THURSDAY, APRIL 24, 1913.

CHEMISTRY OF COAL MINING.

(1) *Coal, and the Prevention of Explosions and Fires in Mines.* By Dr. J. Harger. Pp. vii+183. (Newcastle on-Tyne: Andrew Reid and Co., Ltd.; London: Longmans, Green and Co., 1913.) Price 3*s.* 6*d.* net.

(2) *Safety in Coal Mines: a Text-book of Fundamental Principles for Firemen and other Workers in Mines.* By Prof. D. Burns. Pp. vi+158. (London: Blackie and Son, Ltd., 1912.) Price 2*s.* 6*d.* net.

(1) IN the first of two papers read respectively on February 27 and October 8, 1912, before the Manchester Geological and Mining Society, Dr. Harger expresses his views regarding a means of preventing the occurrence of explosions as follows:—

"The dry mines in this country are more dangerous than they were several years ago, and are likely to become more so in the future if the Government has its way; . . . a reduction of 1 per cent. in the oxygen content, and the addition of ½ per cent. of carbon dioxide in the ventilating current, is all that is required for most mines; and for the more dangerous mines . . . a reduction of 2 per cent. in the oxygen content and the addition of about ¾ to 1 per cent. of carbon dioxide would make the intake airways absolutely safe."

In the second paper Dr. Harger suggests the same means for preventing "gob-fires" (spontaneous combustion). His book is an elaborated edition of both papers, prefaced with some chapters on the nature of coal and its occluded gases, combustion, respiration and the mechanism of explosions.

It is self-evident that if the proportion of oxygen in the air of mines can be reduced in practice to such a point that it cannot support the combustion of either firedamp or coal, neither explosions nor gob-fires could happen. But it is unfortunate that whatever intrinsic value our author's proposals may have—and few would be rash enough at this stage to say they have none—they are based partly upon erroneous impressions regarding the phenomena of great explosions, and partly on the results of what appear to be faulty experiments conducted on too small a scale.

Great explosions do not, as Dr. Harger imagines, travel either exclusively or generally *against* the direction of the ventilating currents; and they do not avoid the working faces or return airways because, as he imagines, the air in these places already contains too little oxygen and too much carbon dioxide to admit of its supporting the combustion of coal-dust.

With regard to the first point, the shot which originated the explosion at Altofts Colliery, to which he refers, was fired in an intake airway at a distance of 550 yards from the bottom of the downcast. The flame traversed all the intake airways but one, at the entrance to which it was arrested by dampness, and in every case (excepting only in the 550 yards) in the *same direction* as the air-currents (Proc. Roy. Soc., vol. xlii., p. 174).[1]

With regard to the second, it was shown (Proc. Roy. Soc., vol. xxviii., p. 416) that return air saturated with, and carrying visible globules of, moisture caught fire at a naked light and burned with a large flame when mixed with a certain coal-dust. That coal-dust came from a colliery adjoining Ferndale, and was of the same quality, so far as volatile matter is concerned, as the *pure* Ferndale dust with which our author failed to get an ignition in his apparatus with normal air. This fact, coupled with the further one that two great explosions have happened at Ferndale colliery—one in 1867 with 178 deaths, the other in 1869 with fifty-three deaths—seems to show that the experiments are not wholly trustworthy, and that some of the conclusions drawn from them as to the quality of air required to prevent ignition will have to be modified.

Dr. Harger proposes to effect his purpose by mixing the necessary proportion of flue gases, which emanate from the boiler furnaces found at every colliery, with the intake air, after having passed them, while still hot, over some catalytic material such as bog iron ore, oxide of copper, finely divided metallic copper, and so on. He contends that if they were thus treated the residual oxygen contained in them would combine with the carbon monoxide, hydrocarbons and smoke, and render them innocuous; and he quotes the authority of Dr. J. S. Haldane and others to show that air of the required quality is not only harmless, but healthful.

His proposals have the distinguishing merit of originality, and have been set forth with such vigorous insistence both in his book and in his papers that they cannot fail to command attention.

(2) This book is designed to meet a want created by the Coal Mines Regulation Act (1911),

[1] Now that this question has assumed some importance it is perhaps rather unfortunate that the Royal Society did not publish the whole of this paper (which is a description of Altofts explosion) as well as the plan of the workings which accompanied it, as some of the misunderstandings and controversies which have arisen during the last twenty-five years might have been thereby avoided.

which provides that, after January 1, 1913, every fireman, examiner, or deputy employed as a fireman, with certain exceptions which need not be here specified, must possess a full certificate stating (1) that he can test for gas with a safety-lamp and is able to see a 2 per cent. "cap," (2) that he can measure an air-current, (3) that his hearing is good.

As a knowledge of the first two requirements cannot be attained by men of this position without tuition, numerous classes have been formed in all the colliery districts for the purpose of instructing them.

Prof. Burns's book is intended to serve as a text-book for these classes, and is, with certain reservations, admirably adapted to its purpose. In attempting to make it suitable to the requirements of both teachers and pupils, however, its author has produced a work which is in some parts too elementary for the former, and in others (indicated by means of asterisks) too abstruse for the latter.

The number of teachers and assistants employed by the education committee of the Glamorgan County Council and the number of candidates who have presented themselves for examination before the same authority during the last eight months are, respectively, eighty-seven and more than 8000. The candidates are thus likely to constitute by far the more numerous class of his readers, and we feel certain that they would much better appreciate the book if those parts of it intended for teachers, together with most of the chemical and other formulæ, descriptions of methods of preparing methane and other gases, and all the more complicated exercises, were omitted. We therefore recommend Prof. Burns, when preparing another edition, to avoid the solecisms which abound in the present book, to eliminate all but the simple matter suitable to the capacity of firemen—which we have no hesitation in pronouncing to be excellent in its present form—and, if he thinks it desirable or necessary, to write another more advanced book for the use of teachers and others.

SOUTH AFRICAN ARCHÆOLOGY.

The Pre-historic Period in South Africa. By J. P. Johnson. Second edition, revised and enlarged. Pp. iv + 115 + plates + map. (London: Longmans, Green and Co., 1912.) Price 10*s*.

IT is satisfactory to find that there is a sufficient interest in the subject of South African archæology to require a second edition of Mr. J. P. Johnson's book on "The Pre-historic Period in South Africa" within two years. In the new edition some new finds are referred to, and there is an appendix by Mr. A. S. Kennard on the sequence of the stone implements in the Lower Thames Valley. Mr. Johnson describes and figures chipped stones from Leijfontein, below the Campbell Rand, which closely resemble those from the plateau of Kent, and he does not hesitate to call them "eoliths." Implements of river-drift types are distributed all over South Africa. "Among the amygdaliths [his term for the common type of implement] every gradation is met with between the thick Chelléen form with unworked butt, the thinner Acheuléen type with edge carried all round, and the proto-Solutréen form pointed at both ends"; he calls them all "Acheulic." He also recognises "Solutric" implements; amongst these are "pigmy implements" of chert. Dr. Péringuey found implements at Bloemsbosch in what Johnson considers a Solutric site, apparently contemporary with a large extinct buffalo and horse. In the present state of our knowledge it is rather begging the question to apply without qualification to South African finds the terms used to designate special "industries" of European archæology. It would be a wiser plan to use non-committal designations while pointing out the similarities in the forms of the implements.

The Coast middens described by Dr. Péringuey are referred to, and several excellent reproductions are given of petroglyphs and rock-paintings, the peckings made by the Bantu being markedly inferior to Bushman work. The upper drawing of his Fig. 37 is of a rock-painting described by G. W. Stow in "The Native Races of South Africa" (p. 121). Mr. Johnson has no doubt that the "Solutric" implements were made by the ancestors of the present Bushmen, who, he believes, were very far from being a homogeneous people. Prof. Sollas, in "Ancient Hunters and their Modern Representatives," regards it as highly probable that in Aurignacian times a race allied to the Bushmen inhabited western Europe (p. 268). Mr. Johnson, however, seems to class the Aurignacian, Solutrian, and Magdalenian stages under the term Solutric. Support is given to the view that the famous forts or kraals and other ruined structures in Rhodesia were built by prehistoric Bantu in connection mainly with gold-mining, and he supplies plans of four stone-walled ruined kraals at Ramoo Kop for comparison with those already published.

ASPECTS OF THE EARTH.

(1) *Lehrbuch der Grundwasser- und Quellenkunde.* Für Geologen, Hydrologen, Bohrunternehmer, Brunnenbauer, Bergleute, Bauingenieure und Hygieniker. By Prof. K. Keilhack. Pp. xi+545. (Berlin: Gebrüder Borntraeger, 1912.) Price 20 marks.

(2) *The Geology of Soils and Substrata.* With Special Reference to Agriculture, Estates, and Sanitation. By H. B. Woodward. Pp. xvi+366. (London: E. Arnold, 1912.) Price 7*s.* 6*d.* net.

(3) *Die erklärende Beschreibung der Landformen.* By Prof. W. M. Davis. Deutsch bearbeitet von Dr. A. Rühl. Pp. xviii+565. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 11 marks.

(1) PROF. KEILHACK has produced a book on water-supply which presents a remarkable contrast with the brief treatment of the subject in many works on engineering. Yet he regards these five hundred tall and handsome pages as constituting a preliminary "Lehrbuch," leading up to a future "Handbuch" of Teutonic magnitude. The geologist here subordinates himself willingly to his technical purpose. The kinds of rocks are dealt with in a few short sentences, but their structure and the passage-ways for water in them are at once impressed upon the reader as of paramount importance. The characters of soils as water-bearers receive rather slight attention, and the necessity for discriminating between the "fine earth" used experimentally and the soil as part of the earth's crust, with all the stones in it, seems left to the intelligence of the reader.

In all questions involving maps Prof. Keilhack is on ground that is specially his own, and he makes good use of the beautiful products of the Prussian Geological Survey. The discussion of the form of the surface of the subterranean water-table is unusually detailed. The problems of the European karstlands are considered; but the author probably leaves for his still larger treatise the interesting feature of water-supply in more arid countries, such as rivers disappearing into sandy wastes, the origins of oases, and the salts deposited in the surface-zone of excessive evaporation. Prof. Keilhack's book is an excellent example of the application of scientific research, wide and without ulterior motive, to the stimulating needs of human enterprise.

(2) Mr. H. B. Woodward's latest addition to Arnold's Geological Series is an attempt to look at soils from a geological point of view, and at the strata below them from the attitude of an agriculturist. The proper treatment of the soil is rapidly becoming a matter for the organic chemist and the biologist, but the foundation on which the soil-activities are based is an aggregate of mineral particles spaced in very various ways. The soil-forming minerals are rather briefly treated on pp. 55–6, and the calcium fluoride and chloride of apatite have somehow got attached to dolomite. The beneficial character of some of these minerals and the deadly effect of others are not indicated at this stage; but we find a good deal of diffused information when we reach the accounts of soils formed on various types of rock. The vexed question of what is "clay" is left alone, but we may hesitate to accept the statement (p. 78) that the Kimeridge, Gault, and London Clays contain "up to 95 per cent. clay." The remark on p. 73 that "alumina, in the form of silicate of aluminia or clay," absorbs and retains moisture and serves as a binding material does little to help us towards understanding the rock known as clay. Analyses of the clays mentioned above, moreover, are given on p. 59, and show at the most 50 per cent. of aluminium silicate.

If we feel that the first part of the book does not quite realise the author's aim, and does not explain the soils and their structures to an agriculturist as a geologist might explain a landscape to a painter, the latter section will convey much special information to landowners in the British Isles. The soils on the subdivisions of our stratified series are described by one who knows their aspect well, and these chapters form a general account of the superficial deposits of England, with many useful notes on those of Scotland and of Ireland.

(3) Prof. W. M. Davis has always a question to ask which must be answered in the field itself. At times he may seem to ignore the mineral details which lie at the root of rock-structure, and therefore at the root of the features produced during a cycle of erosion. But he rightly, on p. vii. of the present work, distinguishes between geological and geographical description; in the latter, all attention must be concentrated on the surface-forms as they are to-day. The lectures delivered in German by Prof. Davis in 1908–9 at the University of Berlin are here presented, with the assistance of Dr. Rühl, as a general treatise on land-forms. They are illustrated by the author's line-drawings, minute and thoughtful, like the work of Albrecht Dürer, and sometimes presenting, as the earth does, too many problems in the limits of a single scene.

Anyone who examines these drawings will be made to understand features that he remembers viewing casually, perhaps even from a railway train; and now for the first time he perceives

them in their true relations. The dissected highland of fig. 116, with the broad cone of detritus forming the only habitable region at its foot, will remind the traveller of the valley of the Inn or of the Drau. The volcanic relics in fig. 132 explain Gergovia and Mont Dore. The eighth chapter, on "Der aride Zyklus," appeals strongly to pioneers on the edges of our colonised lands, and would have edified the Roman senate, when it republished the Carthaginian text-books and faced the problems of the desert and the steppes. On pp. 375–6 the evidence for a recent uplift of central and southern Africa is well stated. A characteristic discussion on the methods of presenting geographical problems finds its way somehow into this chapter. British geologists will turn with interest to the chapters on glacial conditions and marine erosion. The explanation of the features of the coast of south Devon on p. 502, which seems at first somewhat complex, is fully justified when we realise that the "soft rocks" postulated really exist in the form of Cretaceous and perhaps Eocene limestones beneath the English Channel.

The disguise of Prof. Davis as a Prussian is a thin one. Who does not recognise him in the brilliant description of the Roman area on pp. 393–4, which is to occupy four minutes of oral instruction; or in the terrifying discovery on p. 398 that every land-form can be treated geographically in four-and-fifty different ways?

GRENVILLE A. J. COLE.

OUR BOOKSHELF.

The Manufacture of Iron and Steel: a Handbook for Engineering Students, Merchants, and Users of Iron and Steel. By H. R. Hearson. Pp. xi+103. (London: E. and F. N. Spon, Ltd., 1912.) Price 4*s.* 6*d.* net.

THIS small volume is obviously primarily intended to give engineering students an outline of the manufacturing operations of iron and steel, and also an idea of the chemical characteristics and the mechanical properties of the finished products. The author has undoubtedly, to a great extent, produced a lucid and useful little text-book.

After a preliminary chapter on elements, the blast furnace is considered, being followed by a short chapter on wrought iron. Steel is next dealt with, including the Bessemer, Crucible, and Siemens methods. The book has so much valuable and accurate information that it may be of very great use to elementary students of iron and steel metallurgy, but several remarkable errors should be revised in any future edition. For instance, on page 37, steel containing 0·3 per cent. of carbon is classified as medium instead of mild, and steel containing 0·7 per cent. of carbon is designated hard instead of medium. In describing the manufacture of "blister steel" by cementation, the author states, "None of the bars is carburised right through to the centre, so the centre still remains as iron." This is true of, say, No. 2 bars, but high-number bars are always "steel through." Some of the paragraphs on crucible steel also need serious revision; for instance, the curious assertion that if kept too long in the furnace the steel will become brittle by taking up too much silicon from the crucible. Mr. Hearson also revives the obsolete dictum that mild steel is crystalline and wrought iron fibrous. On page 77 the somewhat astounding information is given that the top of an ingot may be prevented from rapidly solidifying by covering the top with sand. The chapter on the mechanical testing of steel is excellent, but in the brief final chapter dealing with the heat treatment of steel many metallurgists will be surprised to learn that steel containing 0·25 per cent. of carbon becomes "hard" on quenching, and the paragraphs on hardening are out of date. If carefully revised, however, the book will become of distinct value. J. O. A.

Photochemische Versuchstechnik. By Dr. Johannes Plotnikow. Pp. xv+371. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1912.) Price 11 marks.

THIS book forms the complement of a previous volume by Dr. Plotnikow on the theory of photochemistry ("Photochemie," W. Knapp in Halle a.S., 1910). In the present work he describes at length the apparatus and the experimental methods used in photochemical research. Part i. contains a useful summary of the characteristics of the various sources of light that may be employed. The mercury arc lamp, in which a steady electric current is passed through the vapour of mercury in a highly exhausted tube of Uviol glass or of fused quartz, is recommended as providing a constant and trustworthy source. Other sources discussed are the arc and spark between metal terminals, the carbon arc, the Nernst lamp, and the Röntgen ray tube. In part ii. Dr. Plotnikow describes the construction of the special forms of thermostat which he has devised for photochemical experiments, and enumerates a number of solutions that may be employed as light filters with the mercury vapour lamp in order to give approximately monochromatic light.

Part iii. contains an account of the instruments used in optical measurements, including photometers, spectrophotometers, spectrometers, refractometers, and polarimeters.

In part iv. the author describes a number of interesting lecture experiments for illustrating the fundamental laws of photochemical reactions, the various phenomena of luminescence, and the principal facts of photoelectricity. It is satisfactory to find attention directed to the subject last named, since the separation of negative electrons under the influence of light probably forms the clue to the understanding of the mechanism of all photochemical processes.

Part v. contains a collection of tables likely

to be useful in photochemical work. The values of the function e^{-x} are tabulated in thirteen pages from $x=0$ to $x=10$, and fifty-six pages are assigned to tables by Dr. N. Rosanow showing the reciprocal of the wave length and the frequency for every Ångström unit from λ 2000 to λ 8000. H. S. A.

The Economics of Everyday Life. Part i. By T. H. Penson. Pp. xiv+174. (Cambridge University Press, 1913.) Price 3*s.* net.

IT is surprising how difficult it apparently is to write a good short text-book of economics, but Mr. Penson has been eminently successful in doing so. He has fully grasped the fact that the first need for such a book is to be simple and elementary as well as short. Where possible, he rightly prefers the ordinary terms of everyday use to the technical phrases of economics. For instance, instead of production, exchange and distribution, he talks of the "source of income," "buying and selling," and the "individual income." These, in my opinion, are far more intelligible to the beginner. Moreover, his definitions are nearly always both clear and adequate, those of demand and supply affording a good example.

The method of treatment follows, on the whole, that of the modern school, of which Prof. Marshall may be regarded as the head, and exchange is treated before, and not after, distribution. The subjects of consumption, taxation, trade unions and cooperative societies are left to the second part of this book, which has yet to be published.

The present volume clearly marks Mr. Penson as possessing great capacity as a teacher. He chooses wisely not only his terms, but the subjects of which he treats. Omitting nothing that is essential, he has avoided thorny and difficult subjects likely to confuse the beginner. His definitions, too, are both concise and complete. A new and valuable feature of the book is found in the simple tables and diagrams by which the argument is rendered easy to understand, but mathematical methods are rigidly, and in such a book rightly, avoided. Occasionally, however, the author treats unimportant matters somewhat too fully. Usually he is neither too long nor too short, but, like Sidney Godolphin, "is never in the way, and never out of it." N. B. DEARLE.

Dent's Practical Notebooks of Regional Geography. By H. Piggott and R. J. Finch. Book i., The Americas. Pp. 64. (London: J. M. Dent and Sons, Ltd., 1913.) Price 6*d.* net.

IF every geography teacher set the same practical exercises, this conveniently arranged notebook would have a wide circulation; but naturally a teacher's exercises should reflect his own individuality. The little book may be commended, however, as affording a good example of the way in which pupils can be led to acquire an intelligent knowledge of geography as the result of their own activities.

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.]*

An Application of Mathematics to Law.

I HAVE attempted to apply mathematical symbolism to some of the difficult problems of patent law. The question to be decided by the Court in a patent law suit is usually this: assuming that the alleged invention deals with "a manner of manufacture" (*i.e.* is, or yields, something concrete), was there ingenuity and utility in the step from what was already known? Ingenuity means inventive or creative ingenuity as apart from the normal dexterity of the craftsman, which of itself is insufficient to support a patent, as otherwise patents would unduly hamper industry. It will be seen at once that it is a most subtle question for any court to determine whether a given act, the selection of one out of many alternatives, the assemblage of various old elements, the adaptation of old elements to new uses—whether such an act is one which calls for ingenuity as apart from the expected skill of the craftsman.

To express the problem symbolically I will start from an admirable dictum of Lord Justice Fletcher Moulton (Hickton Pat. Syn. *v.* Patents Improvements). He stated that invention might reside in the idea, or in the way of carrying it out, or in both; but if there was invention in the idea plus the way of carrying it out, then there was good subject-matter for a patent. I express this by representing any idea as a functional operator, and the way of carrying it out (*i.e.* the concrete materials adopted) as a variable. Calling result I:

$$I=f(x).$$

Here I represents what the Germans call the "technical effect" of the invention, or what Frost calls the manufacturing "art," and we see at once that a patent cannot be obtained for a mere principle or idea (f, which is not concrete) unless some way of carrying it out (x) is also given. But the invention may reside either in f or in x.

Let us express in general terms a manufacture (M) which is not an invention. We will use f to represent a known operator or idea, ϕ to represent a new operator or idea. a, b . . . will represent known variables, ways of carrying out an invention (*e.g.*, valves, chemical substances, &c.), and x, y, new variables.

It is obvious that $f(a)$ is not an invention, nor will it normally be an invention to add $f(b)$ to it. Moreover, the craftsman is not to be tied down to this. He is at perfect liberty, within limits, to make variations in his variables, to alter the size of a crank, to substitute one alkali for another, and so on; in other words, he can take $f(a+\delta a)$.

Generalising, we may say:

$$M=\Sigma f(a+\delta a).$$

Developing this by Taylor's theorem, and proceeding from an infinitesimal to a finite change, we have, neglecting quantities of the second order:

$$M=\Sigma f(a)+\Sigma\delta f(a).$$

This is the general equation for a manufacture which is not an invention. To be an invention, ingenuity (i) must be involved.

$$I=M+i \text{ or } I=\psi(M),$$

thus:

$$I=\psi[\Sigma f(a)+\Sigma\delta f(a)]=\Sigma f(a)+\Sigma\delta f(a)+i.$$

I will now consider in various actual examples the nature of ψ, the inventive function, and of i, the inventive increment.

One of the commonest cases in which a decision is necessary is that of a combination. Suppose that $f(a)$ and $f(b)$ are old; will there be invention in combining a and b?

The answer is this:

(1) $I = f(a, b)$
(2) $M = f(a) + f(b)$
(3) $I = M + i$.

If the result of the combination is given by (1), there is an invention; this is termed a "combination." If the result is given by (2), there is no invention; this is termed an "aggregation." It is interesting to compare this definition with one given by Lord Justice Buckley (Brit. United Shoe Mach. Co. *v.* Fussell) of a "combination" as "a collocation of intercommunicating parts, with a view to obtaining a simple result."

An example of a true "combination" is found in the case of Cannington *v.* Nuttall, in which a patent was upheld for a glass furnace, although each and every part (a, b, c) had been employed before in glass furnaces (employment $= f$). But, owing to the combination, and the co-operation of the parts, a new result was obtained.

$$I = f(a, b, c) = f(a) + f(b) + f(c) + i.$$

On the other hand Bridge's case is an example of an aggregation; in fact, a patent was refused by the Law Officer, showing that the case was considered absolutely devoid of invention. The alleged invention consisted in the employment in a shutter for dividing-up rooms (f) of means (a) to guide the shutters along the floor, and cogs (b) to hold the shutters against the wall. $f(a)$ and $f(b)$ were both old, and no new result flowed from their juxtaposition. Hence $M = f(a) + f(b)$: there was no invention; each part simply played its own rôle, and there was no interaction.

Another type of invention is that of varying proportions in a known combination. Here, if $M = f(a, b, c)$, and if there is a maximum at one value or range of values of c, invention may be involved. The maximum relates to the technical effect, and may be with respect to efficiency, economy, &c.

Thus if $\frac{\partial f(a, b, c_1)}{\partial c} = 0$ at the value c_1, the function will be a maximum or a minimum and there may be an invention. This will not be the case if $\frac{\partial f(a, b, c_1)}{\partial c} \neq 0$.

Other singular points may be inventions, *e.g.* where $\frac{\partial f(a, b, c_1)}{\partial c} = \infty$ (discontinuity), or where $\frac{\partial^2 f(a, b, c_1)}{\partial c^2} = \infty$ (kink in the curve). This also holds for a range of values from c_1 to c_2.

Examples of the application of this equation are to be found in the cases of Edison *v.* Woodhouse, and Jandus Arc Lamp Co. *v.* Arc Lamp Co. In Edison's case f represented the employment in an incandescent lamp of an exhausted glass vessel (a), leading-in wires (b), and a carbon filament (c_1). $f(a, b, c)$ was known, but it had never been proposed to use a very thin carbon conductor or "filament." Here, owing to the high resistance and flexibility of the filament, the efficiency was a maximum:—

$\frac{\partial f(a, b, c_1)}{\partial c} = 0$, and the choice of this value c_1, which made the difference between failure and success, was held to be an invention.

In the Jandus Arc Lamp case, f represented the employment in an arc lamp of carbons (a), a tightly fitting sleeve (b), and an envelope of glass, &c. (c), inside the outer globe. By making the glass envelope 3 in. in diameter a maximum efficiency was obtained, and on this ground the patent was upheld, although envelopes had previously been made 9 in. in diameter. Here again:

$$\frac{\partial f(a, b, c_1)}{\partial c} = 0 \text{ when } c_1 = 3 \text{ in.}$$

A further example is an old case (Muntz *v.* Foster) in which a sheathing for ships was made of sixty parts of copper (a) and forty of zinc (b).

Alloys of copper and zinc had been used before in about the same proportions, but in this case the same result would not have been attained, because Muntz specified the best selected copper and highly purified zinc. The impurities (δx) were of great and unsuspected importance. Moreover, other alloys of copper and zinc (probably even of purified metals) had been made. We may consider the two points separately.

(1) Impurities:—

$f(a + \delta x, b + \delta x)$ was old, where δx represents impurities. Muntz's alloy was $f(a, b) = f(a + \delta x, b + \delta x) + i$, hence there was an invention.

(2) Selection of 60 : 40 percentage:—

$\frac{\partial f(a_{60}, b_{40})}{\partial a} = 0$ since at this percentage the efficiency was a maximum, because the alloy oxidised just fast enough to prevent barnacles adhering to the ship, but not fast enough to waste away excessively.

On the contrary, the case of Savage *v.* Harris was one in which there was held to be no invention in changing the size of part of a device for retaining ladies' hats in place. There was a back portion (a) and teeth (b), and the size of the back was altered:—

$\frac{\partial f(a_1, b)}{\partial a} \neq 0$, and there was no invention.

A known device or material (a) may be employed for a new purpose (ϕ). If $f(a)$ is the old use, and $\phi(a)$ the new use, we have for an invention $I = \phi(a) = f(a) + i$. But if $M = \phi(a) = f(a)$, there is no invention. The oft-quoted case of Harwood *v.* Great Northern Railway Company was one of the latter type. Fishplates (a) had been used for connecting (f) logs of timber, and it was held there was no invention in applying them (ϕ) to rails in which they acted in the same manner:—

$$\phi(a) = f(a).$$

But in Penn *v.* Bibby, wood (a) was employed (ϕ) for the bearings of propellers in order to allow the water to pass round the friction surfaces. Wood had previously been employed (f) in water-wheels, but $\phi(a) = f(a) + i$, and it was held that there was invention.

A similar type of invention is that in which different materials are employed in the same process. Here $f(a)$ is old, and $f(x)$ is new. If $f(x) = f(a)$ there is no invention. If $f(x) = f(a) + i$ there is invention. In the recent case, Osram Lamp Works *v.* Z Lamp Works, a patent was upheld for the use (f) in incandescent filament lamps of tungsten (x), though osmium (a) was known. Tungsten was more efficient and cheaper:—

$f(x) = f(a) + \delta i$, where δi represents a small degree of invention. This in itself might not have been sufficient, but it was coupled with the fact that one particular process of removing the carbon from the filaments was selected out of three known processes. This may be considered to require an amount of ingenuity Δi. $\delta i + \Delta i = i$, and therefore $f(x) = f(a) + i$, and there is invention involved.

Another type is the omission of one step in a known process. In the case of Badische Anilin- und Soda-Fabrik *v.* Soc. Chim. des Usines du Rhône, it was

held that there was subject-matter in such an omission. A process had been proposed for preparing dyes called anisolines (A) from rhodamines (r) by first forming a potassium salt (1st step=f), and then transforming this salt into anisoline (2nd step=F). Thus the known process was:—

$$A=F[f(r)].$$

Now it was shown that the potassium salt did not exist, *i.e.* $f(r)$ was imaginary; the patent in question obtained anisoline direct from rhodamine, $A=f(r)$, and this was held to be an invention.

I may note two final points. When a patent is granted, the criterion of ingenuity is not applied, as this is left for the Court to determine. However, if there is absolutely no ingenuity possible, the Law Officer may refuse to grant a patent. His criterion of rejection is, therefore, not $f(x)=f(a)$, as in the Court, but $f(x)\equiv f(a)$.

A patent is invalid for "insufficiency of description" if it casts on the public the burden of experiment beyond a certain point. This may be expressed by saying that in this case the equation $I=\phi(a)$ is indeterminate. HAROLD E. POTTS.

University Club, Liverpool, April 2.

A University in the Tropics.

THE importance and value of the establishment of a university in the tropics can only be appreciated fully by those who, trained in the universities of Europe, are suddenly brought face to face with the unfamiliar conditions obtaining in a tropical country. That the proposition may be thoroughly considered and eventually realised must be the wish of all interested in the development of our tropical possessions.

The question of a site for an imperial tropical university is one upon which divergent views may be expected; few men know the equatorial belt with uniform intimacy, and are liable in consequence to be prejudiced in favour of one part or another. Admitting my own imperfect knowledge, I would like to bring forward the claims of British East Africa as an eminently suitable situation for such a university.

Dissected by the equator, it cannot be equalled for position in British territory. Rising from sea-level to plateaus more than 8000 ft. in altitude, with a mountain rising more than 17,000 ft., far above the snow-line; with heavy rainfall in one part and almost rainless deserts in another; with healthy districts and parts uninhabitable by man in consequence of deadly disease; with soils varying from coral through sands to loams and clays; with standard crops from cocoanuts, rubber, and cotton, to coffee, maize, and wheat; with a large native population possessing many different languages and customs; with a flora and fauna as diversified as climate and altitude, and probably as varied as is to be found in any country; with a geological structure presenting some of the most interesting features in the world—British East Africa, the only British territory through which the equator passes, is surely uniquely situated for the seat of an imperial tropical university for the study and advancement of our knowledge of medical, agricultural, botanical, zoological, anthropological, ethnological, and other branches of science.

The capital of the country, Nairobi, is situate within 100 miles of the equator, is in a healthy district, is twenty-four hours by rail from the coast tropical belt, and the same distance from the Victoria Nyanza and Uganda, both full of the most diverse subjects of scientific interest.

The proximity of India is another great advantage in this respect. Practically all the natural conditions obtaining there—even acquaintance with the natives and their languages—may here be studied while residing in a climate resembling an English summer.

If any more suitable position for an imperial tropical university can be found than Nairobi, then the British Empire is indeed most fortunate, but a glance at the map does not suggest the possibility of such a collection of favourable factors occurring elsewhere. The passage is seventeen days, with choice of five steamship lines. U. H. KIRKHAM.

Government Laboratory, Nairobi, February 24.

The Twinkling of Stars.

IN three papers in *The Journal of Physiology* I have described a number of new visual phenomena which show that the photochemical stimulus is situated externally to the cones, and that the foveal region is sensitised from the periphery of the retina. The result of this is that at one moment the foveal region may be the most sensitive part of the whole retina, and at another blind. The twinkling of stars may be imitated in the dark-room. If a small light be looked at in a dark-room, as, for instance, that coming through the smallest diaphragm of my colour perception lantern, which represents a $5\frac{1}{2}$ in. bull's-eye railway light at a thousand yards when seen at a distance of 20 ft., care being taken not to move the eye, the light will appear to twinkle like a star. It will be noticed that pale bluish-violet circles start at the periphery of the field of vision, and, gradually contracting, reach the centre. On reaching the centre the light brightens. If the circles stop the light disappears. The colour of the circle is the same for white light or any colour.

There is another simple experiment which shows how the centre of the retina is sensitised from the periphery. On opening one eye on awaking in the morning and looking at the ceiling, the central portion is seen as an irregular, circular, rhomboidal, or star-shaped black spot. On closing the eye again a bluish-violet circle appears at the periphery or middle of the field of vision, contracts, and then, after breaking up into a star-shaped figure and becoming brighter, disappears, to be followed by another contracting circle. If the eye be opened when the star figure has formed in the centre it will appear as a bright rose-coloured star much brighter than any other part of the field of vision. If, however, we wait until the star has broken up and disappeared before opening the eye, it will be found that only a black spot is seen in the centre. F. W. EDRIDGE-GREEN.

London, April 14.

Gain of Definition obtained by Moving a Telescope.

A SLIGHT adaptation of the explanation offered by your correspondent Mr. G. W. Butler (April 10, p. 137) appears to furnish a more natural solution of the problem. When an object at rest is seen against a background which it closely resembles there is nothing to differentiate between the object and the slight irregularities of the background. So soon as the object moves, such a differentiation becomes possible, the moving irregularities being now attributed to their real origin. It seems unnecessary to assume a "cumulative impression of contrast."

The following simple experiment lends support to this explanation. A small opening is cut in a sheet of paper covered with irregular markings, such as ink dots. Against the back of this is held another sheet similarly marked. If now the sheets are observed from such a distance that the edges of the opening are invisible, its position cannot be determined

except by sliding one sheet over the other, when the motion of some of the dots with respect to the others immediately betrays its situation. R. S. CAPON.

Oxford.

MR. M. E. J. GHEURY concludes a note in the issue of NATURE of March 27, relating to the gain of definition obtained by moving a telescope, with the words: "Perhaps some of your readers have noticed something similar and could throw a little light on this mysterious phenomenon."

By a curious coincidence "something similar" did come to my notice just one day previous to my reading of Mr. Gheury's note. I do not propose to throw any light on the question, nor do I wish to imply that there is anything more than an accidental and external similarity between the two cases in question. But it may not be out of place to direct attention to a peculiar observation recorded in *The Mechanic's Magazine* of the year 1829, and rescued from oblivion in a recent number of the German periodical *Prometheus*. The experiment is extremely simple, and can be repeated by anyone with the very simplest materials.

Take a piece of paper of such thickness that when it is laid over a sheet of printed matter the characters just show through but cannot be read. Place this over a page of printed characters, move it about with a circular motion, and you will no doubt be surprised to find that now the print shows through and can be read with comparative ease. It is, of course, necessary to adjust the thickness of the paper and the size of the type, but two or three trials are sufficient to determine the right conditions for the experiment.

ALFRED J. LOTKA.

New York, April 11.

THE NEW SEISMOLOGY.

FOR very many years past in Italy, and to a lesser extent in other countries, earthquakes had been recorded, while a few private individuals collected and analysed earthquake statistics. These, however, were the days of seismoscopes and the old seismology. The new seismology did not come until macroseisms had been measured and teleseisms had been discovered. With their arrival new lines of physical, and particularly geophysical, research were opened for exploitation. Commencing in Japan, the desire to record and discuss the felt and unfelt palpitations of our earth spread like an epidemic round the world. In 1880 the Seismological Society of that country was founded, and the twenty volumes which it issued contain initiatives for very many of the investigations carried out since that date. When this society ceased to exist the Japanese Government established an Earthquake Investigation Committee, which up to date has published more than eighty quarto volumes.

In the early days attention was first directed towards obtaining instruments which would give actual measurements of earthquake motion. Steady-point instruments were devised, and, for earthquakes we feel, are now in use throughout the world. From a knowledge of the actual nature of earthquake motion derived from these instruments, new rules and formulæ for the use of engineers and builders were established. To test the suggested new departures in building and engineering practice, structures in brick and other materials were fixed upon platforms actuated by powerful machinery and subjected to movements closely corresponding to those of heavy earthquakes. The results of these investigations in Japan and other countries have been extensively applied in the construction of piers for bridges, tall chimneys, walls, ordinary dwellings, embankments, reservoirs, &c. Inasmuch as the new types of structure have for very many years withstood violent shakings, while ordinary types in their neighbourhood have failed, it may be inferred that much has already been accomplished to minimise the loss of life and property.

The application of seismology to the working of railways, particularly in Japan, led to the localisation of faults on lines, and alterations in the balancing of locomotives. The result of the latter has been to decrease the consumption of fuel.

Later, instruments were devised to record earthquake motion which cannot be felt, with the result that a person living in any one part of the world can record and obtain definite information about any *large* earthquake originating even so far off as his antipodes. These records of the unfelt movements of earthquakes have from time to time indicated the position, the time of occurrence, and, what is of more importance, also the cause of certain cable interruptions. The practical importance of this latter information, especially to communities which may by cable failures be suddenly isolated from the rest of the world, is evident.

The many occasions on which earthquake records have furnished definite information respecting disasters which have taken place in distant countries, corrected and extended telegraphic reports relating to the same, is another illustration of the practical utility of seismic observations. Seismograms have frequently apprised us of sea waves and violent earthquakes in districts from which it is impossible to receive telegrams, while the absence of such records has frequently indicated that information in newspapers has been without foundation or at least exaggerated. Localisation of the origin of these world-shaking earthquakes, besides indicating sub-oceanic sites of geological activity, indicates positions where the hydrographer may expect to find unusual depths. They have also shown routes to be avoided by those who lay cables.

Seismograms of unfelt movements throw light upon what have but recently been regarded as unaccountable deflections in the photograms from magnetographs, barographs and other instruments sensible to slight displacements. They have also explained unusual rates in certain time-keepers.

Among the very many scientific results which the new seismology has contributed to science is that it has given us the velocities at which motion is propagated in various directions through the world. Until these observations had been made our knowledge respecting the interior of the earth

chiefly related to its density and temperature. Now we know much respecting its rigidity.

With the object of increasing our knowledge of teleseismic disturbances, in 1896 the British Association, with the assistance of the British Government, communicated with many foreign States and Colonies suggesting that they should establish a certain type of seismograph. The result has been that the British Association now enjoys the cooperation of fifty-nine similarly equipped stations which are fairly evenly distributed over the world. The general outcome from this and the work carried out in Japan is that nearly every civilised country in the world has had its attention directed to this new departure in geophysics and has established seismographs.

In the last-mentioned country observers are to be found in most towns, and many instruments have been installed to record macroseisms and teleseisms. The annual outlay for earthquake work in that country is about 5000*l*. Russia, for the support of a system extending over its vast territories, expends a similar amount. Italy, which is the oldest country for recording earthquake phenomena, is covered with stations. Austria, France, Switzerland, Chile, the United States of America, the Balkan States and the small States of Central America each have their organised systems, while in Germany we find the headquarters of the International Seismological Association. This is supported by yearly contributions of about 1600*l*. from twenty-two countries. The headquarters of this body is in Strassburg, but it also controls stations in Beirut and Reykjavik. In Great Britain teleseisms are now recorded in thirteen different places. Three of these stations are owned by private persons, but the one in the Isle of Wight is largely supported by grants from the Royal Society, the British Association and Mr. M. H. Gray. The remaining nine are attached to existing observatories or other institutions.

J. MILNE.

THE PROBLEM OF TUBERCULOSIS.

THE final report of the Departmental Committee on Tuberculosis was recently published. Since the interim report of 1912 (April) was issued the committee has been engaged in devising methods for dealing with the general problem of tuberculosis as it affects the community. This introduces at once the difficulty as to the policy to be followed with those cases occurring among the non-assured under the National Insurance Act. The funds for this purpose are now promised by the Government up to one half of the estimated cost, and whilst giving the ratepayers control of the local administration the funds mentioned are to be drawn from national sources.

Dr. Newsholme has shown how largely the improvement recorded in respect of this disease is really due, not so much to successful treatment, but more to the segregation of the advanced cases in special institutions, chief among these being those wards of the Poor Law infirmaries set apart as sanatoria. But the law has till now left (and still leaves) the patient the right to "claim his discharge" when he pleases, and this is frequently exercised to his own detriment; but the committee now realises that, in addition, he is a source of danger to others in his environment. On this ground it is proposed to withdraw this liberty from the class of infective "ins and outs." It is a noteworthy point that the tuberculosis of children is now accepted by the committee as mainly of bovine origin.

The outstanding feature of the report is that of the provision for research, and its recognition in a fuller sense than has yet found its way to the statute book. The committee computes that an income for this purpose will accrue under the Insurance Act of about 57,000*l*. a year, and it proposes the establishment of various grades of research workers, to include the appointment of full-time men, who shall entirely devote themselves to research "at an adequate salary," with a subsequent pension.

The outline of a detailed scheme is given which includes the use of existing agencies, but contemplates also the formation of a central bureau with an expert secretary director at the head. This is primarily designed for the reduction of statistics to comparable form, and may comprise a research institution as well.

In view of the scattered distribution of the workers some such arrangement is clearly necessary; and, further, the committee indicates the need, in its opinion, of keeping the workers in touch with the work done abroad.

The creation of scholarships is recommended, but a department of foreign inquiry, either by scholarship or commission, would enhance the knowledge of the whole body, and prove a constant stimulus to the highest effort.

A point of considerable importance is raised by the reference to laboratory facilities. "Access" to these by various local centres of work must always give way in effectiveness to work done by small equipments for diagnosis at these centres. The Commissioners consider that not merely tuberculosis, but any disease from which the assured may suffer may come under similar review.

On taking the figures from the 1909 census report, tuberculosis claims 10·5 per cent. of all causes of mortality, and that of the "respiratory" group following—pneumonia and bronchitis—it will be noted that thus combined this figure exceeds the former. It must not be forgotten, however, that the latter includes cases of non-diagnosed tubercle, and others the essential feature of which is old age.

Tuberculosis, therefore, would claim the fullest, if not the sole, attention at first. This is confirmed by the figures just to hand of the results of the first year's working of the compulsory notification of infective diseases, including tubercle. Tuberculosis heads the list with 110,551 cases, which amount to 3·06 per 1000

population. The next return is scarlet fever, 2·98 per 1000. This takes no account of the difference in mortality or disability entailed by these two diseases, and if allowed for would greatly raise the former.

The committee is to be congratulated upon an earnest attempt to deal constructively with a complex question. Its tendency throughout to ignore the medical department of the Local Government Board will doubtless be rectified later in the interests of unified public health administration.

NOTES.

THE Secretary of State for the Colonies has appointed a Commission to study the nature and the relative frequency of the fevers occurring amongst the Europeans, natives, and others in West Africa, especially with regard to yellow fever and its minor manifestations. The members of the Commission are:—Sir James K. Fowler, K.C.V.O. (chairman), Major Sir Ronald Ross, K.C.B., F.R.S., Colonel Sir William Leishman, F.R.S., Prof. W. J. R. Simpson, C.M.G. Mr. A. Fiddian, of the Colonial Office, has been appointed secretary to the Commission, and Mr. T. F. G. Mayer assistant secretary. In the absence of special reasons, the members of the Commission will not themselves proceed to West Africa, but local investigators will work under their direction at certain centres. As at present arranged, those centres will be Freetown in Sierra Leone and Sekondi and Accra on the Gold Coast. The investigation will be set on foot towards the end of April or early in May. Endeavours have been made to enlist the cooperation of all medical men practising in the British dependencies in West Africa, whether as Government medical officers or otherwise. The funds for this investigation will be provided by the West African dependencies.

M. JULES DE PAYER has furnished the Paris correspondent of *The Pall Mall Gazette* with particulars of his projected arctic expedition, which is intended to leave France in the summer. With the support of the Government and various societies, he will follow his father, the distinguished explorer, in making for Franz Josef Land. One of his objects is to locate the margin of the polar basin to the north-east of that archipelago, an investigation which, if successfully carried out, will provide data for an estimate of the relative areas of the basin and the continental shelf in that quarter of the arctic region. A scientific staff will accompany M. de Payer, with equipment for the prosecution of research in all the various departments which have become associated with polar work; among them the investigation of the upper atmosphere by means of kites is specially indicated. The party will be provided for a sojourn of one year or longer in the north, its ship returning in the meantime. It is to be provided with two aëroplanes, the utility of which as instruments in polar research will be observed with interest: a visit to the pole itself is mentioned as a possibility, but does not appear as a prime object of the expedition. Wireless telegraphy will be installed at the headquarters.

ALL who had the pleasure of the acquaintance of Mr. Carl Hagenbeck—whose death occurred at Hamburg on April 15—could not fail to recognise the indomitable will and dogged perseverance of the man, coupled as they were with a manner of unusual gentleness and kindliness. It was no doubt owing to this unusual combination that Hagenbeck was so signally successful in his trade, for by the former traits he carried out in the most thorough manner every venture upon which he embarked, while by the latter he attracted and tamed his captives in a manner peculiarly his own. Born in a suburb of Hamburg in 1844, young Hagenbeck early acquired an interest in animals from his father, and eventually succeeded in securing the greater portion of the world's trade in wild beasts. In fact, if an animal was wanted you had but to tell Hagenbeck, and, unless war or other political obstacles barred the way, it was practically sure to come. But Hagenbeck's fame was largely based on his novel ideas with regard to the treatment of wild animals in confinement, more especially in the matter of an outdoor life for tropical species in Europe, and in the abolition of visible walls and bars, so that spectators might behold the captives in a state of comparative freedom. These ideas were embodied in the animal park at Stellingen. In 1899 Hagenbeck published, under the title "Von Tieren und Menschen," an account of his life and experiences, an abbreviated English translation of which appeared during the same year.

THE South Metropolitan Gas Company has appointed Mr. J. S. G. Thomas as research physicist to undertake investigations for technical purposes.

THE death is announced, at fifty-two years of age, of Prof. A. C. Elliott, professor of engineering at the University College of South Wales and Monmouthshire, and president of the Institution of Locomotive Engineers.

MR. A. R. HINKS, F.R.S., chief assistant at the Cambridge University Observatory, has been appointed Gresham professor of astronomy, London, in succession to the late Mr. S. A. Saunder.

PROF. L. J. Landouzy, dean of the Paris faculty of medicine, and known by his researches in connection with nervous diseases and tuberculosis, has been elected a member of the Paris Academy of Sciences, in succession to the late M. Teisserenc de Bort.

ON Thursday last, April 17, Mr. G. Hamel, accompanied by a passenger, accomplished a non-stop flight on a two-seater Blériot monoplane from Dover to Cologne, the direct distance being nearly 250 miles, in about four hours and a quarter.

AT the ordinary scientific meeting of the Chemical Society, held on Thursday, April 17, the president, Prof. W. H. Perkin, F.R.S., announced that an extra meeting will be held in the rooms of the society on Thursday, May 22, at 8.30 p.m., when a lecture in honour of the memory of the late Prof. Jacobus Henricus van't Hoff, honorary and foreign member, will be delivered by Prof. James Walker, F.R.S., of Edinburgh.

A FURTHER valuable gift has just been made to the Hull Municipal Museums Committee by Mr. C. Pickering, the donor of the new Museum of Fisheries and Shipping at the Pickering Park. It was recently represented to him that the new museum was already crowded with exhibits, and he has kindly presented a strip of land stretching from the Hessle Road to the Pickering Park, and adjoining the present museum, for the purpose of extension.

ON Tuesday next, April 29, Prof. W. Stirling will begin a course of three lectures at the Royal Institution on recent physiological inquiries. Owing to the illness of Prof. Bateson, his course of lectures on the heredity of sex and some cognate problems has been postponed. In addition to the Friday evening arrangements already announced, discourses will probably be given by Mr. F. Balfour Browne, Capt. C. G. Rawling, Prof. Silvanus P. Thompson, Mr. Owen Seaman, and Dr. Francis Ward.

UNDER its curator, Mr. A. G. Thacker, the Public Museum at Gloucester is being actively developed. The fine collection of Roman remains is being extended and rearranged. In the archæological department the museum has received from Sir W. T. Thiselton-Dyer a collection of the "river-drift" type of palæoliths. The Cotswold district abounds in Neolithic implements, which are here well represented. But in this latter department, by the gift of the fine collection made by the late Mr. G. B. Witts, the museum at Cheltenham holds, perhaps, a higher place. Between the two the Neolithic culture of the southern midlands is now admirably represented.

IN the transmission of pathogenic trypanosomes of man and domestic animals by tsetse-flies in Africa there has been some difference of opinion amongst investigators as regards the connection between the infectivity of the fly and the invasion of its salivary glands by the trypanosomes. Kleine was of opinion that the development of *Trypanosoma gambiense* in *Glossina palpalis* was limited to the intestine of the fly, while the Royal Society's commissioners in Uganda considered that the invasion of the salivary glands was necessary to render the fly infective. In a memoir published in *Annals of Tropical Medicine and Parasitology* (vol. vi., No. 4), Kinghorn, Yorke, and Lloyd publish a number of experiments on the transmission of *T. rhodesiense* by *G. morsitans*, which prove in the most convincing manner that the fly only becomes infective when its salivary glands are invaded and is non-infective when the trypanosomes are confined to the intestine only, even if swarming in this part. The trypanosomes found in the salivary gland resemble the stumpy form found in mammalian blood, and differ from the predominant type found in the intestine of the fly. The same result has been obtained by Miss Muriel Robertson in her researches on the development of *T. gambiense* in *G. palpalis* (Phil. Trans. (B), vol. cciii.).

THE fresh-water fishes of South Africa form the subject of an illustrated report by Messrs. Gilchrist and Wardlaw Thompson, published as part 5 of vol. xi. of the Annals of the South African Museum. It is based on collections in the South African, Bulawayo, and Transvaal Museums, a large proportion of which was procured by the aid of grants from the British and the South African Associations for the Advancement of Science. A considerable number of species are described as new.

ACCORDING to the report for the past year, the Rugby School Natural History Society continues its activity in all branches, the entomological section being particularly remarkable for its energy, as exemplified by a long list of the species of four orders of insects collected in the neighbourhood. We have also received the seventy-ninth report of the Bootham School Natural History, Literary, and Polytechnic Society, in which it is recorded that two of the members obtained prizes at a public-school essay competition arranged by the Royal Society for the Protection of Birds.

MR. G. FISCHER, Jena, has sent us a reprint from the "Handwörterbuch der Naturwissenschaften," entitled "Leitfaden der Descendenztheorie," by Prof. L. Plate, of Jena (price 1.60 marks). The author attempts in fifty-five pages, of which nearly half the space is occupied by illustrations, to sketch the outlines of the evidence on which the evolution theory is based. When the difficulties of compressing the subject to this extent are remembered, the result must be regarded as remarkably successful. All the chief lines of argument are mentioned, with the exception of those derived from the study of heredity and experimental morphology, which are dealt with in a separate section of the *Handwörterbuch*. The style is simple, and the cases chosen in illustration well suited to the purpose, but it is perhaps unfortunate that scarcely any examples are taken from the vegetable kingdom.

IN the report of the American Museum of Natural History for 1912 attention is directed to the policy of instituting exploring and collecting expeditions, rather than depending on purchase, as the chief means of increasing the collections. "While specimens for exhibition are the chief aim of the explorer, he brings back a large amount of information regarding the country visited, as well as photographs, drawings, or paintings, which are absolutely essential both for publication and as accessories to exhibition. . . . In all, thirty-five parties were operating in the field during the year 1912; every continent on the globe except Australia has been visited, and remarkable success has crowned the efforts of the leaders." Illustrations of several of the new exhibits, including one of a fine pair of African forest-hogs, render the report highly attractive.

THE report of the Dove Marine Laboratory, Cullercoats, for the year ending June 30, 1912, deals with a considerable number of subjects bearing more or less directly on practical fishery questions. In most cases these are dealt with very briefly, and it might perhaps be suggested that conclusions of more permanent value would be reached if fewer subjects were investigated, and those that were attempted were more thoroughly and exhaustively done. The paper by B. Storrow on *Nephrops norvegicus* is the most

satisfactory from this point of view, and is based on a somewhat extensive collection of valuable data. The note on the spawning of the plaice by the same author, on the other hand, with its accompanying plate, seems to be of only trifling value, and might well have been allowed to rest in the laboratory notebook until further and more conclusive observations could be added. Prof. Meek contributes short papers on lobster culture, on mussel culture, and on the protection of crabs and lobsters, and measurements of certain samples of herrings are also recorded.

IN the current number of *The Quarterly Journal of Microscopical Science* (vol. lviii., part 4) Mr. G. E. Johnson gives an account of those familiar yet little-known organisms, the nematodes of the common earthworm. Larval nematodes occur abundantly, both encysted in the body-cavity and in an active condition in the nephridia. These are shown to belong to the same species, which the author distinguishes as "*Rhabditis pellio*, Bütschli, non Schneider." As Schneider's species was described first it is obvious, as the author points out, that a new specific name will be required for the form under discussion, but he refrains from giving this name until Schneider's species shall have been re-examined. Apparently the nematodes do no harm to the earthworm, and they only reach the adult condition in the decaying body of the worm after the latter has died. There is no evidence of another host, but the complete life-history is not yet known. Another paper of interest from the point of view of economic zoology is by Mr. J. Davidson, being the first part of an elaborate memoir on the structure and biology of the woolly aphis of the apple-tree, often known as the American blight. Captain Meek contributes a useful discussion on the mechanism of mitosis, from which it appears very evident that, in spite of numerous theories, no satisfactory explanation of the phenomena has yet been arrived at. The only general conclusion that can be drawn at present appears to be "that the mitotic spindle is not a figure formed entirely by the action of forces at its poles."

THE April number of *Bedrock* (vol. ii., No. 1) offers a varied and interesting bill of fare to its readers, ranging from a study of Japanese colonial methods, by Miss Ellen Churchill Semple, to Prof. H. H. Turner's essay on the nebular hypothesis and its developments. Miss Semple's article affords an interesting glimpse of the up-to-date application of scientific principles to colonisation as practised by the Japanese. In the island of Formosa the savage aborigines are isolated by means of a wire fence 300 miles long, the lowest wire of which is charged with an electric current strong enough to stun or kill anyone trying to climb over or creep under it. The fence is guarded at intervals of 500 yards by block-houses with armed police, one of whose functions is to receive the natives within the pale of civilisation when they are prepared to submit, and thenceforth to educate and look after them generally. Prof. Poulton contributes a very useful account of the latest advances in our knowledge of the phenomena of mimicry, as illustrated by the African Papilioninæ. It will be remembered that the polymorphic females of certain species of this group of butterflies are adapted to mimic various species of Danainæ and Acræinæ in different parts of the continent, and that one and the same female may produce several different forms of mimicking offspring. Prof. Poulton dismisses the suggestion that the different forms of mimicking pattern have arisen by sudden mutation, and brings forward evidence to show that they have been produced gradually by natural selection. At the same time he adduces evidence which suggests that the different patterns may be inherited in Mendelian fashion. The discussion on telepathy as a fact of experience is continued by Sir Oliver Lodge and Sir Ray Lankester, and Mr. McDougall has a very interesting article on modern materialism, in which he discusses the question of Vitalism *versus* Mechanism. Considerations of space prevent us from mentioning other valuable contributions.

REPRINTS have been received of two interesting papers dealing with the evolutionary aspects of plant ecology, one by Rev. G. Henslow ("Evolution considered as Bearing upon the Evolution of Plants," *Scientia*, vol. xiii., 1913, 19 pp.), and the other by Mr. L. Cockayne, F.R.S. ("Observations Concerning Evolution Derived from Ecological Studies in New Zealand," Trans. N.Z. Inst., vol. xliv., 1912, 50 pp., 8 plates). The latter is of especial importance from the wealth of observational data which it contains, throwing light upon various problems in the ecology and biology of plants in general, and suggesting many others which are open for investigation. It is not possible here to analyse these publications, which will doubtless receive attention in the newly founded *Journal of Ecology*. It must suffice to say that both authors urge that students of evolution have not paid sufficient attention to the material drawn from the ecological study of vegetation, and that many facts concerning the relation of plants to environment can only be adequately explained on the assumption that characters evoked by stimuli affecting the body-cells are emphatically capable of being inherited.

LADY ISABEL BROWNE has sent a reprint of "Contributions to our Knowledge of the Anatomy of the Cone and Fertile Stem of Equisetum" (*Annals of Botany*, vol. xxvi.), from which it appears—as so frequently happens—that the re-investigation of the structure of even the most familiar plants, especially those belonging to groups which had a much greater development in the past than at the present day, results in the filling-up of various gaps in the knowledge of these groups. The author gives an historical introduction indicating previous work done on this much-investigated genus, and after presenting the results of her own thorough examination of the anatomy of the cone and fertile stem of several horsetail species, discusses the general organisation of the cones in the recent and extinct Equisetales. The structure of the cone axis or stem supports the view that the spore-bearing organs (sporangiophores) are whole appendages and not lobes of a sporophyll or leaf. The collar-like outgrowth (annulus) below the cone in recent horsetails appears to represent a reduced node;

this is confirmed by the anatomy of abnormal specimens of the field horsetail in which more than one annulus is present.

THE report of experiments carried out in 1912 at the Harper Adams Agricultural College and in Shropshire and Staffordshire contains accounts of inquiries into the effect of pruning and of grass on fruit trees, the wart disease of potatoes, the manuring of grass land for milk, &c. During the past year oats in many parts of the country were badly attacked by the frit-fly (*Oscinis frit*), and since the life-history of this pest is not fully known, investigations in this direction have been instituted. Although preventive measures cannot be given at present, it may be noted that early sown crops are not so liable to attack as those sown later, and also that a dressing of nitrate of soda helps the plant to recover from initial attack by the pest. How far the severity of attack depends on the variety of oat has still to be ascertained, but striking differences were observed among the varieties cultivated last year.

MESSRS. E. S. SALMON and C. W. B. WRIGHT contribute a paper to the March number of the Journal of the Board of Agriculture on lime-sulphur wash for American gooseberry mildew. As a result of extended observations it has been found that different varieties of gooseberries differ to a marked degree as regards the susceptibility of the foliage to injury from the wash. It is possible with some varieties, *e.g.* "May Duke," to spray repeatedly throughout the season with lime-sulphur, at a strength (1·01 sp. gr.) sufficient to prevent the attacks of the mildew, without causing any injury to the foliage. In other cases it seems probable that the foliage of a variety may be resistant to injury from the wash, while showing susceptibility later in the season. Other varieties, such as "Valentine's Seedling" and "Yellow Rough," are so sensitive that they cannot safely be sprayed with lime-sulphur.

THE report of Stonyhurst College Observatory (Lancashire) for 1912 contains results of meteorological, magnetical, and seismological observations, together with mean and extreme values for the last sixty-five years. Some of the meteorological results for last year are noteworthy from several points of view. The annual rainfall was $7\frac{1}{4}$ in. above the average; in March the amount was more than double the average, and was the greatest on record for that month. The duration of bright sunshine was nearly 410 hours below the yearly average (thirty-two years); August had only 50 per cent. of the normal amount, and the maximum temperature was 11·6° below its average highest reading. Father Sidgreaves states that owing to the decision of the Meteorological Office to reduce the number of its observing stations the connection of Stonyhurst with the office would cease at the end of March, but we are glad to learn that the automatic recorders are to remain there, and will be kept in active service. This observatory is one of those adopted by the first Meteorological Committee (1867) for the continuous registration of meteorological phenomena at important positions in the British Islands. In the report of the Meteorological Committee for the year ended March 31, 1912, it was explained that the urgency of questions connected with the upper air had decided it to withdraw in some cases the grants made for the continuance of observations in the old form.

PART 5 of the first volume of the science reports of the Tohoku Imperial University, Japan, contains a paper on the magnetic susceptibilities of iron, steel, nickel, and cobalt up to temperatures of 1300° C., by Profs. Honda and Takagi. The method used depends on the measurement of the force under which the magnetisable material moves from a weak to a strong part of the magnetic field in which it is placed. The field was provided by a small du Bois electromagnet, and the force was measured by means of a delicate spring balance. The materials tested were placed in a small magnesia capsule surrounded by an electric furnace. The temperature of the specimen was determined by means of a platinum platinum-rhodium thermo-junction standardised by the use of the melting points of lead, zinc, antimony, copper, and nickel. As the result of their investigations, the authors find that Curie's law, according to which the susceptibility should vary inversely as the absolute temperature, does not hold for nickel below 500° C., does not hold over any extended range of temperature for cobalt, and is not even approximately true of iron or steel in what is known as the γ state above 800° or 900° C.

MESSRS. TOWNSON AND MERCER, LTD., have sent us a specimen of a new type of inorganic filter for laboratory purposes. The filter is cone-shaped, and is understood to be composed of powdered alundum (a variety of fused alumina) cemented by firing with siliceous material. It is sufficiently porous to allow of rapid filtration, is not sensibly affected by solutions of common chemical reagents, and withstands the usual temperatures employed in the laboratory. For use, it is fitted into an ordinary glass funnel by means of rubber tubing, and connected with a filter-pump. Paper filters can be employed with it, or not, according to requirements. One of the chief advantages is that the filter can be used for quantitative determinations in the same manner as a Gooch type of filter, but without the trouble of preparing an asbestos layer every time. A light aluminium stand is supplied for convenience in weighing. How far any difficulty of cleansing or liability to fracture might prove troublesome, only extended trial could show; but a few summary experiments indicate that the filters will probably be very convenient for many gravimetric chemical operations. The makers are the Norton Company, Massachusetts.

IN the course of an article on the relation of engineering and architecture, *The Builder* for April 11 suggests two main considerations as accounting for the division which now exists: one, the public willingness to accept great works of engineering as necessary evils from an æsthetic point of view; the other, the greater extent to which the engineer must be immersed in the practical considerations of high mathematical problems which have to be solved in connection with many engineering works. The latter, it is asserted, tends to the narrowing of the mental point of view. The remedies suggested are the education of public opinion so that it will demand the æsthetic treatment of engineering work, and the

unification of engineering and architecture as component parts of one calling. Our contemporary considers that the engineer should have a preliminary training in architecture, and that the architect would be the better artist if he had studied something of the principles which underlie engineering, instead of going through the world content to hoe his own furrow irrespective of the general field.

Engineering for April 18 contains a very full illustrated description of the new Cunard liner *Aquitania*, which is being built and engined by Messrs. John Brown and Co., Ltd., of Clydebank. This vessel is the largest ship yet built for the express service to New York. The following are the principal dimensions:—Length over all, 902 ft.; breadth, 97 ft.; depth, 64 ft.; displacement, 49,400 tons; shaft-horsepower of the four-screw steam turbines, 60,000; 4230 passengers and crew are provided for. There are forty-one watertight compartments in the double bottom, and eighty-four watertight compartments in the moulded structure of the ship above the double bottom, formed by transverse and longitudinal bulkheads and watertight decks. The transverse bulkheads have been carried up to an unusual height. The conditions are such that should the fore part of the ship for the first five compartments, or the after part of the ship for the six after compartments, or the five centre compartments, be open to the sea, the ship would still remain in a perfectly stable condition. To render possible the launching and navigation of the vessel to the sea, it has been necessary to widen and deepen the channel of the River Clyde, a work which will be of lasting benefit to navigation. The ship was launched successfully on Monday last.

IN the announcement of Canadian tide tables made in NATURE of March 27 (p. 95), it was implied that they are issued by the Government Printing Bureau at Ottawa, whereas, Mr. W. Bell Dawson writes to point out, they are merely printed there, and are prepared and issued under his direction from the office of the Tidal and Current Survey, Ottawa. It may here be mentioned that the Tide Tables are issued in two series, which refer to eastern Canada and the Pacific respectively, the tides of two oceans 3000 miles apart, on opposite coasts. The work of the Canadian Survey is thus very extended, and the limited staff which carries it on is beginning further investigation in Hudson Bay, an area much larger than the North Sea, and quite as complex in its tides.

OUR ASTRONOMICAL COLUMN.

THE SOLAR UNION AT BONN.—The fifth meeting of the International Union for Cooperation in Solar Research will be held in the Physical Institute of the Bonn University on July 31 next, and a preliminary programme for that occasion has now been circulated. On the evening of July 30 a reception will be held in the large hall of the reading and recreation society, and the mornings of July 31, August 1 and 2, and afternoons of the two former dates, will be devoted to the discussions. The afternoon and evening of August 2 and the whole day of August 3 will be taken up with a visit to Cologne, a reception being given in the hall of the Gürzenich at the invitation of the city of Cologne, and probable alternative excursions to (1) motor through the Eifel to the valley of the Mosel, and (2) tour in the Siebengebirge. August 4 and 5 will see the resumption of the meetings, and the afternoon of the latter date may be employed in a steamer trip on the Rhine. In addition to the above, Prof. Küstner will receive the members at the observatory on the afternoon or evening of August 1, Prof. Karl Hausmann invites them to visit the Technical High School at Aachen, and the Astrophysical Observatory at Potsdam invites members for August 11.

A CASE OF LARGE PARALLEL PROPER MOTION.—Dr. Ragnar Furuhjelm, of the Helsingfors Observatory, communicates to the *Astronomische Nachrichten* (No. 4642, p. 179) an instance he has found of two stars fairly wide apart having the same velocity and direction of proper motion. The stars in question are a double star, BD+45° 4408 and No. 12740 in Burnham's catalogue (8·3 m. and 8·3 m., α=0h. 0m. 23s., δ=+45° 15·5′, 1900·0), the proper motion of which was earlier known and measured, and a star of the magnitude 9·5 m., its distance from the above binary being about 5·5 minutes of arc. Dr. Furuhjelm gives in detail the measures he made of both these stars on several plates which he had taken at different times in that region, and deduces the value of 0·9″ for the proper motion of the system, and 327·58″ and 254° 13·7′ for the distance and position angle of stars. Finally, he directs attention to another similar case of large parallel proper motion as is exhibited in the stars A Ophiuchi and 30 Scorpii, which are about 12·2′ apart, and undergo a proper motion of 1·25″. In this instance also one of the stars is a double with a distance of 4·2″. Such systems form important objects for study.

THE SOLAR ROTATION IN 1911.—In the March number of *The Astrophysical Journal* (vol. xxxvii., No. 2) Messrs. J. S. Plaskett and Ralph E. DeLury describe and give the results of their very thorough investigation relating to the spectroscopic determination of the solar rotation. The work was carried out at the Dominion Observatory at Ottawa, the observatory having undertaken this programme of work on the lines determined by the International Union for Cooperation in Solar Research. The instrumental equipment at the Ottawa Observatory is of first-rate quality, and is all that is needful for the research which has been so successfully brought to an issue. The communication in question is of considerable length, and the authors describe and discuss the difficulties met with as regards personalities in measurement, instrumental errors, &c. The chief conclusions to which they ultimately reached were that the values they deduced for the solar rotation could be represented by formulæ which were in exceedingly good agreement with those obtained by Dunér and Adams (1908), except for a small and nearly constant angular difference. The absolute velocity of the solar rotation seems to be uncertain by a small amount, amounting to 2 or 3 per cent., due, as they suggest, to personal differences in the habit of measurement of the rotational displacements on the plates. No systematic differences of velocity were found for different elements, although they discussed 3000 residuals from different lines and elements. It is of interest to give here the different formulæ for the rotation as deduced by the authors and previous investigators:—

	Angular velocity.
Dunér	$10{\cdot}60^\circ + 4{\cdot}21^\circ \cos^2\phi$
Halm	$12{\cdot}03^\circ + 2{\cdot}50^\circ \cos^2\phi$
Adams (1908)	$10{\cdot}57^\circ + 4{\cdot}04^\circ \cos^2\phi$
Adams (mean)	$11{\cdot}04^\circ + 3{\cdot}50^\circ \cos^2\phi$
Plaskett (1911) ...	$10{\cdot}32^\circ + 4{\cdot}05^\circ \cos^2\phi$
DeLury (1911)	$10{\cdot}04^\circ + 4{\cdot}00^\circ \cos^2\phi$

THE TENTH INTERNATIONAL GEOGRAPHICAL CONGRESS AT ROME.

THE report of progress and the discussion regarding the international map of the world and polar exploration were the two predominant subjects at the International Geographical Congress just concluded at Rome. The long postponement from October, 1911, to April, 1913, was sufficient to account for the meagre attendance of British representatives, of whom there were only ten, and indeed foreign members as a whole. Polar exploration—both arctic and antarctic—was, however, well represented. Of the former, Admiral Peary, Admiral Cagni, Dr. Bruce, Mr. Bridgeman, and Mr. Stefánsson were representative, whilst Dr. Bruce, Dr. Nordenskjold, and Lieut. Lecointe represented antarctic exploration. There were also many others specially interested in polar research, as was testified by the presence of thirty delegates at the Polar Commission, which took the opportunity of meeting at the same time and place as the Geographical Congress. Although no striking results have accrued from this rather anomalous body, yet it gives an excellent opportunity for polar explorers and their supporters to meet and discuss matters of common interest, and, being in strong force, special interest was naturally shown in their work, and several important communications given.

International Map.

The most important result of the congress was the discussion and agreements reached regarding the international map of the world on a scale of 1 : 1,000,000. The British representatives who took special part in this section were Col. C. F. Close, Director-General of the Ordnance Survey of Great Britain; Col. W. C. Headley, Mr. F. Grant Ogilvie, C.B., and Mr. G. G. Chisholm. General Jules de Shokalsky, St. Petersburg; Prof. Albrecht Penck, Berlin; Engineer Charles Lallemand, and Prof. Paul Helbronner, Paris; Lieut. A. H. Byström, Stockholm; Dr. H. von Hartenthurn, Vienna, also took part in the discussion. Nine States had undertaken the production of sheets of the international map in accordance with the resolutions of the official conference held in London in November, 1909, namely Argentina, Chile, France, Great Britain, Hungary, Italy, Japan, Spain, and the United States, and preparation work was also reported by the delegates of Portugal and Sweden, and the thanks of the congress were voted to those States.

By direction of the president of the congress in accordance with the resolution proposed by Prof. Penck, and approved at the general meeting of the congress, March 29, delegates of all countries interested in the international map held a meeting on March 31, 1913, and passed the following resolutions unanimously, and the resolutions were submitted to the congress :—

(1) It is desirable that another official conference should be held to consider questions affecting the international map of the world on the scale of 1 : 1,000,000, in the capital of a State which has already undertaken the preparation of sheets of the map; and it is thought that it would be convenient to all concerned if this capital were Paris.

(2) In view of the fact that the general principles governing the construction of the map are already settled and adopted, the new conference should be asked to consider questions of detail only, such as the size of the lettering, character for railways, &c.

(3) It is desirable that all civilised States should be invited to send delegates to the proposed conference.

(4) It would be convenient if the date of the proposed conference were towards the end of the year.

(5) London (Geographical Section of the General Staff, War Office) remains the official centre of the undertaking until the assembly of the proposed conference, and communications of interest with regard to the international map should be addressed to that office. Also, it is desirable that a set of not fewer than fifty copies of a selected sheet already printed should be sent by each country which has produced a sheet or sheets to the above office, at an early date. These sheets will be distributed to those Governments invited to the new conference, and to recognised private authorities.

Polar Exploration.

In arctic exploration special interest was also shown in Mr. Vilhjálmur Stefánsson's plans of the Canadian Arctic expedition, which leaves Vancouver about June 1 for a period of three and a half years. As a preliminary to laying these plans before the congress, Mr. Stefánsson gave a detailed account in two sections of his six years' work on the Mackenzie River and along the arctic shores of Canada and on the islands to the north. During practically the whole of that time he lived as an Esquimaux among Esquimaux, learning their language and many of their customs, and making himself dependent on the resources of the country. By this account of his previous work he showed that no one was better fitted to carry out the plans of the new Canadian Arctic expedition, which he himself had formulated. It was of special interest to hear Mr. Stefánsson emphasising not only the importance, but the great accuracy of the work of the late Dr. John Rae.

Mr. Stefánsson's plan generally is to explore the Beaufort Sea and to seek for new lands to the north-west of those known islands lying to the north of the mainland of Canada, and to carry on further research, especially as regards his discovery of Esquimaux of a blonde type living to the north-west of Victoria Land. Special interest attaches to the expedition, because the theory which Mr. Stefánsson and others have is that the tides indicate a considerable area of land lying in the Beaufort Sea to the north-west of Victoria Land.

Admiral Peary, in supporting the plans, pointed out that the American Geographic Society and the American Museum of Natural History had in the first place come forward, each offering to pay half, but that subsequently the Government of Canada had desired to make the expedition a Canadian one, seeing that it was for the exploration of Canadian arctic regions, and had offered to pay the whole cost. They in the United States appreciated the attitude of Canada. They had followed Mr. Stefánsson's past and present work with the greatest interest, and wished his expedition the success it deserved. Dr. Bruce, in supporting the proposal, pointed out how, whereas the Pacific side of the south polar regions had received most attention from explorers, it had been on the Atlantic side that the north polar regions had been chiefly explored. This was due, he said, to the fact that the Atlantic side of the arctic regions was nearer the centres of civilisation. The regions Mr. Stefánsson intended to explore was particularly interesting from the oceanographical point of view, because no oceanographical research had been carried out on the Behring Straits side of the Arctic Ocean. Mr. Stefánsson was taking with him a considerable oceanographical equipment and an excellent oceanographer, in the person of Mr. James Murray, who had done signal service with Sir John Murray in the Scottish Loch Survey, and with Sir Ernest Shackle-

ton in the antarctic regions. He thought the action of the Canadian Government was to be applauded, and served as an example to other Governments on this side of the Atlantic.

Mr. Bridgeman gave a note on the Crocker Land expedition, as well as an interesting eulogy on Admiral Peary, entitled "Peary: the Man and His Work." Mr. Bridgeman showed a most beautiful series of slides of arctic scenery. Among other arctic papers was one by Dr. O. J. Skattum, of Christiania, on the map of Spitsbergen. Excellent as is the recent work of the Norwegians in Spitsbergen, he made a serious omission by making no reference to the highly detailed geodetic work in Prince Charles Foreland that has been done by Dr. W. S. Bruce and Mr. John Mathieson in 1906, 1907, and 1909. Neither did he acknowledge the financial and other help given to the Norwegians by the Prince of Monaco, who has also helped the Scottish expeditions. Dr. Skattum should spell "Spitsbergen" with a central "s" and not "z." the word being of Dutch and not German origin.

An arctic paper of great interest and importance was given by General de Shokalsky, who also made several other important communications. It was on the work carried out by the officers of the Russian Navy and the Russian Geographical Society during the last twelve years. This work includes much detailed and valuable geographical research, on strictly scientific lines, that has been done along the arctic shores of Russia and Siberia, and seas adjacent. His paper on the new hypsometrical map of the Government of Moscow on a scale of 1 : 168,000 might also be regarded as an important contribution to arctic geographical research.

Antarctic Research.

Dr. W. S. Bruce gave an account of his plans for another Scottish Antarctic expedition, which have already been given in detail at a meeting of the Royal Scottish Geographical Society, and for which the treasurer of the society is receiving subscriptions amounting already to a considerable but, as yet, by no means adequate amount. The plans, it will be remembered, are to carry out further extensive oceanographical research in the region of the Weddell Sea, to explore the continent in the neighbourhood of Coats Land, and to complete a sectional survey of Antarctica, by a journey across from the Atlantic to the Pacific side of the continent. The plans were very strongly supported by Admiral Peary, who urged the special importance of a journey to the south pole on the Weddell Sea side of Antarctica, and the importance of detailed oceanographical research. He agreed with Dr. Bruce that there was plenty of room for many nations to work together in the antarctic region, and hoped that the United States would take part in the south polar campaign. Mr. G. G. Chisholm, secretary of the Royal Scottish Geographical Society, said that the plans had the hearty support of that society. The plans were also cordially supported by Prof. Penck, of Berlin, who referred to the work of Lieut. Filchner and his important discovery of an extension of Coats Land to the south-west. Dr. Otto Nordenskjold's was the other antarctic contribution, namely, "A Comparison of the Inland Ice of Arctic and Antarctic Lands," an important contribution to glaciology.

Dr. Gerhard Schott, of Hamburg, gave an account of recent German oceanographical research in the Atlantic Ocean, and Prof. Drechsel, of Copenhagen, dwelt on the importance of continuous and periodic hydrographic researches carried on at definite stations, such as has been carried out recently by the Prince of Monaco and Dr. Richard in the Mediterranean. Prof. J. Thoulet, of Nancy, dwelt on the construction and utility of bathy-lithogical submarine charts, a paper that was in many respects very suggestive. Miss Owens's account of the geysers of Yellowstone Park was an important contribution.

On the whole the papers were of good quality, and showed the result of steady geographical research during the past four and a half years. But there is little doubt that the congress was seriously affected by the postponement on account of the Turco-Italian war, many who had offered contributions withdrawing them and presenting them to various geographical societies in the meantime.

It was resolved to hold the next congress at St. Petersburg on the invitation of the Russian Government, presented to the congress by General de Shokalsky.

A rather heated discussion arose on the question of introducing Spanish as an official language, but this proposal was withdrawn, a special veto being given to the proposal by General de Shokalsky threatening to introduce Russian as an official language if the proposal were insisted on.

INTERNATIONAL METEOROLOGY.

A MEETING of the International Meteorological Committee was held in Rome on April 7–12, at the invitation of Prof. Palazzo, director of the Italian Meteorological Service. The meeting was attended by Dr. W. N. Shaw, president of the committee, Geheimrat Hellmann, the director of the Prussian Meteorological Service, secretary, and the following members, representing the meteorological services of their respective countries:—*France,* M. Angot; *Portugal and Azores,* M. Chaves; *Holland,* M. van Everdingen; *Sweden,* M. Hamberg; *Switzerland,* M. Maurer; *Italy,* M. Palazzo; *Denmark,* M. Ryder; *Russia,* M. Rykatcheff; and *Canada,* Mr. Stupart. There were also present Prof. Hergesell, the president of the International Commission for Scientific Aëronautics, and Prof. Bjerknes, who had made important proposals, at the meeting of this commission held in Vienna in 1912, regarding the form in which meteorological data for the upper air should be published. At the opening meeting letters expressing regret at their inability to attend the meeting were read from Prof. Mohn, *Norway*; Prof. Willis Moore, *United States of America*; Prof. Nakamura, *Japan*; and Dr. G. T. Walker, *India.*

It is the function of the International Committee to deal with questions of organisation in which international cooperation is required. A considerable number of such questions has become ripe for consideration by the committee in the three years which have elapsed since the last meeting, held in Berlin in 1910.

After the conclusion of the formal inaugural business the first meeting was devoted to the consideration of a letter which had been received from the president of the International Institute of Agriculture, asking for the assistance of the committee in furthering questions connected with the influence of the weather in agricultural affairs. Apart from questions connected with weather forecasting, there are many problems connected with the influence of weather on the yield or quality of crops or the suitability of particular climates for particular crops which are capable of advancement by statistical methods, but as yet little progress has been made in this direction. The committee finally appointed a permanent commission to undertake the further working out of these questions. M. Angot was asked to act as president of this commission, and MM. Börnstein, Brounow, Louis Dop, Hergesell,

Palazzo, and Stupart as members, it being understood that the commission would coopt additional members.

The second day's sitting was devoted to the consideration of the report of the Commission on Weather Telegraphy, which had held a meeting in London in September last, and of the comments which had been received from the various institutes concerned on the proposals of the commission. Apart from a few minor modifications, the committee approved the recommendations of the commission, which have been already referred to in a previous number of NATURE (vol. xc., p. 107). The institutes are invited to introduce the suggested modifications in the present arrangements for exchange of telegraphic meteorological reports within the European system on May 1, 1914. From that date onwards a uniform telegraphic code will be adopted throughout Europe, though the differences between the units adopted in this country and on the Continent will persist. Arising out of the report of the commission was the question of the receipt of information from ships at sea by wireless telegraphy. Up to the present this country stands alone in having a system for obtaining wireless reports from liners. Our geographical position invests such reports with special importance to us. It is now hoped that the regulations connected with weather radio-telegrams adopted at the International Radiotelegraphic Conference, held in London in the summer of last year, will result in a considerable curtailing of the time which these messages occupy in transmission. Should this anticipation be realised, it is probable that other countries would also desire to avail themselves of this means for securing information from the Atlantic Ocean, and the president was therefore requested to make inquiries regarding the matter.

At this meeting the committee also considered a report on the velocity equivalents of the numbers of the Beaufort scale of wind force in use in different countries drawn up by Messrs. Palazzo, Köppen, and Lempfert, by request of the Commission on Weather Telegraphy. The report showed that the equivalents used in different countries differ considerably, but they all have one feature in common, viz., that they are based on comparisons of estimates of wind force with hourly means of wind velocity as measured on Robinson cup anemometers. The last few years have witnessed a considerable advance in our knowledge of wind structure in consequence of demands which have been put forward by aviators, and thus the question arises whether the velocity in gusts should not find a place in any specification of the velocity equivalents of the Beaufort numbers that may be recommended for general international use. For this and other reasons the committee considered it inexpedient at the present juncture to recommend a definite scale of equivalents for general use, and contented itself with suggesting that if any meteorological service wishes to make a change in the hourly equivalents which are now in use, the new values should be so selected that they do not fall outside the limits set by the scales adopted in Germany and in this country. The gentlemen referred to above were requested to prepare a further report, on which the committee might base a more definite recommendation on some future occasion.

At the next meeting questions arising out of the investigation of the upper air were considered. M. Hergesell gave an account of the past work and future plans of the commission of which he is president. In connection with future plans, he stated that upper-air investigation would form an important part of the scientific work proposed by Capt. Amundsen in his projected drift across the polar basin in 1915, and it thus was very desirable to organise other observations in polar latitudes simultaneously with Capt. Amundsen's expedition. In connection with this subject, M. Rykatcheff stated that Russia contemplated carrying out soundings of the upper air at Jakoutsk and Verkhoyansk, and that there was also some prospect of expeditions being sent to Nova Zemlya and to the mouth of the Lena at the time of Amundsen's expedition, if other countries were prepared to cooperate in other parts of the polar basin. Inquiries elicited the fact that prospects seemed favourable for such cooperation. Thus M. Hergesell hoped to be able to arrange for the German station on Spitsbergen to remain in operation, and Mr. Stupart thought that he might be able to arrange for some work of the kind contemplated by the Stefánsson expedition which the Canadian Government is sending out. The committee warmly supported the proposal, and appointed MM. Hergesell, Rykatcheff, Ryder, and Stupart a small subcommittee to deal with the question.

A second question of importance arising out of the upper-air work concerned the units to be adopted in the international publication in which the results of ascents made in all parts of the world are collected. A proposal brought forward by Prof. Bjerknes had led the commission responsible for this work to adopt at its meeting in Vienna in 1912 a resolution recommending that pressure values should be given in absolute units, millibars, instead of in millimetres of mercury, with the proviso, however, that the recommendation should only become effective when it received the approval of the International Meteorological Committee. The proposal has given rise to acute controversy in meteorological periodicals during the past year. Absolute pressure units are in many ways particularly suited to upper-air measurements, and no one would oppose their use if it were possible to start afresh without reference to the material which has been already collected and published in other units. Actually opinion has been sharply divided between those who trust that the temporary inconveniences associated with all changes will soon be outweighed by the advantages accruing from the new system, and those who deprecate any departure from established practice. After considerable discussion, the committee met the difficulty by requesting the commission to print pressure values in absolute units, millibars, as well as in millimetres of mercury. The committee further recommended that this practice should be adopted in all publications giving the results of observations in the free atmosphere. Thus a very difficult question has been settled for the present at the expense of a slight increase in the number of figures to be printed. A further proposal, originating with Prof. Bjerknes, to give heights in "dynamic meters," or rather to give geopotential instead of height in units of length, was referred back to the commission for further consideration, at M. Hergesell's request.

At the following meeting the report of M. Maurer, the president of the Radiation Commission, was received. A letter from Mr. Hunt, the meteorologist of the Commonwealth of Australia, directed the attention of the committee to the Campbell-Stokes sunshine recorder. Instruments of this type are widely used for recording the duration of bright sunshine, and their indications are generally regarded as reasonably comparable *inter se*. It appears, however, that the British Meteorological Service alone has adopted a definite specification for the instrument, but there is no similar provision in other countries. The Radiation Commission was therefore requested to take into consideration the question of instituting comparisons between instruments of different form.

At the last meeting the report of the Commission on Maritime Meteorology and Storm Warning Signals was considered. The recommendations of the commission regarding day and night signals, drawn up at the meeting held in London in September, 1912, were adopted except for a few points, such as the night signal for a hurricane, which was found to be likely to be confused with other signals already in use. These recommendations have already been described in NATURE (*loc. cit.*). A substantial measure of international agreement in the matter of day and night storm warning signals has thus been attained.

The Rome meeting of the committee was the third which has been held since the Conference of the Directors of Meteorological Observatories and Institutes which met at Innsbruck in 1905. In accordance with established practice another conference of directors should be held before the committee can hold another meeting, and it was agreed to call together such a conference for the year 1915. Holland was suggested as a suitable country for the meeting.

M. Palazzo had been at great pains to entertain his visitors and to afford them opportunities of seeing the geodynamical and meteorological observatories near Rome. On the Tuesday the committee was entertained at a dinner, at which the Chief Inspector of Mines presided on behalf of the Minister of Agriculture, who sent a message regretting his inability to be present in person. On Wednesday the members were received at the International Institute of Agriculture by its president, the Marquis de Cappelli. The whole of Thursday was devoted to an excursion which had for its object the seismological observatory at Rocca di Papa, with which was combined a visit to the Lake of Albano and to Frascati. On Friday afternoon the committee was invited to a meeting of the Physical Society at Rome, where it was welcomed by the president, Prof. Blascona, and subsequently listened to a lecture by Prof. Bjerknes on the fields of force.

On Saturday afternoon, April 12, the military observatory at Bracciano was visited by motor. This observatory has been recently established, and many of the instruments were not yet finally installed. It is fully equipped, not only for ordinary meteorological work, but also for taking aërial soundings with kites, registering or pilot balloons. A pilot balloon ascent was carried out in the presence of the visitors, who were subsequently entertained by the commandant and his officers.

NICKEL STEELS IN CLOCK CONSTRUCTION.

IN a pamphlet on "Les Aciers au Nickel et leurs Applications à l'Horologerie" (Paris, Gauthier-Villars), M. Ch-Ed. Guillaume gives in a simple form an account of the properties of nickel steels and of their application to the construction of compensated clocks, chronometers, torsion clocks, and even watches. The well-known peculiarities of the nickel steels as regards dilatation and variation of elastic modulus and other properties with temperature are briefly described and explained on the ground that the presence of nickel depresses the temperature of the allotropic modification which occurs in iron at 890° C., and at the same time changes the transformation point of iron into a wide range of transformation temperature in the alloys. It is when they are within this widened transformation range that these steels possess abnormally low coefficients of expansion, &c.

M. Guillaume's exposition of the applications of these steels shows, however, that although the alloy-steel known as "invar" can be produced so as to have negligibly low expansion, that is not the result to be desired for horological purposes. In the case of clock pendulums having an invar rod, with bob and suspension of other metal, the compensation principle of Graham, used in the mercury pendulum, is employed, but the use of a nickel steel of low expansion avoids the use of a liquid and makes the attainment of compensation both simpler and more perfect in its results. A steel of zero expansion would be less convenient.

More striking still is the application of nickel steel of a desired (low) coefficient of expansion to the balance-wheels of chronometers of high accuracy. Here the use of these special steels has made it possible to eliminate the second-order errors arising from the fact that compensation effected for two definite temperatures did not, with the older materials, avoid serious errors at intermediate temperatures, owing to the fact that the expansion curves of the two compensating metals only crossed at two points and lay widely apart at intermediate temperatures.

The elimination of this secondary error has made it worth while to seek other improvements in chronometer construction, so that an almost revolutionary improvement in these instruments has been brought about. For watches in which a compensated balance-wheel is excluded on account of cost, the use of a hair-spring of a special nickel steel, to which some chromium has been added in order to raise the naturally low elastic limit, has resulted in the evolution of a cheap method of producing compensated watches. In this case the abnormal manner in which the elastic modulus of these steels varies with temperature has been utilised.

The similar anomalous variation of the torsion modulus has also been utilised in connection with the construction of clocks with torsion pendulums, and has brought these clocks into the range of reasonably accurate instruments for the measurement of time. They have the advantage of requiring very little driving power, and can therefore run for four hundred days on a single winding.

M. Guillaume points out that these important developments must all be regarded as resulting from the study of the internal transformations of solutions and of alloys and that they have resulted indirectly from the study of nickel steels for purposes of metrology. The gradual and also the transient changes of dimension to which steels of the "invar" type are known to be subject are fortunately too minute to interfere with these applications, provided the steel has been properly aged. W. ROSENHAIN.

VARIATIONS OF THE SPECTRUM OF TITANIUM IN THE ELECTRIC FURNACE.

ENHANCED lines are taking a more and more prominent part in the discussion of both terrestrial and celestial spectra, and another valuable contribution to the subject comes from the researches of Mr. A. S. King, of the Mount Wilson Solar Observatory (*Astrophysical Journal*, vol. xxxvii., No. 2, March). The investigation which he has in hand deals with variations in the spectrum of titanium by different temperatures of the electric furnace in order, if possible, to fix the place of the enhanced lines on the temperature scale. As enhanced lines are in general difficult to produce in the furnace, he made the attempt of forcing the furnace temperatures up in order to make them appear in the spectra. This he has very successfully accomplished, and in the process he has been able to observe several re-

markable phenomena bearing directly on the nature of enhanced lines in general, which he describes in the present communication. Using larger dispersion than in his former experiments, and employing thinner tubes in the furnace, he ran the furnace until the tube wore thin with the strong vaporisation of the carbon, and ultimately broke. It was near this breaking period that the important observations were made.

The description of the experiments is given very fully in the paper, and is finely illustrated with reproductions of some of the spectra obtained, but here only the leading features of the research can be stated. The titanium enhanced lines appear in the regular furnace spectrum for temperatures probably somewhat higher than 2000° C., but are very faint compared with the arc lines. At still higher temperatures, the furnace conditions still existing, there is an indication of a slight increase in the relative strength of the enhanced lines. At the stage when the furnace tube burns through, resulting in the formation of a low-voltage arc, the consumption of electrical energy at the point being very large, the enhanced lines of titanium and the spark line λ4267 of carbon appear with an intensity usually attainable only in powerful sparks. Photographs taken with the slit across the entire image of the tube's interior show that the relative strength of the enhanced lines is much greater in the centre of the tube than near the wall, the effect being very pronounced in the case of the carbon spark line. Mr. King also directs attention to the important observation that the vapour in the centre of the broken tube shows a tendency to give a line farther to the red than near the wall, this being shown in the increasing dissymmetry of the lines from the end towards the middle. This effect, he points out, is in harmony with the action of the condensed spark, but can scarcely, in the case of the furnace lines, be ascribed to pressure.

ARISTOTLE AS A NATURALIST.[1]

AMONG the isles of Greece there is a certain island, *insula nobilis et amoena,* which Aristotle knew well. It lies on the Asian side, between the Troad and the Ionian coast, and far into its bosom, by the little town of Pyrrha, runs a broad and sheltered lagoon. It is the island of Lesbos. Here Aristotle came and spent two years of his life, in middle age, bringing his princess-bride from the petty court of a little neighbouring State where he had already spent three years. It was just before he went to Macedon to teach Alexander; it was ten years later that he went back to Athens to begin teaching in the Lyceum. Now in the "Natural History," references to places in Greece proper are very few indeed; there is much more frequent mention of places on the northern and eastern coasts of the Ægean, from Aristotle's own homeland down to the Carian coast; and to places in and round that island of Lesbos or Mytilene, a whole cluster of Aristotle's statements and descriptions refer. Here, for instance, Aristotle mentions a peculiarity of the deer on a neighbouring islet, of the weasels by the wayside by another island town. He speaks of the big purple Murex shells at Cape Lectum, and of the different sorts of sponges found on the landward and the seaward side of Cape Malia. But it is to the lagoon at Pyrrha that Aristotle oftenest alludes. Here were starfish, in such abundance as to be a pest to the fishermen; here the scallops had been exterminated by a period of drought, and by the continual working of the fishermen's dredge; here the sea-urchins come into season in the winter time, an unusual circumstance. Here among the cuttlefishes was found no octopus, either of the common or of the musky kind; here was no parrot-wrasse, nor any kind of spiny fish, nor sea-crawfish, nor the spotted nor the spiny dog-fish; and, again, from this lagoon, all the fishes, save only a little gudgeon, migrated seaward to breed. And though with no special application to the island, but only to the Asiatic coast in general, I may add that the chameleon, which is the subject of one of Aristotle's most perfect and minute investigations, is here comparatively common, but is not known to occur in Greece at all.

I take it then as probable, or even proven, that an important part of Aristotle's work in natural history was done upon the Asiatic coast, and in and near to Mitylene. He will be a lucky naturalist who shall go some day and spend a quiet summer by that calm lagoon, find there all the natural wealth ὅσσον Λέσβος . . . ἐντὸς ἐέργει, and have around his feet the creatures that Aristotle loved and knew. Moreover, it follows for certain, if all this be true, that Aristotle's biological studies preceded his more strictly philosophical work; and it is of no small importance that we should be (so far as possible) assured of this, when we speculate upon the influence of his biology on his philosophy.

Aristotle is no tyro in biology. When he writes upon mechanics or on physics, we read him with difficulty: his ways are not our ways; his explanations seem laboured; his science has an archaic look, as it were coming from another world to ours, a world before Galileo. Speaking with all diffidence, I have my doubts as to his mathematics. In spite of a certain formidable passage in the "Ethics," where we have a sort of *ethica more geometrico demonstrata,* favourite use of the equality of the angles of a triangle to four right angles, as an example of proof indisputable, in spite even of his treatise, "De Lineis Insecabilibus," I am tempted to suspect that he sometimes passed shyly beneath the superscription over Plato's door.

But he was, and is, a very great naturalist. When he treats of natural history, his language is our language, and his methods and his problems are well-nigh identical with our own. He had familiar knowledge of a thousand varied forms of life, of bird, and beast, and plant, and creeping thing: he was careful to note their least details of outward structure, and curious to probe by dissection into their parts within. He studied the metamorphoses of gnat and butterfly, and opened the bird's egg to find the mystery of incipient life in the developing chick. He recognised great problems of biology that are still ours to-day, problems of heredity, of sex, of nutrition and growth, of adaptation, of the struggle for existence, of the orderly sequence of nature's plan. Above all, he was a student of life itself. If he was a learned anatomist, a great student of the dead, still more was he a lover of the living. Evermore his world is in movement. The seed is growing, the heart beating, the frame breathing. The ways and habits of living things must be known: how they work and play, love and hate, feed and procreate, rear and tend their young; whether they dwell solitary, or in more and more organised companies and societies. All such things appeal to his imagination and his diligence. Even his anatomy becomes at once an *anatomia animata,* as Haller, poet and physiologist, was wont to describe the science to which he gave the name of physiology. This attitude towards life, such knowledge got thereby, afterwards helped to shape and mould Aristotle's philosophy.

I have no reason to suppose that the study of biology "maketh a man wise," but I am sure it helped

[1] From the Herbert Spencer lecture delivered at Oxford on February 14 by Prof. D'Arcy W. Thompson, C.B.

to lead Aristotle on the road to wisdom. Nevertheless he takes occasion to explain, or to excuse, his devotion to this study, alien, seemingly, to the pursuit of philosophy. "Doubtless," he says, "the glory of the heavenly bodies fills us with more delight than we gain from the contemplation of these lowly things; for the sun and stars are born not, neither do they decay, but are eternal and divine. But the heavens are high and afar off, and of celestial things the knowledge that our senses give us is scanty and dim. On the other hand, the living creatures are nigh at hand, and of each and all of them we may gain ample and certain knowledge if we so desire. If a statue please us, shall not the living fill us with delight; all the more if in the spirit of philosophy we search for causes and recognise the evidences of design. Then will nature's purpose and her deep-seated laws be everywhere revealed, all tending in her multitudinous work to one form or another of the beautiful." In somewhat similar words does Bacon retranslate a familiar saying: "He hath made all things beautiful according to their seasons; also he hath submitted the world to man's enquiry." On the other hand, a most distinguished philosopher of to-day is struck, and apparently perplexed, by "the awkward and grotesque, even the ludicrous and hideous forms of some plants and animals." I commend him, with all respect, to Aristotle—or to that Aristotelian verity given us in a nutshell by Rodin, "Il n'y a pas de laideur!"

To be sure, Aristotle's notion of beauty was not Rodin's. He had a philosopher's comprehension of the beautiful, as he had a great critic's knowledge and understanding of poetry; but wise and learned as he was, he was neither artist nor poet. His style seldom rises, and only in a few such passages as that which I have quoted, above its level didactic plane. Plato saw philosophy, astronomy, even mathematics, as in a vision; but Aristotle does not know this consummation of a dream. The bees have a king, with Aristotle. Had Plato told us of the kingdom of the bees, I think we should have had Shakespearian imagery. The king would have had his "officers of sorts," his magistrates, and soldiers, his "singing masons building roofs of gold." Even Pliny, arid encyclopædist as he is, can now and then throb and thrill us as Aristotle cannot do—for example, when he throws no little poetry and still more of music into his description of the nightingale's song.

But let us now come, at last, to exemplify, by a few brief citations, the nature and extent of Aristotle's zoological knowledge. Among the bloodless animals, as Aristotle called what we call the invertebrates, hé distinguishes four great genera, and of these the Molluscs are one. These are the cuttle-fish, which have now surrendered their Aristotelian name of "molluscs" to that greater group, which is seen to include them, with the shellfish, or "ostracoderma" of Aristotle. These cuttle-fishes are creatures that we seldom see, but in the Mediterranean they are an article of food, and many kinds are known to the fishermen. All, or well-nigh all, of these many kinds were known to Aristotle, and his account of them has come down to us with singular completeness. He describes their form and their anatomy, their habits, their development, all with such faithful accuracy that what we can add to-day is of secondary importance. He begins with a methodical description of the general form, tells us of the body and fins, of the eight arms with their rows of suckers, of the abnormal position of the head. He points out the two long arms of Sepia and of the Calamaries, and their absence in the octopus; and he tells us, what was only confirmed of late, that with these two long arms the creature clings to the rock and sways about like a ship at anchor. He describes the great eyes, the two big teeth forming the beak; and he dissects the whole structure of the gut, with its long gullet, its round crop, its stomach, and the little coiled coccal diverticulum; dissecting not only one but several species, and noting differences that were not observed again until Cuvier re-dissected them. He describes the funnel and its relation to the mantle-sac, and the ink-bag, which he shows to be largest in Sepia of all others. And here, by the way, he seems to make one of those apparent errors that, as it happens, turn out to be justified; for he tells us that in Octopus the funnel is on the upper side, the fact being that when the creature lies prone upon the ground, with all its arms spread and flattened out, the funnel-tube (instead of being flattened out beneath the creature's prostrate body) is long enough to protrude upwards between arms and head, and to appear on one side or other thereof, in a position apparently the reverse of its natural one. He describes the character of the cuttle-bone in Sepia, and of the horny pen which takes its place in the various calamaries, and notes the lack of any similar structure in Octopus. He dissects in both sexes the reproductive organs, noting without exception all their essential and complicated parts; and he had figured these in his lost volume of anatomical diagrams. He describes the various kinds of eggs, and, with still more surprising knowledge, shows us the little embryo cuttle-fish, with its great yolk-sac, attached (in apparent contrast to the chick's) to the little creature's developing head.

But there is one other remarkable feature that he knew ages before it was rediscovered, almost in our own time. In certain male cuttle-fishes, in the breeding season, one of the arms develops in a curious fashion into a long coiled whip-lash, and in the act of breeding may then be transferred to the mantle-cavity of the female. Cuvier himself knew nothing of the nature or the function of this separated arm, and, indeed, if I am not mistaken, it was he who mistook it for a parasitic worm. But Aristotle tells us of its use and its temporary development, and of its structure in detail, and his description tallies closely with the accounts of the most recent writers.

Among the rarer species of the group he knew well the little Argonaut, with its beautiful cockle-shell, and tells how it puts up its two broad arms to sail with, a story that has been rejected by many, but that, after all, may perhaps be true.

Now in all this there is far more than a mass of fragmentary information gleaned from the fishermen. It is a plain orderly treatise, on the ways and habits, the varieties, and the anatomical structure, of an entire group. Until Cuvier wrote there was none so good, and Cuvier lacked knowledge that Aristotle possessed.

As exact and scarce less copious is the chapter in which Aristotle deals with the crab and lobster, and all such crustacean shell-fish, and that in which he treats of insects, after their kind. Most wonderful of all, perhaps, are those portions of his books in which he speaks of fishes, their diversities, their structure, their wanderings, and their food. Here we may read of fishes that have only recently been rediscovered,[2] of structures only lately re-investigated, of habits only of late made known.[3] And many such anticipations of our knowledge, and many allusions to things of which perhaps we are still ignorant, may yet be brought to light; for we are still far from having

[2] *E.g. Parasilurus aristotelis*, a siluroid fish of the Achelous.

[3] *E.g.* the reproduction of the pipe-fishes (Syngnathi), the hermaphrodite nature of the Serrani, the nest-building of the wrasses, &c.

interpreted and elucidated the whole mass of Aristotle's recorded erudition, which whole recorded mass is only, after all, *tanquam tabula naufragii.*

There is, perhaps no chapter in the "Historia Animalium" more attractive to the anatomist than one which deals with the anatomy and mode of reproduction of the cartilaginous fishes, the sharks and rays, a chapter which moved to admiration that prince of anatomists Johannes Müller.[4] The latter wrote a volume on the text of a page of Aristotle, a page packed full of a multitude of facts, in no one of which did Johannes Müller discover a flaw. The subject is technical, but the gist of the matter is this: that among these Selachians (as, after Aristotle, we still sometimes call them) there are many diversities in the structure of the parts in question, and several distinct modes in which the young are brought forth or matured. For in many kinds an egg is laid, which eggs, by the way, Aristotle describes with great minuteness. Other kinds do not lay eggs, but bring forth their young alive, and those include the torpedo and numerous sharks or dogfish. The eggshell is in these cases very thin, and breaks before the birth of the young. But among them there are a couple of sharks, of which one species was within Aristotle's reach, where a very curious thing happens. Through the delicate membrane, which is all that is left of the eggshell, the great yolk-sac of the embryo becomes connected with the parental tissues, which infold and interweave with it; and by means of this temporary union the blood of the parent becomes the medium of nourishment for the young. And the whole arrangement is physiologically identical with what obtains in the higher animals, the mammals, or warm-blooded vivipara. It is true that the yolk-sac is not identical with that other embryonic membrane which comes in the mammals to discharge the function of which I speak; but Aristotle was aware of the difference, and distinguishes the two membranes with truth and accuracy.

It happens that of the particular genus of sharks to which this one belongs, there are two species differing by almost imperceptible characters; but it is in one only of the two, the γαλεὸς λεῖος of Aristotle, that this singular phenomenon of the *placenta vitellina* is found. It is found in the great blue shark of the Atlantic and the Mediterranean; but this creature has grown to a very large size before it breeds, and such great specimens are not likely to have come under Aristotle's hands. Cuvier detected the phenomenon in the blue shark, but paid little attention to it, and for all his knowledge of Aristotle, did not perceive that he was dealing with an important fact which the philosopher had studied and explained. In the seventeenth century, the anatomist Steno actually rediscovered the phenomenon, in the γαλεὸς λεῖος, the *Mustela laevis* itself, but he was unacquainted with Aristotle. And the very fact was again forgotten until Johannes Müller brought it to light, and showed not only how complete was Aristotle's account, but how wide must have been his survey of this class of fishes to enable him to record this peculiarity in its relation to their many differences of structure and reproductive habit. I used to think of this phenomenon as one that Aristotle might have learned from the fishermen, but after a more careful study of Johannes Müller's book, I am convinced that this is not the case. It was a discovery that could only have been made by a skilled and learned anatomist.

[4] *Cf.* Cavolini, in his classical 'Mem. sulla Generazione dei Pesci," Naples, 1787: "E quando io . . . scorro la Storia degli Animali di Aristotile, non posso non essere da stupore preso, in esse leggende veduti quei fatti, che a noi non si son potuti che a stento manifestare: e rilevati poi con tutta la nettezza, e posti in parallelo coi fatti già riconosciuti nel feto del gallo;" &c.

In a lengthy and beautiful account Aristotle describes the development of the chick. It is on the third day that the embryo becomes sufficiently formed for the modern student to begin its study, and it was after just three days (a little earlier, as Aristotle notes, in little birds, a little later in larger ones) that Aristotle saw the first clear indication of the embryo. Like a speck of blood, he saw the heart beating, and its two umbilical blood-vessels breaking out over the yolk. A little later he saw the whole form of the body, noting the disproportionate size of head and eyes, and found the two sets of blood-vessels leading, the one to the yolk-sac, the other to the new-formed allantois. In the tiny chick of the tenth day, he saw the stomach and other viscera; he noted the altered position of the heart and great blood-vessels; he traced clearly and fully the surrounding membranes; he opened the little eye, to seek, but failed to find, the lens. And at length he describes in detail the appearance and attitude of the little chick, the absorption of the yolk, the shrivelling of the membranes, just at the time when the little bird begins to chip the shell, and before it steps out into the world. While this account contains but a part of what Aristotle saw (and without a lens it would be hard to see more than he), it includes the notable fact of the early appearance of the heart, the *punctum saliens* of later writers, whose precedence of all other organs was a chief reason for Aristotle's attributing to it a common, central, or primary sense, and so locating in it the central seat of the soul. And so it was held to be until Harvey's time, who, noting the contemporaneous appearance of heart and blood, held that the contained was nobler than that which contained it, and that it was the blood that was "the fountain of life, the first to live, the last to die, the primary seat of the soul, the element in which, as in a fountain-head, the heat first and most abounds and flourishes"; so harking back to a physiology more ancient than Aristotle's—"for the blood is the life thereof." All students of the "Timaeus" know that here Aristotle parted company with Plato, who, following Hippocrates and Democritus, and others, placed the seat of sensation, the sovereign part of the soul, in the brain. Right or wrong, it was on observation, and on his rarer use of experiment,[5] that Aristotle depended. The wasp or the centipede still lives when either head or tail is amputated, the tortoise's heart beats when removed from the body, and the heart is the centre from which the blood-vessels spring. To these arguments Aristotle added the more idealistic belief that the seat of the soul, the ruling force of the body, must appropriately lie in the centre; and he found further confirmation of this view from a study of the embryo plant, where in the centre, between the seed-leaves, is the point from which stem and root grow. And Ogle reminds us how, until a hundred years ago, botanists still retained an affectionate and superstitious regard for that portion of the plant, calling it now *cor*, now *cerebrum*, the plant's heart or brain.

And now is it possible to trace directly the influence of Aristotle's scientific training and biological learning upon his sociology, his psychology, or in general on his philosophy? That such an influence must have been at work is, *prima facie*, obvious. The physician who becomes a philosopher will remain a physician to the end; the engineer will remain an engineer; and the ideas of pure mathematics, Roger Bacon's "alphabet of philosophy," will find issue and expression in the philosophy of such mathematicians as

[5] Aristotle's experiments were akin to Voltaire's, who employed himself in his garden at Ferney in cutting off the horns and heads of snails, to see whether, or how far, they grew again.

Plato, Leibnitz, Spinoza, or Descartes. Moreover, it is not only the special training or prior avocation of the philosopher that so affects his mind. In divers historical periods the rapid progress or the diffused study of a particular science has moulded the philosophy of the time. So on a great scale in the present day does biology; so did an earlier phase of evolutionary biology affect Hegel; and in like manner, in the great days of Dalton and Lavoisier, did chemistry help, according to John Stuart Mill, to suggest a "chemistry of the mind" to the "association" psychologists? A certain philosopher,[6] in dealing with this theme, begins by telling us that "Mathematics was the only science that had outgrown its merest infancy among the Greeks." Now it is my particular purpose to-day to show, from Aristotle, that this is not the case. Whether Aristotle's biological forerunners were many or few, whether or not the Hippocratics (for instance) had failed to raise physiology and anatomy to the dignity of a science, or, having done so, had only reserved them, as a secret cult, to their own guild; in short, whether Aristotle's knowledge is in the main the outcome of his solitary labours, or whether, as Leibnitz said of Descartes, *praeclare in rem suam vertit aliorum cogitata,* it is at least certain that biology was in *his* hands a true and comprehensive science only second to the mathematics of his age.

The influence, then, of scientific study, and in particular of biology, is not far to seek in Aristotle's case. It has ever since been a course or plan to compare the State, the body politic, with an organism, but it was Aristotle who first employed the metaphor. Again, in his exhaustive accumulation and treatment of facts, his method is that of the observer, of the scientific student, and is in the main inductive. Just as, in order to understand fishes, he gathered all kinds together, recording their forms, their structure, and their habits, so he did with the constitutions of cities and of States. Those two hundred and more πολιτεῖαι which Aristotle laboriously compiled, after a method of which Plato would never have dreamed, were to form a natural history of constitutions and governments. And if we see in his concrete, objective treatment of the theme a kinship with Spencer's descriptive sociology, again, I think, a difference is soon apparent between Spencer's colder catalogue of facts and Aristotle's more loving insight into the doings and into the hearts, into the motives and the ambitions, of men.

But whatever else Aristotle is, he is the great Vitalist, the student of the body with the life thereof, the historian of the soul.

Now we have already seen how and where Aristotle fixed the soul's seat and local habitation. But the soul has furthermore to be studied according to its attributes, or analysed into its "parts." Its attributes can be variously analysed, as in his "Ethics" Aristotle shows. But it is in the light of biology alone that what amounts to a scientific analysis, such as is developed in the "De Anima," becomes possible; and in that treatise, it is only after a long preliminary physiological discussion that Aristotle at length formulates his distinctive psychology. There is a principle of continuity, a συνέχεια that runs through the scale of structure in living things, and so, little by little, by imperceptible steps, does nature make the passage from plant, through animal, to man: it is with all the knowledge summarised in a great passage of the "Natural History," and embodied in this broad generalisation, that he afterwards proceeds to indicate the same gradation in psychology, and to draw from it a kindred classification of the soul.

[6] Ritchie, "Darwin and Hegel," p. 39.

But observe that, though Aristotle follows the comparative method, and ends by tracing in the lower forms the phenomena incipient in the higher, he does not adopt the method so familiar to us all, on which Spencer insisted, of first dealing with the lowest, and of studying in successive chronological order the succession of higher forms. The historical method, the realistic method of the nineteenth century, the method to which we insistently cling, is not the only one. Indeed, even in modern biology, if we compare, for instance, the embryology of to-day with that of thirty years ago, we shall see that the pure historical method is relaxing something of its fascination and its hold. Rather has Aristotle continually in mind the highest of organisms, in the light of the integral and constituent phenomena of which must the less perfect be understood. So was it with one whom the Lord Chancellor of England has called "the greatest master of abstract thought since Aristotle died." For Hegel, as I feel sure for Aristotle, *Entwicklung* was not a "time-process but a thought-process." To Hegel, an actual, realistic, outward, historical evolution seemed but a clumsy and materialistic philosophy of nature. In a sense, the "time-difference has no interest for thought." And if the lower animals help us to understand ourselves, it is in a light reflected from the study of man.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At a meeting of the electors to the Plumian professorship of astronomy held on April 19 Mr. A. S. Eddington, chief assistant at the Royal Observatory, Greenwich, was elected into the professorship, in succession to the late Sir George Darwin.

The adjudicators of the Adams Prize for the period 1911–12 consider that the two essays submitted to them with the following titles are of distinction: "The Theory of Radiation," by Mr. S. B. McLaren, and "The Fundamental Spectra of Astrophysics," by Dr. J. W. Nicholson, between whom the prize is divided in equal shares.

OXFORD.—The Romanes lecture will be delivered on Thursday, May 8, at 3 p.m., by Sir W. M. Ramsay. The subject is "The Imperial Peace: an Ideal Pervading European History."

The Halley lecture will be delivered on Thursday, May 22, at 8.30 p.m., by Dr. Louis A. Bauer, of the Carnegie Institution of Washington, U.S.A. Subject, "The Earth's Magnetism." The lecture will be illustrated by lantern slides.

On Tuesday, April 22, Convocation authorised the expenditure of a sum not exceeding 6000*l.* for the erection of additional buildings forming an extension of the School of Rural Economy. The money will be provided partly by a grant from the Development Fund of the Treasury, and partly out of the sum presented to the University in 1912 by Mr. Walter Morrison for the promotion of the study of agriculture.

UNDER the title *Educação,* a new fortnightly twelve-page magazine has been started in Portugal, dealing with elementary education, and we have now received the current issues, which commence with January. It contains original articles and reviews, an interesting feature being the series of experiments in elementary physics classed under two categories, namely experiments performed with simple apparatus (such as coffee-pots, kitchen utensils, and the like) and experiments suited for a laboratory.

THE seventeenth annual conference of the Parents' National Educational Union will be held at the Caxton Hall, Victoria Street, S.W., on May 5. Among the subjects of papers are:—Education and social sympathy, J. St. G. Heath; the reading habit and a wide curriculum, Miss C. M. Mason; knowledge and learning, Stanley Leathes, C.B.; and knowledge and its relation to national efficiency, J. L. Paton. Further particulars may be obtained from Miss Parish, 26 Victoria Street, S.W.

THE University of Edinburgh announces the establishment, in October next, of a mathematical laboratory for practical instruction in numerical, graphical, and mechanical calculation and analysis, as required in applied mathematical sciences and for research in connection with the mathematical department. A course of practical work has been drawn up by Prof. E. T. Whittaker, F.R.S., including methods of interpolation, graphic solution of equations, practical Fourier analysis, use of calculating instruments, and calculations of elliptic functions, Bessel functions, gamma functions, and, indeed, new functions not previously tabulated. Prof. Whittaker proposes to give sufficient theoretical explanation to render the more advanced work intelligible to those who have not previously studied the functions of higher analysis.

THE Board of Agriculture and Fisheries proposes to award in October next twelve research scholarships in agricultural science, of the annual value of 150*l.*, and tenable for three years. These scholarships have been established in order to train promising students under suitable supervision, with the view of their contributing to the development of agriculture, either by carrying out independent research, or by acting in an advisory capacity to agriculturists. They will be granted only to students who show distinct promise of capacity for advanced study and research in some one of the sciences bearing on agriculture. Applicants must be graduates of a university, or holders of a diploma of a university or college of university rank, and application should be made not later than June 9 on a form to be obtained from the secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

THE annual conference of the Association of Teachers in Technical Institutions will be held this year in Bradford at Whitsuntide. The proceedings will be opened on Whit-Monday, when the Lord Mayor of Bradford, Alderman Fred Foster, will officially welcome the conference to Bradford. This will be followed by the address of the president, Mr. P. Coleman, of the Northern Polytechnic Institute. The meeting on Tuesday evening will be addressed by the Right Hon. J. A. Pease, President of the Board of Education, and in view of the introduction of the new Education Bill soon after Whitsuntide, this address will be looked forward to with exceptional interest. This meeting will also be addressed by Dr. M. E. Sadler, Vice-Chancellor of the University of Leeds, Sir William Priestley, M.P., Sir Alfred Keogh, K.C.B., rector of the Imperial College of Science and Technology, Mr. F. W. Jowett, M.P., and others. Papers will be read to the conference on corporate life in a technical institution, by Mr. W. Hibbert, the Polytechnic, Regent Street; vocational education, by Mr. A. C. Coffin, director of education, Bradford, and coordination within a county area, by Mr. F. N. Cook, secretary for higher education in the West Riding of Yorkshire.

THE January issue of the Bulletin of the Massachusetts Institute of Technology contains the report of the president, Dr. R. C. Maclaurin, presented to the governing body of the institute in December last. Taken in conjunction with that of the previous year, the report shows that during the last eighteen months nearly 1,400,000*l.* has been paid or promised by way of gift to the Massachusetts Institute of Technology. The principal items include 600,000*l.* for buildings, 160,000*l.* for land, 320,000*l.* for general endowment, 150,000*l.* for endowment of the department of naval architecture, 40,000*l.* for scientific research, and 100,000*l.* for scholarships. It is not surprising to find that the institute attracts students from all parts of the United States, and, indeed, from all parts of the world. Students come in large numbers from China, South America, Canada, and in considerable numbers from Europe, India, Egypt, South Africa, and a few from Australia. The proportion of foreign students at the institute is more than double that at almost any other institution in the United States. The number of students on November 1 last reached 1611, the largest in the history of the institute. The total number of members of the teaching staff for these students was 254, of whom 56 were full professors, while there were, in addition, 16 research professors.

SOCIETIES AND ACADEMIES.

Royal Society, April 17.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. W. **Watson**: The luminosity curves of persons having normal and abnormal colour vision. The author has calculated the form of the luminosity curves corresponding to different degrees of deficiency of the red and green sensation, and shows that in the great majority of cases of colour blindness the observed points agree with the calculated curves, and hence the correctness of Sir W. Abney's sensation curves and his theory as to partial colour blindness is supported. The cases of abnormal luminosity curves given by persons having normal colour vision are shown to be probably due to variation in macular pigmentation.—Prof. W. H. **Bragg** and W. L. **Bragg**: The reflection of X-rays by crystals. The paper deals with the reflection of a beam of X-rays by the cleavage faces of various crystals, an ionisation method being employed to measure the strength of the reflected rays. The apparatus corresponds to a spectrometer, the parallel planes in which the atoms of the crystal are arranged taking the place of the lines of a grating, and the ionisation chamber that of a telescope. A fine slit in front of the X-ray bulb allows a beam of rays to fall on the face of the crystal, and both crystal and ionisation chamber turn about the axis of the instrument and can be set at any desired angles. By this method evidence has been found of the existence of three very homogeneous components in the rays from the bulb employed, which are only reflected from the crystal at definite angles. They show as a very strong reflection superimposed on the general reflection which takes place at all angles. Each of these has a definite absorption coefficient in aluminium, and can be recognised when reflected from many crystals. The absorption of the homogeneous rays in different metals corresponds in all respects to the absorption of characteristic X-rays.—Prof. J. C. **McLennan**: A fluorescence spectrum of iodine vapour.—Dr. W. **Wahl**: The relation between the crystal-symmetry of the simpler organic compounds and their molecular constitution. Part I.—Prof. H. E. **Armstrong** and E. E. **Walker**: Studies of the processes operative in solutions. XXVIII., The causes of variation in the optical rotatory power of organic compounds and of anomalous rotatory dispersive power. Attention is directed to the explanation of the anomalous rotatory dispersive power displayed by some organic compounds,

notably, the tartrates, which was given by Biot, the original discoverer of optical rotatory power, viz. that it may be due to the presence of two compounds of opposite rotatory power (+ and −) differing in rotatory dispersive power. This explanation appears to have been generally overlooked. The behaviour to be expected of compounds varying in their optical properties in different ways is discussed. The results arrived at serve to explain the apparently abnormal variation in optical behaviour often noticed in optically active compounds; they also appear to be of significance as indicating a relation among solvents generally and underlying their action towards substances generally of a very definite and regular character; each solvent would seem to have its definite sphere and mode of action, so that any two solvents behave relatively always in the same way towards solutes generally, apart from the exceptional cases in which some special property of the solute comes into operation to disturb regularity of action.

Geological Society, April 9.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. G. **Hickling**: The variation of *Planorbis multiformis*, Bronn. The writer gives an account of an investigation of the above-named Miocene gasteropod, based on a suite of 532 specimens from a single block of stone. A study was made of the variation in height presented by the shells, which include every gradation between perfectly discoid forms and types with a spire the height of which considerably exceeds the diameter of the base. By sorting the whole of the shells into ten grades, according to height, it was shown that forms of mean height were common, while extreme forms were rare, the height being distributed, in fact, according to a typical "variation-curve." If more than one species were really present, it is in the highest degree improbable that the various types should be distributed in the proportions actually found, and this is taken as the most satisfactory proof possible of the specific unity of the group. It is shown that the shells also vary extensively in respect of the amount of carination, the degree of involution, the form of cross-section of the whorls, the form of aperture, and the stage of development at which various characters are acquired, the variation in each character being, however, "continuous."—Miss M. Colley **March**: The structure and relationships of the Carbonicolæ. The evidence for the relationship of the Carbonicolæ to the Unionidæ, based on shell-structure, muscle-scars, form, habitat, ligament, and hinge-teeth, appears insufficient.

Physical Society, April 11.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—A. **Campbell** and H. C. **Booth**: Errors in magnetic testing due to elastic strain. In magnetic tests on sheet material considerable errors may occur if the sheets or strips are tested while in bent form. These errors, which are in general agreement with the known effects of compression and tension, were investigated experimentally with one or two forms of magnetic circuit similar to those sometimes occurring in practice.—Dr. G. W. C. **Kaye**: Note on kathodic sputtering. The paper gives an account of the volatilisation of an aluminium kathode in a discharge tube containing helium. The sputtered deposit on the glass indicates that, under the conditions which prevailed, the disintegration was restricted to the edges of the kathode and did not occur elsewhere. Accordingly the complete outline of the kathode (made by rolling a sheet of aluminium into a nearly complete cylinder) was traced out by the deposit on the walls of the tube.—A. **Campbell**: Vibration galvanometers with unifilar torsional control. The author exhibited a moving-coil vibration galvanometer in which a novel principle is used to obtain the fine adjustment of the control torque requisite for accurate tuning.

DUBLIN.

Royal Dublin Society, April 15.—Dr. James H. Pollok in the chair.—Prof. H. H. **Dixon** and W. R. G. **Atkins**: Extraction of zymase by freezing. Yeast frozen solid by exposure to liquid air, and centrifuged when thawed, gives up its sap. The sap thus extracted amounts to about one-third of the volume of the yeast originally treated. It is free from fermentable carbohydrates, but actively ferments cane-sugar when supplied to it. Its activity, in the samples examined, was as great as that of the extract prepared from the same samples by Lebedeff's maceration method. The method of extraction by means of liquid air has the advantage of great rapidity. Culture experiments show that the yeast is killed by exposure to the temperature of liquid air.—Prof. H. H. **Dixon** and W. R. G. **Atkins**: Osmotic pressures in plant organs. III., The osmotic pressure and electrical conductivity of yeast, beer, and wort. Measurements of osmotic pressure were made by the thermo-electric method of cryoscopy previously described. The yeast juice was obtained by freezing the yeast in liquid air and centrifuging the resultant liquid mass. It was found that ordinary yeast has an osmotic pressure of about 41 atm., that of wort being about 14. Thus there is a marked rise in pressure during fermentation. The impermeability of the yeast cell to electrolytes is shown by the conductivity of the juice being about four times as great as that of the beer, which is practically the same as that of the unfermented wort. Both the osmotic pressure and electrical conductivity of pressed yeast are greater than is the case in actively fermenting yeast.—R. Lloyd **Praeger**: The buoyancy of the seeds of some Britannic plants. The importance of the question of the buoyancy of seeds in water in connection with the dispersal and distribution of plants has been long recognised. The experiments of Darwin, Martins, Thuret, and Guppy lead to the generalisation that only about one-tenth of a flora bear seeds capable of more than a very brief period of buoyancy. The present experiments were undertaken in order to furnish further data for a study of the dispersal of our native species. Hitherto results were available for about 330 native species. The number of species tested is now raised to 900. The results bear out the conclusion already mentioned; also Guppy's conclusion that the buoyant seeds belong mainly to maritime and marsh species. Some results relating to fresh and dried fleshy fruits and also to fruiting branches are given.

PARIS.

Academy of Sciences, April 14.—M. F. Guyon in the chair.—Emile **Picard**: Application of the theory of integral equations to certain problems in the analytical theory of heat on the hypothesis of a sudden rise of temperature at the surface of separation of the bodies in contact.—J. **Boussinesq**: The velocity of slow fall of a liquid spherical drop, after becoming uniform, in a viscous liquid of slightly greater density than the falling drop.—M. **Landouzy** was elected a member of the section of free academicians in the place of the late M. Teisserenc de Bort.—G. de **Saint-Aubin**: An apparatus allowing of a variation of the carrying surface of an aëroplane. The apparatus consists of two auxiliary planes with surfaces of slight curvature, with their centres of sustentation for a given angle of attack on the same line passing through the centre of sustentation of the ordinary planes of the aëroplane. J. **Guillaume**: Observations of the sun made at the

Observatory of Lyons during the fourth quarter of 1912. Tables are given of the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude. Observations were possible on fifty-nine days.—J. **Lagrula**: A new method for the rapid visual search for the small planets. The method is based on the application of binocular vision, combined with the use of a coloured screen. The presence of a small planet in the field can be proved in less than a minute. An error of position of the asteroid 233, Asterope, was detected on the night of April 1 in less than five minutes.—M. **Tzitzéica**: A generalisation of non-Euclidean minimal surfaces.—G. **Valiron**: Integral functions of finite order.—Georges **Rémoundos**: The series and families of algebroid functions in a domain.—G. **Pólya**: The method of Graeffe.—M. **Gunther**: The characteristics of systems of partial differential equations.—Albert **Turpain**: The reception in the Morse code of radio-telegrams with simultaneous photographic record. Diagrams showing the results obtained by the system of relays described in an earlier communication (March 17).—M. de **Broglie**: The reflection of the Röntgen rays. Reproductions of photographs obtained by the reflection of Röntgen rays by various crystals at a grazing angle. The exact interpretation of the results is still uncertain.—H. **Guilleminot**: The variation of the electrical resistance of selenium when irradiated by the Röntgen rays and by radium rays. The results are given in a table showing the fall of resistance of a selenium cell under the action of the X-rays; a preliminary study of the effects of varying voltage and temperature was necessary. Similar measurements were made with exposure to radium rays, but the results are not given.—Camille **Matignon**: The reduction of magnesia by aluminium. A mixture of aluminium powder and magnesia, heated to 1200° C. in a vacuous steel tube, the upper portion of which was kept cool, gave metallic magnesium as crystals in the cold portion. The yield of magnesium was good.—L. C. **Maillard**: The formation of humus by the action of polypeptides on sugars.—Paul **Gaubert**: The polymorphism of codeine, thebaine, and narcotine. A new type of sphærolite.—L. **Collot**: The celestine of the sedimentary strata.—G. **André**: The evolution of the mineral and nitrogenous materials in some annual plants.—F. **Baco**: Comparative budding of grafted and ungrafted vines.—Jules **Glover**: An intensive physiological telephone. The action of the current on the receiving magnet of the telephone does not depend on its strength so much as on the variations in strength. The new arrangement described is based on the study of the physiological causes of these variations.—B. **Roussy**: The mathematical theory of the geometric law of the surface of the human body. The body is pictured as consisting of twenty-six truncated cones and a formula derived for obtaining the true surface. Various approximations are discussed.—Raphaël **Dubois**: Microzymas, coccoliths, and vacuolids.—Charles **Nicolle**, A. **Cuénod**, and L. **Blaizot**: Some properties of the virus of trachoma. Immunity in trachoma. The Algerian ape (*Macacus inuus*) contracts trachoma, but throws off the disease completely in from one to three months. Immunisation experiments were carried out on this animal with successful results; results of the application of similar treatment to man are also given.—Charles **Lepierre**: The replacement of zinc by uranium in the culture of *Aspergillus niger*. Uranium can replace zinc in Raulin's fluid; the stimulation of growth of the mould is less intense, however, with uranium than with zinc.—E. **Voisenet**: New researches on a ferment of bitter wines. A bacillus has been isolated, named *Bacillus amaracrylus*, which produces all the characteristics of bitterness in wines. It converts glycerol partially into acrolein, to which the bitter taste is due, the other products formed including hydrogen, carbon dioxide, ethyl alcohol, and various fatty acids.—M. **Piettre** and A. **Vila**: The preparation of fibrinogen by dialysis on saccharose syrup.—L. **Cayeux**: The sedimentary iron minerals considered in their relations with the destruction of mountain chains.—I. **Assada**: The levels of the Lyons plateau.—M. **Durand-Gréville**: The laws relating to wind-storms causing a kink in the barometric chart.—De Montessus de **Ballore**: Destructive earthquakes and atmospheric precipitations.

CALCUTTA.

Asiatic Society of Bengal, April 2.—R. **Gurney**: Entomostraca from Lake Tiberias. Dr. Annandale obtained eight species of Entomostraca in the Lake of Tiberias and in small pools near it. Eight other species were bred from earth taken from a dried-up pool between Tiberias and Nazareth. The collection does not comprise any forms hitherto unknown.—D. **Hooper**: Sarcocolla. This is a description of a drug known to the early Greek and Arabian physicians, and used largely in India. It is the gum of *Astragalus fasiculifolius*, Buissier, a spiny shrub growing in Persia. Chemical examination shows that it consists principally of a peculiar glucoside differing from saponin and glycyrrhizin.

BOOKS RECEIVED.

Bulletin International. Résumés des Travaux Présentés. Classe des Sciences Mathématiques, Naturelles et de la Médecine. XVII^e Année. Pp. iii+419+plates. (Prague: L'Académie de Sciences de l'Empereur François Joseph.)

Icones Plantarum Formosanarum nec non et Contributiones ad Floram Formosanam, or Icones of the Plants of Formosa, and Materials for a Flora of the Island, based on a Study of the Collections of the Botanical Survey of the Government of Formosa. By B. Hayata. Fasc. ii. Pp. ii+156+xl plates. (Taihoku: Bureau of Productive Industries, Government of Formosa.)

Reprints of Papers from the Science Laboratories of the University of Sydney, 1908–9 to 1911–12. (Sydney.)

A Manual of Agricultural Chemistry. By H. Ingle. Third edition. Pp. 397. (London: Scott, Greenwood and Son.) 7*s*. 6*d*. net.

The Fauna of British India, including Ceylon and Burma. Hymenoptera. Vol. iii. By C. Morley. Pp. xxxvi+531+1 plate. (London: Taylor and Francis.) 20*s*.

Nomography, or the Graphic Representation of Formulæ. By Capt. R. K. Hezlet. Pp. iv+54. (Woolwich: Royal Artillery Institution.) 2*s*. 6*d*.

A Handbook of Forestry. By W. F. A. Hudson. Pp. ix+82. (Watford: Cooper Laboratory for Economic Research.) 2*s*. 6*d*. net.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 95 Jahresversammlung vom 8–11 September 1912 in Altdorf. Teil I. Pp. vii+210+171+plates. Teil II. Pp. vii+251+2 plates. (Aarau: H. R. Sauerländer et Cie.)

The Works of Aristotle, translated into English. De Coloribus. By T. Loveday and E. S. Forster. (Oxford: Clarendon Press.) 5*s*. net.

A Manual of Petrology. By F. P. Mennell. Pp. iv+256. (London: Chapman and Hall, Ltd.) 7*s*. 6*d*. net.

The Conquest of Bread. By P. Kropotkin. Cheap edition. Pp. xvi+298. (London: Chapman and Hall, Ltd.) 1s. net.

Elementary Experimental Dynamics for Schools. By C. E. Ashford. Pp. viii+246. (Cambridge University Press.) 4s.

Vegetation of the Peak District. By Dr. C. E. Moss. Pp. x+235+plates. (Cambridge University Press.) 12s. net.

Die gnomonische Projektion in ihrer Anwendung auf kristallographische Aufgaben. By Dr. H. E. Boeke. Pp. iv+54. (Berlin: Gebrüder Borntraeger.) 3.50 marks.

Die Rehobother Bastards und das Bastardierungsproblem beim Menschen. By Dr. E. Fischer. Pp. vii+327+19 plates. (Jena: G. Fischer.) 16 marks.

E. Strasburger. Das botanische Praktikum. Fünfte Auflage. By Drs. E. Strasburger and M. Koernicke. Pp. xxvi+860. (Jena: G. Fischer.) 24 marks.

Proceedings of the London Mathematical Society. Second series. Vol. xi. Pp. xlviii+482. (London: F. Hodgson.)

IVe Conférence Internationale de Génétique, Paris, 1911. Comptes rendus et rapports. Edited by P. de Vilmorin. Pp. x+571. (Paris: Masson et Cie.) 25 francs.

Elementary Practical Mathematics. By Prof. J. Perry. Pp. xiv+335. (London: Macmillan and Co., Ltd.) 6s.

DIARY OF SOCIETIES.

THURSDAY, APRIL 24.

ROYAL SOCIETY, at 4.30.—(1) Protostigmata in Ascidians; (2) The Origin of the Ascidian Mouth: A. G. Huntsman.—Experiments on the Kidneys of the Frog: F. A. Bainbridge S. H. Collins, and J. A. Menzies.—(1) The Probable Value to *Bacillus coli* of "Slime" Formation in Soils; (2) Variation in *B. coli*. The Production of Two Permanent Varieties from One Original Strain by Means of Brilliant Green: Cecil Revis.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. II. Religious Monuments of Asia Minor: Prof. J. Garstang.

SOCIETY OF DYERS AND COLOURISTS (London Section), at 8.—The Chemistry of the Vat Dyes: E. de B. Barnett.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Phase-Advancing: Dr. G. Kapp.

CONCRETE INSTITUTE, at 7.30.—Discussion on Reports of the Science Standing Committee on: (1) A Standard Notation for Structural Engineering Calculations; (2) A Standard Specification for Reinforced Concrete Work; (3) Standard Connections and Joints in Reinforced Concrete.

FRIDAY, APRIL 25.

ROYAL INSTITUTION, at 0.—Meroë: Four Years' Excavations of the Ancient Ethiopian Capital: Prof. J. Garstang.

PHYSICAL SOCIETY, at 5.—A Graphic Method of Optical Imagery: W. R. Bower.—Spectroscopic Resolution of a Graph: Dr. C. V. Burton.—Some Experiments to Detect β-rays from Radium-A: Dr. W. Makower and Dr. S. Russ.

MONDAY, APRIL 28.

ROYAL SOCIETY OF ARTS, at 8.—Antiseptics and Disinfectants. II.: Dr. D. Sommerville.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—400th Anniversary of the Discovery of the Pacific Ocean by Blasco Nunez de Balboa: Sir Clements R. Markham, K.C.B.

INSTITUTE OF ACTUARIES, at 5.—An Investigation into the Effects of Family and Personal History upon the Rates of Mortality Experienced in Various Classes of Life Assurance Risks, with Special Reference to Tuberculosis: E. A. Rusher and C. W. Kenchington.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Law in Relation to Engineering: T. F. Thomson.

TUESDAY, APRIL 29.

ROYAL INSTITUTION, at 3.—Recent Physiological Inquiries. I. Motion and Locomotion: Prof. W. Stirling.

ILLUMINATING ENGINEERING SOCIETY, at 7.30.—*Discussion:* Standard Clauses for Inclusion in a Specification of Street-lighting: A. P. Trotter.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Annual General Meeting.

WEDNESDAY, APRIL 30.

ROYAL SOCIETY OF ARTS, at 8.—The Science Museum: Dr. F. G. Ogilvie.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.—The Spectra of Comets: Prof. A. Fowler.—A Popular Star Finder: G. F. Chambers.—Seeing: J. W. Worthington.

THURSDAY, MAY 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Capacity for Heat of Metals at Different Temperatures: Dr. E. H. Griffiths and Ezer Griffiths.—The Transition from the Elastic to the Plastic State in Mild Steel: A. Robertson and G. Cook.—Studies of the Processes Operative in Solutions XXVIII. The Influence of Acids on the Rotatory Power of Cane Sugar, of Glucose and of Fructose: F. P. Worley.—The Attainment of High Potentials by the Use of Radium: H. G. J. Moseley.—The Decrease in Velocity of α Particles in passing through Matter: E. Marsden and Dr. T. S. Taylor.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. III. Cults of Northern Syria: Prof. J. Garstang.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Use of the Electrostatic System for the Measurement of Power: C. C. Paterson, E. H. Rayner, and A. Kinnes.

LINNEAN SOCIETY, at 8.—The Structure of the Wood of East Indian Species of Pinus: Prof. P. Groom and W. Rushton.—Branching Specimens of *Lyginodendron oldhamium*, Will: Dr. Winifred Brenchley.—A Problem in Weismannism: A. C. F. Morgan.—Note on *Sphenopus marsupialis*: Mrs. L. J. Wilsmore.—Polychæta of the Indian Ocean, with some Species from the Cape Verde Islands—The Serpulidæ, with a Classification of the Genera Hydroides and Eupomatus: Miss Helen L. M. Pixell.—Report on the Arachnida of the Seychelles: S. Hirst.—*Gypsina plana*, Carter: Miss Marjorie Lindsay.—Nitidulæ, Heterocidæ: A. Grouvelle.—Fselaphidæ de l'Archipel des Seychelles: A. Raffray.—Anthribidæ of the Seychelles: Dr. K. Jordan.—Hispinæ from the Seychelles: S. Maulik.

FRIDAY, MAY 2.

ROYAL INSTITUTION, at 9.—Blood Parasites: H. G. Plimmer.

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