotland, Ireland and Wales, and it is certainly to be expected that they will perform the true function of such assemblies and act as a healthy stimulant to further research work in this important subject.

PHOTOGRAPHY OF DIFFRACTION AND POLARISATION EFFECTS.

IT was natural that such a subject as physical optics should call forth the best skill of mechanicians, and science owes a debt to their beautiful instruments; but the very excellence of these has perhaps filled the worker with too much awe and made him feel that wave interference can only be observed in a great laboratory. The present object is to give details of simple arrangements which enable all such phenomena to be seen and photographed.

Diffraction.—The general appearance of the apparatus is shown in Fig. 1. It may be seen at the Victoria and Albert Museum. The middle stand carries a square piece of soft wood blackened, 3 inches square, $\frac{3}{16}$ inch thick, with a $\frac{3}{4}$ inch square cut out of the centre. A dozen or more of these wooden squares should be made, as holders for the various objects which cause diffraction. It is desirable to have some sheet aluminium and rolled brass, the thickness in each case about No. 30 standard wire gauge. Several objects can be made of aluminium and attached with pins to the centre of the wooden squares: a single edge; a rectangular edge for Grimaldi's crested fringes; two straight edges with adjustable distance, the adjusting edge of aluminium being made to slip under two clips of aluminium pinned down, one on either side. The pins should be cut short to about the thickness of the wood; a slight tap with a hammer rivets them. Let three of the 3-inch squares have the central hole covered over with aluminium and let pinholes of various sizes be made; the aluminium is easily cut with scissors and pierced with a needle; when the hole is less than $\frac{1}{4}$ mm. the phenomenon is different from that given by larger holes.

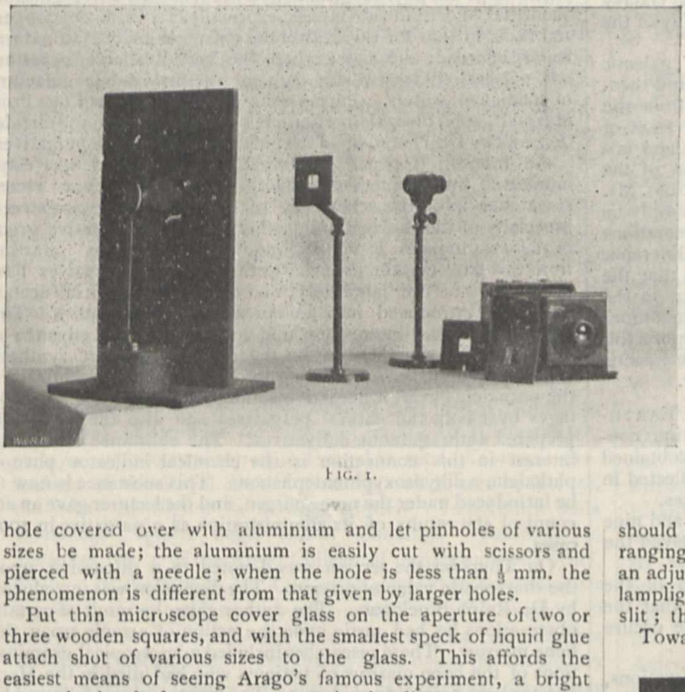


FIG. 1.

Put thin microscope cover glass on the aperture of two or three wooden squares, and with the smallest speck of liquid glue attach shot of various sizes to the glass. This affords the easiest means of seeing Arago's famous experiment, a bright centre in the shadow of an opaque circular disc.

Other suitable objects are needles of various sizes, needle eyes and needle points. Fig. 2 shows diffraction by a fine and a thick needle. The centre of the shadow is a line of light in both cases; it is the finer needle which has the broader central line. For the same cause the central light broadens towards the points, and the centre of the shadow of a quartz fibre is very broad indeed. On one side of a needle place a strip of aluminium; this causes the interior bands to disappear at this position. To one side of a needle, along half its length, apply a piece of microscope cover glass; this shows Arago's crucial experiment to prove that the velocity is less in glass than in air. It is imperfectly described by saying that the fringes are shifted towards the glass side. There is another system of fringes, narrower and more in number as if from a broader needle; the central line of these is shifted towards the glass. The experiment is rather difficult; the edge of the glass gives trouble; it must be placed just over the thickness of the needle, and the needle had better be thin.

Perforated zinc and wire gauze easily give good effects; the former has series of rings in the spaces, and the centre can be made white or any colour with a small movement of the object; also there are fine hexagonal rulings all over the geometrical shadow. The wire gauze gives bright Scotch plaids of any clan, when moved over a range of about two inches.

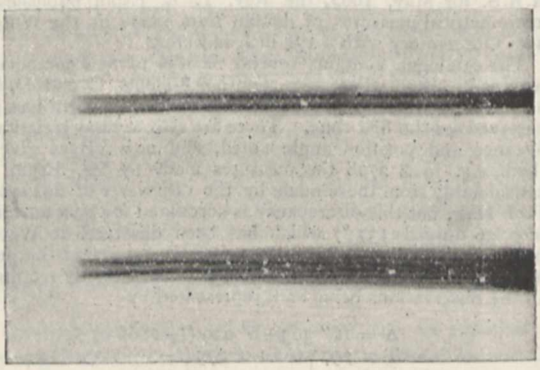


FIG. 2.

Some of the most beautiful effects which can be produced are shown in Fig. 3. The diffracting objects were small groups of four and five circles, circular lines of light photographed on glass, each group being $\frac{1}{10}$ inch diameter. They were made years ago for another species of diffraction, that as studied by Fraunhofer, Schwerd and Herschel, in which a telescope is focussed on to a distant point of light and various screens are placed on the object glass. Our present view is that of Fresnel, in which waves starting from a point, almost mathematical, of light are diffracted or broken by an interposing body.

A word more as to the holder of the objects. In the bottom of the 3-inch squares of wood, Fig. 1, is a slot; this slot is placed over a screw fixed in the top of the oblique bar in the middle stand; a nut on the screw clamps the square and allows adjustment in a vertical plane. The lower end of the oblique bar, which is 3 inches long, has a stiff joint on to the upright, which is 9 inches high; the stiff joint makes an easy adjustment for height.

On the left of Fig. 1 is a wooden screen 16 inches high, 9 inches broad. At a height of 10 inches is a hole $\frac{1}{2}$ inch in diameter; on either side of this let there be a brass spring which will allow one of the 3-inch squares to be slipped under it. The square should have a sliding strip of aluminium, with three pin-holes ranging in size from the smallest that can be made. Sometimes an adjustable slit should be placed here. A convex lens condenses lamplight or sunlight on to this aperture, whether pinhole or slit; this is the source of light.

Towards the right hand in Fig. 1 may be seen an eye-piece for direct observation or a camera for photographing the effects. The distance for either of these is about 2 feet from the wooden screen which carries the source of light. The eye-piece is Beck's B microscope Huyghen's eye-piece. Any simple holder

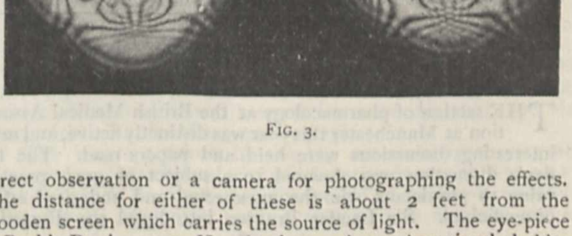


FIG. 3.

can be made to serve, but it is useful to have a sliding tube in a brass upright and at the top a V which is above a stiff joint. On this V the eye-piece can be held with an elastic band; or an eye-piece of different breadth, or a Nicol's prism may be so fixed. Most of the effects may be well seen if a lamp is used for the source of light. It is easier to observe in a room which is rather dark, for then the space between screen and eye-piece need not be

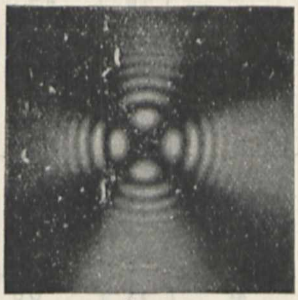


Fig. 4.

covered up. Sunlight may be reflected by a hand-mirror into a darkroom through an open door. The lens which condenses on to the pinhole can be moved a little until it is seen that a pencil of light is just covering the lens of the eye-piece; then the object can be adjusted so as to be also covered by this pencil. Of course, the effects as seen directly by the eye are far more beautiful than the photographs. The object is about 18 inches from the pinhole. With good sunlight there are often groups of brilliant jewels, in which the emeralds and the rubies are made to change places by a small movement of the object. For producing Arago's bright spot with an object so broad as a threepenny piece, the distance from the pinhole to the eyepiece must be about 36 feet.

In photographing the phenomena the same eye-piece is fitted on to the front of a camera, instead of the usual lens; the camera can be placed on a box and adjusted to the right height with books or paper. If there is good sunlight, about 30 seconds' exposure is suitable for an Ilford ordinary plate. There is no question of focus; to whatever position the back of the camera is drawn out the figures are equally in focus. There is a series of folds or zones of light and shade, and prismatic colours which are often crossing one another and suffering interaction of their waves, so that if these zones are cut at various positions there is infinite change of form and colour. If the same eye-piece is used in a telescope or a microscope it will focus the sun or a diatom on to a screen; and when the screen is moved back the image is still in focus; but in these cases the reason is different, for the pencils of light emerge in parallel rays and make clear images at all positions.

Some of us who are fortunate have been inspired in early life at some well-known school of optics where there was the best

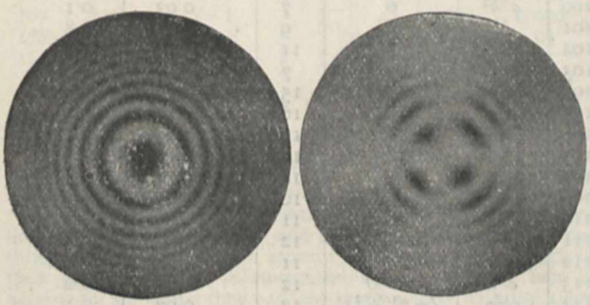


Fig. 5.

teaching and the best instruments; then we descend to our own rough contrivances. There is a third stage, when we watch for examples of wave interference with no apparatus at all. In looking at distant lamps at night-time several forms of Grimaldi's fringes can be seen by moving the eyelids over the eye; with care it is possible to see interference from the light reflected along the eyelashes, and there are fine figures of endless variety which can be produced by slowly lifting the eyelid so as to draw a film of moisture across the eye. Some are similar to the figures of Michelson's refractometer, and all these are probably of the character of thick plates.

Polarisation.—It has often been considered that the rings and brushes made by oblique pencils through crystals can only be seen with elaborate instruments; but according to the method here described all polarisation effects of which the writer has any cognisance have been photographed. It is convenient to cut the cork mounts of the crystals so as to be round, about ¾ inch diameter. Place one of these on the top of the same microscope eye-piece, from which the cap has been removed; if the microscope is at hand, it forms a convenient holder. No objective is put on. A Nicol's prism may be inserted at the bottom of the tube. This, however, is not necessary, for the reflection from the plane mirror under the stage polarises almost as well. A cardboard tube, which fits the eye-piece, may be used instead of the microscope. In this case, cut a hole in the side of the tube at the further end and reflect up polarised light by a piece of microscope cover glass fixed on cork with black sealing-wax. A long pin run through the tube and the cork makes easy adjustment for this reflector.

For an analyser a tourmaline is desirable, as light in colour as possible. The artificial tourmalines are best, but they are now difficult to procure. The tourmaline is placed above the crystal section which is already on the top of the eye-piece. Perhaps the cap of the eye-piece will hold these two steady when they are turned to the right position. It is safer to twist thin copper wire round the top of the tube so as to have a small hook on either side; a thin india-rubber band from hook to hook over

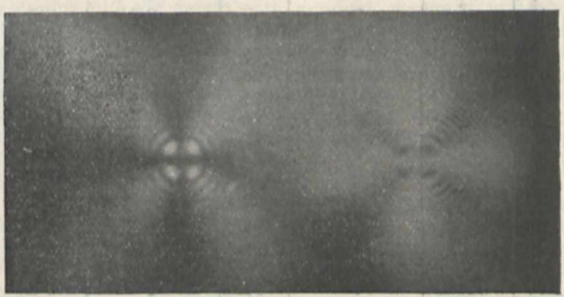


Fig. 6.

the tourmaline holds them securely. It is only necessary to place the tube through the front of a camera from which the lens is removed so as to have the figures projected on the photographic plate. Sunlight is best to work with. Sodium light gives a field covered with fine detail, but does not make effective lantern slides.

Fig. 4 shows the calcite cross; Fig. 5 shows calcite circularly polarised and circularly analysed, or circularly polarised and plane analysed. One of the most attractive of polarisation crystals is Bertrand's prism. It is so cut that light entering directly through one side is internally reflected along the optic axis; it then emerges owing to a similar internal reflection. These reflections polarise and analyse; moreover, the first reflection preserves both the ordinary and extraordinary rays. The result is that by placing this one crystal without polariser and analyser on the eye-piece the black-cross and the white-cross systems both appear at once, as seen in Fig. 6. The interest does not end here; with a slight tilt, made by a shaving of cork under one side of the prism, the white and black crosses change places, with certain other changes of detail in the figures; and there is another tilt which will give two white-cross systems.

If Fig. 6 is to be projected on to a screen on a large scale, the crystal is placed at the focus of a convex lens on to which sunlight is turned, or else at the focus made by the condensers of a lantern when the light is drawn back; this is sufficient without a focussing lens. In both cases the heat may injure the crystal unless about ¼ inch of water is placed between the lens and the crystal. The ordinary crystals of calcite and nitre must have a Nicol on one side and a tourmaline on the other, and be placed at the focus as before. W. B. Croft.

THEORY OF THE MOTION OF THE MOON.[1]

DR. BROWN, in the first two parts of his work, has explained his methods. The third part contains little more than tables of results. Our review, therefore, must be necessarily confined to an extension of the tables that have appeared in NATURE on November 25, 1897, and July 13, 1899. It will be seen that the high order of accuracy to which the computations have been pushed has been maintained, and that most of the latest series of terms are very small and, with a few exceptions, below the limits of observation.

Reference Number.	Characteristic.	Argument.	Number of Terms.	Approximate value in arc of the largest coefficient.	Value of unity in the last figure given in millionths of a second of arc.
1	1	0	13	206265″	0·0002
2	e	l	18	17000	2
3	e'	l'	21	350	0·4
4	α	D	9	80	0 05
5	k	F	11	9000	0·01
6	e^2	$2l$	21	240	3
7	e^2	0	11	340	3
8	ee'	$l+l'$	21	140	4
9	ee'	$l-l'$	22	100	4
10	e'^2	$2l'$	18	6	0·6
11	e'^2	0	10	2	0·6
12	k^2	2F	20	400	0·4
13	k^2	0	11	400	0·4
14	$e\alpha$	$l+D$	19	12	0·6
15	$e'\alpha$	$l'+D$	20	14	0·1
16	α^2	0	9	0·01	0·1
17	ke	$l+F$	10	15	0·06
18	ke	$l-F$	11	45	0·06
19	ke'	$l'+F$	10	1	0·01
20	ke'	$l'-F$	11	0·4	0·01
21	$k\alpha$	$F+D$	10	4	0·02
22	e^3	$3l$	17	11	27
23	e^3	l	18	11	27
24	e^2e'	$2l+l'$	17	6	4
25	e^2e'	$2l-l'$	18	3	4
26	e^2e'	l'	19	8	4
27	ee'^2	$l+2l'$	16	5	0 6
28	ee'^2	$l-2l'$	15	2	0·6
29	ee'^2	l	17	1	0·6
30	e'^3	$3l'$	13	0·3	0·01
31	e'^3	l'	16	0·1	0·1
32	ek^2	$l+2F$	15	11	4
33	ek^2	$l-2F$	17	30	4
34	ek^2	l	16	14	0·4
35	$e'k^2$	$l'+2F$	15	2	0·07
36	$e'k^2$	$l'-2F$	16	1	0·7
37	$e'k^2$	l'	16	4	0·7
38	$e^2\alpha$	$2l+D$	18	0·8	0·6
39	$e^2\alpha$	D	7	1·3	6
40	$ee'\alpha$	$l+l'+D$	16	0·4	1
41	$ee'\alpha$	$l-l'+D$	16	0·8	1
42	$e'^2\alpha$	$2l'+D$	15	0·3	0·02
43	$e'^2\alpha$	D	8	0·4	0·2
44	$k^2\alpha$	$2F+D$	16	0·5	0 1
45	$k^2\alpha$	D	8	3	0·1
46	$e\alpha^2$	l	16	0·03	0·1
47	$e'\alpha^2$	l'	16	0·002	0·02
48	α^3	D	8	0·001	0·03
49	k^3	3F	9	1	0·2
50	k^3	F	8	0·2	0·2
51	ke^2	$2l+F$	10	10	1
52	ke^2	$2l-F$	10	9	1
53	ke^2	F	10	4	1
54	kee'	$l+l'+F$	10	5	0·2
55	kee'	$l+l'-F$	10	3	0·2
56	kee'	$l-l'+F$	11	2	0·2
57	kee'	$l-l'-F$	11	4	0·2
58	ke'^2	$2l'+F$	10	0·8	0 03
59	ke'^2	$2l'-F$	10	0·08	0·3
60	ke'^2	F	10	0·4	0·03
61	$ke\alpha$	$l+F+D$	10	0·1	0·2
62	$ke\alpha$	$l-F+D$	10	0·2	0·2
63	$ke'\alpha$	$l'+F+D$	10	0·2	0·003
64	$ke'\alpha$	$l'-F+D$	10	0·5	0·003
65	$k\alpha^2$	F	8	0·004	0·06
66	e^4	$4l$	13	0·6	32
67	e^4	$2l$	15	0·6	32
68	e^4	0	9	0·5	32
69	e^3e'	$3l+l'$	14	0·3	5
70	e^3e'	$3l-l'$	14	0·3	5
71	e^3e'	$l+l'$	16	0·4	5
72	e^3e'	$l-l'$	17	0·5	5
73	$e^2e'^2$	$2l+2l'$	15	0·2	0·7
74	$e^2e'^2$	$2l-2l'$	15	0·1	7
75	$e^2e'^2$	$2l$	15	0·04	7
76	$e^2e'^2$	$2l'$	14	0·2	7
77	$e^2e'^2$	0	9	0 07	0·7
78	ee'^3	$l+3l'$	13	0·2	1
79	ee'^3	$l-3l'$	14	0·03	1
80	ee'^3	$l+l'$	15	0·05	1
81	ee'^3	$l-l'$	14	0·07	1
82	e'^4	$4l'$	11	0·01	0·16
83	e'^4	$2l'$	11	0·04	0·16
84	e'^4	0	7	0·0001	0·02
85	e^2k^2	$2l+2F$	13	0·5	5
86	e^2k^2	$2l-2F$	14	1·7	50
87	e^2k^2	$2l$	16	1	50
88	e^2k^2	2F	15	2	50
89	e^2k^2	0	9	2	5
90	$ee'k^2$	$l+l'+2F$	13	0·1	7
91	$ee'k^2$	$l+l'-2F$	14	0·1	7
92	$ee'k^2$	$l-l'+2F$	15	0·06	7
93	$ee'k^2$	$l-l'-2F$	14	0·4	7
94	$ee'k^2$	$l+l'$	16	0·6	7
95	$ee'k^2$	$l-l'$	15	0·8	7
96	e'^2k^2	$2l'+2F$	11	0·04	0·1
97	e'^2k^2	$2l'-2F$	13	0·01	1
98	e'^2k^2	$2l'$	13	0·06	1
99	e'^2k^2	2F	13	0·03	1
100	e'^2k^2	0	7	0·03	0·1
101	k^4	4F	9	0·04	0 8
102	k^4	2F	11	0·8	8
103	k^4	0	7	0·8	0·8
104	$e^3\alpha$	$3l+D$	15	0·06	7
105	$e^3\alpha$	$l+D$	16	0·13	7
106	$e^2e'\alpha$	$2l+l'+D$	12	0·05	10
107	$e^2e'\alpha$	$2l-l'+D$	12	0 2	10
108	$e^2e'\alpha$	$l'+D$	12	0·4	10
109	$ee'^2\alpha$	$l+2l'+D$	10	0·06	1·4
110	$ee'^2\alpha$	$l-2l'+D$	11	0·03	1·4
111	$ee'^2\alpha$	$l+D$	12	0·06	1·4
112	$e'^3\alpha$	$3l'+D$	11	0·001	0·2
113	$e'^3\alpha$	$l'+D$	12	0·002	0·2
114	$ek^2\alpha$	$l+2F+D$	12	0·02	0·1
115	$ek^2\alpha$	$l-2F+D$	15	0·02	1
116	$ek^2\alpha$	$l+D$	15	0·2	1
117	$e'k^2\alpha$	$l'+2F+D$	13	0·01	0·2
118	$e'k^2\alpha$	$l'-2F+D$	14	0·01	0·2
119	$e'k^2\alpha$	$l'+D$	15	0·2	0·2
120	$e^2\alpha^2$	$2l$	12	0·002	20

1 "Theory of the Motion of the Moon; containing a New Calculation of the Expressions for the Coordinates of the Moon in Terms of the Time." By Ernest W. Brown, M.A., Sc.D., F.R.S. (From the *Memoirs* of the Royal Astronomical Society, vol. liii.)

Reference Number.	Characteristic.	Argument.	Number of Terms.	Approximate value in arc of the largest coefficient.	Value of unity in the last figure given in millionths of a second of arc.
121	$e^2\alpha^2$	0	7	0·002	20
122	$ee'\alpha^2$	$l+l'$	13	0·0006	0·2
123	$ee'\alpha^2$	$l-l'$	14	0·001	0·2
124	$k^2\alpha^2$	2F	11	0·001	2
125	$k^2\alpha^2$	0	7	0·001	0·2
126	ke^3	$3l+F$	8	0·5	1
127	ke^3	$3l-F$	8	0·3	1
128	ke^3	$l+F$	9	0·7	1
129	ke^3	$l-F$	9	0·7	1
130	ke^2e'	$2l+l'+F$	8	0·2	0·2
131	ke^2e'	$2l-l'-F$	8	0·1	2
132	ke^2e'	$2l-l'+F$	8	0·1	2
133	ke^2e'	$2l-\iota'-F$	9	0·1	2
134	ke^2e'	$l'+F$	9	0·3	2
135	ke^2e'	$l'-F$	9	0·2	2
136	kee'^2	$l+2l'+F$	8	0·2	0·03
137	kee'^2	$l+2l'-F$	8	0 1	0·03
138	kee'^2	$l-2l'+F$	8	0·1	0·03
139	kee'^2	$l-2l'-F$	8	0·1	0·03
140	kee'^2	$l+F$	8	0·04	0·03
141	kee'^2	$l'-F$	9	0·02	0·03
142	ke'^3	$3l'+F$	6	0·02	0·004
143	ke'^3	$3l'-F$	8	0·002	0·04
144	ke'^3	$l'+F$	8	0·01	0·04
145	ke'^3	$l'-F$	8	0·002	0·04
146	k^3e	$l+3F$	7	0·1	0·2
147	k^3e	$l-3F$	7	1·0	0·2
148	k^3e	$l+F$	8	0·5	0·2
149	k^3e	$l-F$	8	4·3	0·2
150	k^3e'	$l'+3F$	6	0·05	0·03
151	k^3e'	$l'-3F$	7	0·03	0·3
152	k^3e'	$l'+F$	8	0·08	0·3
153	k^3e'	$l'-F$	7	0·08	0·3
154	$ke^2\alpha$	$2l+F+D$	8	0·03	0·03
155	$ke^2\alpha$	$2l-F+D$	9	0·06	0·03
156	$ke^2\alpha$	$F+D$	9	0·07	0·03
157	$kee'\alpha$	$l+l'+F+D$	7	0·02	0·4
158	$kee'\alpha$	$l+l'-F+D$	7	0·005	4
159	$kee'\alpha$	$l-l'+F+D$	7	0·007	4
160	$kee'\alpha$	$l-l'-F+D$	7	0·017	4
161	$ke'^2\alpha$	$2l'+F+D$	6	0·001	0·006
162	$ke'^2\alpha$	$2l'-F+D$	8	0·001	0·006
163	$ke'^2\alpha$	$F+D$	8	0·0004	0·006
164	$k^3\alpha$	$3F+D$	7	0·01	0·004
165	$k^3\alpha$	$F+D$	8	0·06	0·004
166	$ke\alpha^2$	$l+F$	7	0·001	0·006
167	$ke\alpha^2$	$l-F$	7	0·0005	0·006
168	$ke'\alpha^2$	$l'+F$	7	0·0002	0·01
169	$ke'\alpha^2$	$l'-F$	7	0·0002	0·01

HOW THE SABRE-TOOTHED TIGERS KILLED THEIR PREY.

DURING the greater portion of the third or last great geological epoch—the Tertiary period of geologists—there flourished certain very large and powerful members of the cat tribe, commonly known, on account of the inordinate length of their upper tusks, as sabre-toothed tigers, although there is nothing to show that they had any more affinity with the tiger than with the lion. Indeed, they were widely separated structurally from both, as they were from all living cats. In these sabre-tooths the upper tusks were huge, compressed, scimitar-shaped teeth, with the front and back edges generally, if not always, finely serrated. In some of the later species, which existed contemporaneously with man, the upper tusks were eight or nine inches in length, and they were longest of all in a South American species. In the earlier members of the group, before they had attained the inordinate development characterising the later forms, the upper tusks were protected by a descending flange at the fore part of each side of the lower jaw. Apparently, however, this was not found to be a satisfactory working arrangement, and it was accordingly discarded in the later forms, the tusks of which became proportionately thicker so as to stand in need of no such protection. At the same time the whole lower jaw became remarkably slender and weak, so much so, indeed, that it is evident it could not have been used in the same manner as the lower jaw of a lion or a tiger. Confirmation of this view is afforded by the circumstance that the lower jaw articulates with the skull in quite a different way from that which occurs in the last-mentioned animals.

Sabre-tooths were distributed over a great portion of the surface of the globe, their remains having been found in England, France, Germany, Hungary, Greece, Persia, India and North and South America. They lived at first at a time when true cats were either very scarce or entirely unknown, and they appear to have survived longest in South America.

A moment's consideration will show that, at any rate in the case of the longest-tusked species, it was quite impossible for these animals to bite in the ordinary manner, as the entrance to the mouth would be barred by the tusks, which must have reached to the sides of the lower jaw if the extent of the gape were only equal to that of a lion or a tiger.

This disability has given rise to several suggestions as to the mode in which the sabre-tooths used their upper tusks. One idea was that they were employed as stabbing weapons, and used while the mouth is closed. With the earlier forms, in which the tusks were shorter and protected by a flange on the lower jaw, this method of use would obviously be an impossibility. Moreover, as is pointed out by a writer whose name will be mentioned later on, it would involve, after long adaptation to striking with the mouth open, a sudden change to attacking with the jaw closed. Perhaps a still more serious objection is the fact that the efficient length of the weapon would be diminished by about a half if the attack were made with the jaw shut, and therefore that the animals might just as well have remained in their primitive form, with comparatively short tusks. Again, the closed mouth would obviously be a very serious disadvantage to an animal which drinks the blood of its victims.

Among other strange suggestions, it has been supposed that the tusks were employed as aids in climbing trees! Apart from other considerations, their brittle structure and finely serrated edges would render them obviously unsuited for this purpose. Another idea is that the sabre-tooths were aquatic in their habits, and that their tusks were used in some respects in the same manner as are those of the walrus. Needless to say, this idea, although difficult to disprove in so many words, may be dismissed without serious comment. It may be added that the long tusks of the later and more specialised sabre-tooths have actually been regarded as the cause of the extinction of the group, the idea being that the creatures, owing to the entrance being barred by the tusks, could not open their mouths sufficiently wide to admit food.

Recently, in the *Memoirs* of the American Museum of Natural History, Mr. W. D. Matthew has suggested an explanation of the puzzle, which, although somewhat startling to preconceived ideas, seems on the whole to be the best solution of the problem hitherto offered. Starting with the indisputable fact that the mode of articulation of the lower jaw to the skull is quite different from that which obtains in the true cats, and also bearing in mind the weakness of the lower jaw itself and the smallness of its tusks, the author suggests that the sabre-tooths dropped the lower jaw into a vertical position, and were thus enabled to use their upper tusks as stabbing weapons. An examination of the skull of the large South American species in the British Museum shows that such a position of the lower jaw is quite possible, the small size of its ascending or coronoid branch allowing the necessary movement to be made without interfering with the cheek-arches.

"Presumably," adds the author, "the ligaments were adjusted to these changes, and if so, there appears to be no reason why the sabre-tooth should not open his mouth far wider than is possible for the cat, laying back the chin against the throat without inconvenience. Along with this change there is a decrease in power of the muscles closing the jaw, due probably to lack of use of the lower canines (used against the upper ones in other Carnivora, but useless in this way to the sabre-tooth)."

It is further urged that the disappearance in the long-tusked species of the flange on the lower jaw which protected the canines in the more primitive forms is correlated with this mode of opening the mouth, as the presence of such a flange would prevent the lower jaw lying close against the throat. Moreover, the anterior cheek-teeth, which are used by modern Carnivora chiefly for bone-crushing, and are most developed in the hyænas, have almost disappeared in the sabre-tooths, while, on the other hand, the shearing carnassial teeth—the sole function of which is flesh-cutting—have been inordinately increased in size and power.

As is well known, a large number of the mammalian contemporaries of the earlier sabre-tooths were short-necked and probably thick-skinned ungulates, some of which were more or less distantly allied to the modern tapirs and others to the pigs. And in the same manner as the long-necked and thin-skinned ruminants of to-day form a large portion of the prey of the modern lion, tiger, leopard, &c., so these early ungulates fell victims to the attack of the sabre-tooths. Now, antelope and deer are killed by the neck being bitten through or broken when attacked by the larger Carnivora; but it seems unlikely that such a method of attack would be successful in the case of short-necked and thick-skinned animals.

Accordingly, it is suggested by Mr. Matthew that in the case of the sabre-tooths "their most advantageous method of attack was to inflict stabbing and ripping cuts at points where an artery could be reached, using their short, broad and powerful fore-feet as fulcrums, and probably bleeding the animal to death."

It is added that the earlier appearance of true cats in Europe as compared with North America, where they are very rare throughout the Tertiary period, may very probably be correlated with the earlier appearance and greater abundance of the modern type of specialised ruminants in the Old World. Finally, the largest and most specialised member of the group, the great *Machaerodus neogaeus* of the Pleistocene of South America, which the author believes to have been the slowest mover of its kind, may have preyed on the huge thick-skinned and slow-moving ground-sloths which attained such a remarkable development in that continent. In a subsequent section the author hazards the suggestion that the more cat-like Carnivora known as Dinictis, the upper tusks of which were noticeably shorter than those of the sabre-tooths, were creatures with a greater turn of speed and therefore better adapted for preying on the smaller and swifter-footed Herbivora than was the case with their long-tusked relatives. R. L.

UNIVERSITIES IN RELATION TO RESEARCH.[1]

IT will perhaps be expedient for me at the outset to say that I propose to use the word research in its widest meaning, *i.e.* as indicating those efforts of the human mind which result in the extension of knowledge, whether such efforts are exerted in the field of literature, of science or of art.

The chief agencies of modern organised research are (1) the learned societies and (2) the universities. The former receive and publish research papers; the latter superintend and direct investigators and publish results. To these should properly be added the various journals which have been established and carried on by private effort. It is a significant fact that the establishment of modern learned societies coincides closely in time with the Renaissance movement. Telesio established one of the earliest mathematico-physical societies—the Academy of Cosenza. Other Italian societies of similar scope were founded in Rome in 1603, in Florence in 1657, and the Royal Society of London dates from 1660 or earlier. Organised research in universities was of slower growth. In them the mediæval spirit was tenacious of life, and it was only in the nineteenth century, in Germany, at the close of the Napoleonic wars, that research, not only in natural philosophy, but in the whole field of knowledge, became the basis of the German educational system, and I might remark, without going into details, that the university systems of France and the other principal countries of Europe, with the exception of Great Britain, are in the main parallel with that of Germany, although not so consistently elaborated.

[1] Abridged from the presidential address delivered by Prof. James Loudon before the Royal Society of Canada at the recent annual meeting of the Society at Toronto.

We are so subject to the authority of words that it is difficult for us to realise that the organisation called a university in Germany is almost entirely different in scope and object from the institution which we so designate in this country. Hitherto, at least in England and Canada, the function of the university has mainly been to impart a general and liberal education, continuing and completing the beginning already made in the secondary school. Speaking generally, I may say that under the German system the work of our secondary schools and universities combined is performed by the gymnasium, the nine or ten years' training of which leaves the young man of nineteen or twenty years of age with a much better liberal education than that possessed by the average graduate in arts of an English, Canadian or American university. How this is accomplished it is not my purpose here to explain. There is no doubt, however, as to the fact, which is substantiated both by the nature of the curriculum of the gymnasium and by the testimony of those familiar with both systems.

It is upon this substantial preliminary training that the work of the German university proper is based. Up to this point the young man has been a "learner"; on entering the university he becomes a "student." This distinction, expressed by the German words "lernen" and "studieren," marks the difference between gymnasium and university—the acquisition of knowledge under the teacher in one, the independent research under the guidance of the professor in the other.

The ultimate object of both professors and students is the advancement of knowledge, and the independence with which research is conducted is well expressed by the two words "Lehrfreiheit" "Lernfreiheit"—the freedom of the professor as to what he teaches and the freedom of the student to select his special line of research. Some idea of the extent of this work may be formed from the number of universities in Germany, twenty-one in all, and from the fact that the aggregate number of matriculated students exceeds 12,000, in addition to non-matriculated students, who are also numbered by thousands, while the philosophical faculty at Berlin and Leipzig in 1901-2 numbered, respectively, 207 and 120. To the twenty-one universities mentioned should be added the nine technische Hochschulen which have now the right to confer the doctor's degree in the applied sciences.

The place and importance of research in the German system is further indicated by the fact that even teachers in the gymnasium devote themselves to such work, their papers being published in the annual reports of their institutions. With such respect is the ability for research regarded that the publication of a paper of this kind may lead directly to a professorship in the university, as was the case, for instance, in the appointment of Weierstrass, the celebrated mathematician.

In the organisation of the German university, research has been shown to be a fundamental principle; in the British university it is as yet incidental or of sporadic manifestation. I do not, of course, ignore the very important contributions which have been made by British scholars to the advancement of learning, but it is worthy of note that the credit for their splendid achievements is rather due to the individuals themselves than to the universities with which many of them were connected. The British university is not primarily an institution for research. In its function of providing the higher grades of a liberal education the proper comparison is with the upper classes of the German gymnasium, not with the German university proper. True, we find in some of the British universities a specialisation in certain subjects, *e.g.* in honour classics and mathematics at Oxford and Cambridge, leading to higher work than that attempted in the gymnasium; but however advanced the studies may be, there is rarely any attempt to guide the English undergraduate in the direction of research. Reading and examinations are the academic watchwords, and to the great mass of students and tutors the field of research is a *terra incognita*.

The attitude of the British nation has been hitherto largely that of indifference towards organised research, and this has been true, not only of the general public, but also of those engaged in academic administration. There has existed a deep-seated conviction, born perhaps of reiterated assertion, that the British university system is superior to that of Germany or any other country, and as near perfection as may well be. We are not concerned just here with the discussion of the merits of the system, which are undoubtedly many and great, but we must admit that the attitude of self-satisfaction which has prevailed, combined with the ignoring of other ideals, is at least unphilosophic. In the midst of such an atmosphere it is not surprising that the development of a true Renaissance spirit has been somewhat tardy.

But the British nation is on the eve of an awakening, an awakening which has already taken place among certain leaders of thought. The fact is dawning upon the British mind that some vital connection really does exist between national progress and scientific discovery, and that the latter should be fostered in connection with the higher institutions of learning. Under the conviction that British commercial supremacy will be seriously threatened unless foreign, and especially German, scientific methods are adopted, universities of a more modern type than Oxford and Cambridge, and also technical colleges, have been established. Such institutions no doubt fill a long-felt want, but they do not go to the root of the matter. On the academic side they are but a modification of the older type; on the technical side they contemplate, not the discovery of new truth, but the application of what is already known. The spirit of research is lacking, and without it no expenditure of money, no raising of examination standards for mere acquirement, will actually increase the capital account of national knowledge.

The policy of the universities of the United States regarding this matter is in marked contrast with the indecision and conservatism which prevail in the mother country. The type of mind which has been developed in the century and a quarter of separate national existence is one of great vigour and originality; but these qualities have for the most part been turned aside by the circumstances of a new country from abstract investigations. Research after the almighty dollar by the nearest short-cut has been, and perhaps still is, regarded as the chief national characteristic of our American cousins, and in this pursuit they have displayed a genius for concrete research in mechanical invention and an ability for commercial and industrial enterprise which have been an object of wonder, and latterly of anxiety, to other nations. During the first hundred years of national existence the university of the gymnasium type which had been inherited from England continued to develop and expand in the United States. Suddenly, however, almost exactly twenty-five years ago, a remarkable modification was introduced.

Since 1877 many universities, including the best of those already in operation, as well as new foundations, have added a graduate department leading to the Ph.D. degree, although none of these, with the exception of Clark University, has made the prosecution of research the sole business of the university. Some idea of the rapid progress of this movement may be gathered from the fact that the numbers pursuing graduate studies in the universities of the United States have increased from 8 in 1850 to 399 in 1875, and to about 6000 in 1902.

I have confined my remarks up to this point almost wholly to the historical aspect of the question, but it will perhaps not be out of place for me to point out in conclusion some of the advantages which in my opinion are connected with the pursuit of university research.

Let us consider first the stimulating effect upon the individuals and institutions concerned. Among those who are affected by this stimulus should first be named the professor. Dr. Samuel Johnson was wont to compare accumulated knowledge to a heap of ice lying exposed to the summer sun, the bulk of which could not be maintained without constant replenishment. Continuing the figure, we can readily imagine that the professor's fund of knowledge which is ample enough for the class-room teaching of immature minds might shrink and trickle away until little is left but the sawdust which we usually associate with the preservation of that commodity. Under the stimulus of research this is impossible, for research into the new implies a full and minute mastery of that branch of knowledge in which the research is being conducted. Hence if no other advantage resulted a good case might be made out along this line of argument.

This stimulus to the professor would react with increased force upon the student. It was a favourite saying of a certain celebrated artist that those who follow after others rarely outstrip them. To hold up before the student either by theory or practice solely the ideal of acquiring what has already been learned is mediævalism pure and simple; it is to teach him to creep where he might walk upright and alone; it is to rob him in part of that intellectual birthright of independent thought which is the inheritance of every man, at least since the Renaissance. It is sometimes objected that the results attained by research students are often trivial or futile. I am disposed, however, to agree with a remark made by one of George Eliot's characters:—"Failure after long perseverance is much grander (and I would say parenthetically more useful) than never to have a striving good enough to be called a failure." It is sometimes also urged that research in the immature student leads to superficiality and conceit. I cannot but think this fear ill-grounded. It has been proved, on the contrary, that nothing will so quickly ripen and enlarge preliminary knowledge and so effectually extinguish presumption as the hand-to-hand struggle with some special problem in the department of study in which the student is already proficient.

Apart from the professor and student, the first effect of the inauguration of research work in our universities, if of the genuine stamp, will be felt upon the teaching profession of the country as a whole. Assuming an educated and interested public opinion, the premium so long placed upon memorised knowledge will disappear, and a change in the principle of selection of teachers both in universities and secondary schools will result.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AFTER consultation with Mr. Astor, and in accordance with his wish, the council of University College, London, has resolved to endow the chair of pure mathematics and to name it the "Astor chair." The staff of the reorganised department of chemistry of the College will be as follows:—General and inorganic chemistry: professor, Sir William Ramsay, K.C.B., F.R.S.; assistant professors: Dr. F. G. Donnan, Dr. Morris Travers and Mr. E. C. C. Baly. Organic chemistry: professor, Dr. J. Norman Collie, F.R.S.; assistant professor, Dr. S. Smiles.

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to science research scholarships for the year 1902, on the recommendation of the authorities of the several universities and colleges:—University of Edinburgh, J. K. H. Inglis; University of Glasgow, A. Wood; University of St. Andrews, W. Wallace; University of Aberdeen, A. C. Michie; University of Birmingham, J. A. Lloyd; Yorkshire College, Leeds, H. D. Dakin; University College, Liverpool, F. Rogers; University College, London, E. P. Harrison; Owens College, Manchester, G. C. Simpson; Durham College of Science, Newcastle-on-Tyne, C. R. Dow; University College, Sheffield, G. B. Waterhouse; Queen's College, Galway, W. Goodwin; University of Toronto, W. C. Bray; Dalhousie College, Halifax, Nova Scotia, T. C. Hebb; University of Melbourne, R. Hosking; University of Adelaide, W. T. Cooke; University of New Zealand, M. A. Hunter. The following scholars nominated in 1901 have had their scholarships continued for a second year on receipt of a satisfactory report of work done during the first year:—F. Horton, A. Slator, R. B. Denison, G. Owen, G. Senter, F. W. Rixon, T. Baker, S. C. Laws, Alice E. Smith, J. Hawthorne, R. K. McClung, C. W. Dickson, G. Harker. The following scholars nominated in 1900 have had their scholarships exceptionally renewed for a third year:—Dr. W. M. Varley, Dr. S. Smiles, J. A. Cunningham, W. S. Mills, J. Patterson, J. Barnes.

THE Cambridge summer meeting organised by the Local Examinations and Lectures Syndicate was opened on Friday last with an address by the vice-chancellor, Dr. A. W. Ward, master of Peterhouse. Many men of distinction are taking part in the meeting, and the lectures cover a very wide range. The general subject of the meeting is "Some Aspects of Life and Thought in Europe and America in the Nineteenth Century." In the section of physical and natural sciences, the following lectures will be delivered during the meeting, which is divided into two parts, and ends on August 26:—"Some Modern Astronomical Speculations," Prof. G. H. Darwin, F.R.S.; "Sidereal Astronomy," Mr. Arthur Berry; "Meteorology in the Nineteenth Century," Dr. W. N. Shaw, F.R.S.; "Pasteur and his Work," Prof. Sims Woodhead; "An Aspect of the Influence of America on Geology," Dr. R. D. Roberts; "Progress of Geology in the Nineteenth Century as illustrated by modern views on (1) The Structure of the Earth's Crust, (2) The Evolution of the Configuration of the Surface," Mr. J. E. Marr, F.R.S.; "Advances of Botany," Prof. H. Marshall Ward, F.R.S.; "A Great Botanist: Sachs," Prof. W. B. Bottomley; "Colour Photography," Mr. T. B. Wood; "The Rise and Development of Electro-Chemistry," Mr. D. J. Carnegie. Among the subjects in the section of education are:—"Hygiene as a Factor in National Education," Miss A. Ravenhill; "Nature-Study" (Six Lectures), Prof. Patrick Geddes;

and "Illustrative Lectures in Nature-Study," Miss Von Wyss. There will be practical courses in nature-study (chemistry and botany) and in geography in its physical aspects. A conference upon the subject "In what sense can and ought Schools (Primary and Secondary) to prepare Boys and Girls for Life?" was opened by Dr. M. E. Sadler on Saturday last, and one on "Hygiene in Schools" will be opened by Miss Ravenhill on August 14.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 28.—M. Bouquet de la Grye in the chair.—On a curious property of a class of algebraic surfaces, by M. Emile Picard.—Reflection and refraction by a body transparent undergoing a rapid translation; equations of motion and some general consequences, by M. J. Boussinesq.—The reduction of nitro-derivatives by the method of direct hydrogenation in contact with finely divided metals, by MM. Paul Sabatier and J. B. Senderens. Nitronaphthalene is readily reduced to naphthylamine by hydrogen in presence of reduced copper at 350° C. With nickel the reduction goes further, ammonia and naphthalene tetrahydride being formed. Nitromethane and nitroethane are reduced completely to the corresponding amines.—A method of spectrum analysis capable of furnishing the still unknown law of rotation of planets of feeble brightness. Verification of the method, with preliminary results, by M. H. Deslandres. This method, which was applied with success in 1895 to the measurement of the rotation of the bright planets, has now been extended to those of lesser magnitude, including Uranus and Neptune.—The entire image of the planet submitted to spectrum analysis undergoes deformations from which the sense of the rotation can be determined, and to a certain extent its velocity. The rotation of Uranus has been found to be retrograde.—On the problem of Dirichlet for domains limited by several contours or surfaces, by M. A. Korn.—On one of the causes of the explosion of steam boilers and on a means of preventing it, by M. J. Fournier. It is shown that with the ordinary form of safety valve the release may take place in the normal way, and yet an insufficient amount of steam may escape to prevent the pressure rising to a dangerous extent. A modification of the ordinary safety valve is described in which this difficulty is overcome.—On magnetic dichroism, by M. Quirino Majorana. Active liquids behave in a magnetic field like uniaxial crystals possessing dichroism.—On the electrochemical equivalent of silver, by M. A. Leduc. A short account of researches the complete description of which will be published shortly in the *Journal de Physique*, in which the effect of temperature changes, current density, and acidity of the bath upon the value of the electrochemical equivalent of silver has been determined.—The silvering of glass and daguerreotype, by M. Izarn. A minute description of the method of silvering glass by means of ammoniacal silver nitrate and solutions of formaldehyde.—On the precipitation of the chlorides and bromides of cadmium, mercury and tin by sulphuric acid, by M. Georges Viard.—On mannite, the nitrates and the alkaloids of normal urine, by M. S. Dombrowski. By applying the method of separation described in a previous note the author has succeeded in isolating from urine sodium nitrate, cadaverine, mannite and a new alkaloid.—An attempt at an immediate analysis of nerve-tissue, by M. N. Alberto Barbieri.—On the ligature of the appendicular extremity of the cæcum in *Cercopithecus cephus*, by M. Jean Maumus.—The internal secretion of the testicle in the embryo and in the adult, by M. Gustave Loisel.—The microbial kinases; their action on the digestive power of the pancreatic juice together with albumin, by M. C. Delezenne.—The parasitic nature of certain calcareous degenerations, of some inflammatory tumours and of special lesions of the skeleton, by MM. A. Charrin and G. Delamare.—A comparative study of hæmatolysis by poisons in the dog and rabbit, by M. C. Phisalix.—On a new form of tactile sensibility, trichesthesia, by MM. N. Vaschide and P. Rousseau.—On the possibility of combating mildew and oidium of the vine by a liquid treatment, by M. J. Guillon.—On a method of concentrating wine, by MM. Baudoin and Schribaux. The method which was found to give the best practical results consisted in first partially distilling the wine at a low temperature and then removing some water from the distillate by freezing.—The prehistoric drawings in the grotto of La Mouthe, Dordogne, by M. Émile Rivière. Facsimiles of drawings of a reindeer and of a horse are given.

NEW SOUTH WALES.

Royal Society, June 4.—Prof. Warren, president, in the chair.—The parks of Sydney; some of the problems of control and management, by Mr. J. H. Maiden.—A possible connection between volcanic eruption and sunspot phenomena, by Mr. H. I. Jensen. The author of this paper mentions that the idea of the existence of such a connection was suggested to him by the fact that Vesuvius was in violent eruption in the years 1813, 1822, 1855, 1867, 1891 and 1900, all of which were minimum years. By means of a chart he shows that earthquakes and eruptions are most violent, numerous and extensive when there is least sunspot activity. Though seismic disturbances do occur at all times, they seem for the last hundred and twenty years to have been most severe around the minimum years—1811, 1822, 1833-4, 1844, 1855-6, 1867-8, 1878-9, 1888-9 and 1900-2—large groups of great earthquakes and eruptions having taken place in and about these years. On the other hand, the chart also shows that in years of maximum, like 1893-8, 1884-5, 1869-71, 1858-65, and so on, these phenomena have been comparatively few and unimportant. The author thinks that the cause of this connection between solar and seismic disturbances is that in years of sunspot minimum there is less heat, and other energy, received from the sun, and consequently there is more rapid radiation from the earth, causing quicker cooling, hence more cracking of the earth's crust. He also suggests that the earth's atmosphere exerts a greater squeeze on the crust in years of minimum, thus forcing lava out of fissures.

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