THURSDAY, FEBRUARY 5, 1914.

THE SCIENCE AND PHILOSOPHY OF INSTINCT.

Instinct and Experience. By Prof. C. Lloyd Morgan, F.R.S. (London: Methuen and Co., Ltd., 1912.) Pp. xvii+299. 5*s.* net.

THIS is an important contribution to the much-discussed subject of instinct. It reveals a perplexing discrepancy of opinion among those who have recently given special attention to the nature of instinctive behaviour in its biological and psychological aspects, and the way in which the author deals with the views of Bergson, Driesch, McDougall, Myers, Stout, and many others is a model of what scientific discussion should be. Perhaps it does not make the book easier to read, but there is a fascination in his Darwin-like method of anticipating difficulties, answering criticisms that have been made, and forestalling others that will be forthcoming all the same. It is now many years since Prof. Lloyd Morgan began a new chapter in the study of instinct, marked by clear-cut experimental work on one hand, and philosophical insight on the other; and in this new book he has made us again his debtors. He is always lucid and always fair; and his vivid, arresting style is especially welcome when the subject-matter is necessarily difficult.

Let us quote a fine summary of much research and thought:—

"Instinctive behaviour is that which is, on its first occurrence, independent of prior experience; which tends to the well-being of the individual and the preservation of the race; which is similarly performed by all the members of the same more or less restricted group of animals; and which may be subject to subsequent modification under the guidance of experience. Such behaviour is, I conceive, a more or less complex organic or biological response to a more or less complex group of stimuli of external and internal origin, and it is, as such, wholly dependent on how the organism, and especially the nervous system and brain-centres, have been built through heredity, under that mode of racial preparation which we call biological evolution."

"Instinct," Lloyd Morgan goes on to say, "is organic behaviour suffused with awareness." Biologically considered, an instinctive act is nothing but a reflex; psychologically considered, it is always something more, in so far as it affords data to the conscious experience which has its physical basis in the higher reaches of the nervous system. The book's particular thesis, which applies primarily to vertebrate animals, is that instinctive behaviour, biologically considered, is dependent upon inherited dispositions within the lower brain-centres. In virtue of these inherited dispositions, the organism appropriately stimulated exhibits adaptive responses, and is subject to visceral disturbances. These afford new stimuli which in turn affect the lower brain-centres. But not these alone, for the initial sensory stimuli, those from the motor organs concerned in behaviour, and those from the viscera, likewise stimulate the cortex of the cerebral hemispheres, with the functional activity of which experience is correlated. And this plays down upon the activities of the lower nerve-centres, controlling them intelligently.

"There are, of course, inherited dispositions in the cortical centres also, which determine mental tendencies. These may be called innate, reserving the narrower term instinctive for behaviour of a specific congenital type, dependent on purely biological conditions, nowise guided by conscious experience, though affording data for the life of consciousness."

Instinctive behaviour is determined by the subtly compounded reflex actions of the lower centres; it is due to the integrative action of these centres; it differs from compound reflex actions (in the ordinary acceptation) in being the outcome of a more complicated coordination. A decerebrate animal may exhibit instinctive behaviour, but, it is pointed out, this fact does not contradict the view that in the intact animal orderly impulses due to performance of instinctive acts may reach the cortex and there generate experience. This experience may form the basis of subsequent cortical or intelligent modification of the instinct, as is continually happening.

Besides its direct contributions to the theory of instinct, the book contains much that is of great value for the student of science and philosophy. Thus it emphasises from first to last the important rule of method "that the more clearly we distinguish the scientific problem from the metaphysical problems the better it will be both for science and for metaphysics"; and another dominant idea is that "the history of the universe, so far as we are able to read it, is one continuous story, every episode in which is, if we may so phrase it, logically correlated with other episodes." So that even the richness and complexity of conscious awareness in human life is the highest outcome of the logic of the world-story, developed *ab intra,* and not an alien insertion from without. Both these general ideas command our heartiest allegiance.

TECHNICAL CHEMISTRY.

(1) *The Fermentation of Cacao.* Edited by H. H. Smith. With a foreword by Sir George Watt, C.I.E. Pp. lv+318. (London: John Bale, Sons, and Danielsson, Ltd., n.d.) Price 10*s.* net.

(2) *Chemistry and its Relations to Daily Life.* By Prof. L. Kahlenberg and Prof. E. B. Hart. Pp. vii+393. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 5*s.* 6*d.* net.

(3) *Industrial Poisoning from Fumes, Gases, and Poisons of Manufacturing Processes.* By Dr. J. Rambousek. Translated and edited by Dr. T. M. Legge. Pp. xiv+360. (London: Edward Arnold, 1913.) Price 12*s.* 6*d.* net.

(4) *The Application of Physico-Chemical Theory to Technical Processes and Manufacturing Methods.* By Prof. R. Kremann. Translated from the German by H. E. Potts, and edited by Dr. A. Mond. Pp. xv+212. (London: Constable and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

(1) THIS is a collection of essays published during the last few years in Germany, Holland, the United States, and this country, discussing the methods and effects of fermentation as applied to the preparation of cacao ("cocoa"). Raw cacao beans, on being removed from the pods and placed in covered heaps, undergo alcoholic and acetic fermentation of the adherent pulp. This loosens the testa of the beans, and improves the quality of the kernel by reducing the amount of bitter astringent substances, developing the aroma, and producing the desired chocolate colour. As to how precisely the improvement is effected there is difference of opinion. Oxidation, either direct or by means of an oxidase; the action of acetic acid, or of heat, or of glucoside-splitting enzymes, are some of the explanations put forward.

Two important suggestions for improving the industry are made: one is that instead of trusting to chance to bring the right kinds of yeast, the planter should employ suitable cultures for starting and prolonging the fermentation. A definite culture of yeast would ensure a more uniform product. The second suggestion is that the "juice" from the fermentation, large quantities of which are now run to waste, might be manufactured into vinegar, which should become a considerable asset to the planter.

(2) Theory has been kept down to the minimum in this work, which is intended for students of agriculture and home economics in (American) secondary schools. The authors take common substances for their material—water, air, vinegar, soda, coal, soap, sugar, clay, wool, bread, milk, and so on. By discussing and experimenting upon these the student is led to a knowledge of some of the fundamental facts of chemistry. The descriptions are simple and interesting; the instruction is sound so far as it goes; and the more important points are emphasised by using different kinds of type in the letterpress. A good deal of life is infused into what many students would regard as the dry bones of chemistry, and many illustrations are provided which further serve to brighten the pages. Students who are not making chemistry their primary study, but desire to have some knowledge of the chemical properties of common articles, will find the book full of trustworthy information.

(3) Dr. Rambousek, a medical man and a chemist, is also professor of factory hygiene and chief State health officer at Prague. He may therefore be regarded as specially qualified to compile a work dealing with the occurrence of poisoning in industrial occupations. The number of such occupations attended with risk is perhaps in general scarcely realised. Thus besides lead and phosphorus poisoning, cases occur in connection with the larger chemical industries (sulphuric acid, bleaching powder, hydrochloric and nitric acids), and with the use of phosgene gas, chloro- and nitro-benzene, methyl bromide, carbon disulphide, aniline, petroleum products; brass, chromates, ferro-silicon, mercury, and nickel carbonyl. The author gives an outline of the dangerous processes, then describes symptoms and treatment, and finally gives an account of the preventive measures hitherto adopted or suggested. The field is so wide that exhaustive discussion within the limits of one small volume is impracticable; but the large number of references supplied will help to remedy this defect.

(4) This work, the English editor explains, is one of a series of monographs on technical chemical methods of manufacture, written by experts and published first in Germany, where they have had an encouraging reception.

The book contains the substance of lectures delivered by Prof. Kremann, whose experience has taught him that the beginner shows most interest in those problems of physical chemistry which have a bearing upon technical questions.

Starting with the fundamental laws of the mechanical theory of heat, the law of mass action is deduced, and the maximum work of a chemical process discussed, the results being then applied to a consideration of the theory of gas engines and of gaseous and solid explosives. The phenomena of catalysis and pseudo-catalysis are next

dealt with, examples of practical application being furnished by the manufacture of sulphuric acid, the Deacon process for chlorine, and the drying of linseed oil. Special cases depending on the law of mass action are found in the production of nitric acid and of ether, and in the caustification of sodium carbonate. The rest of the book is chiefly concerned with applications of the phase rule to manufactures, for example, lime-burning, lead roasting, blast-furnace reactions, and the Solvay ammonia-soda process. Technical chemists and students would often find the book useful and suggestive.

OUR BOOKSHELF.

Meteorological Office. The Observer's Handbook, 1913. Pp. xxiv + 157 + plates. (London: H.M. Stationery Office, 1913.) Price 3*s*.

THE issue of an annual edition of this work, arranged in 1909, was very appropriate—from a scientific point of view—owing to the rapid advance of meteorological research in recent years. The progress of aërial navigation and the proposed general extension of the centimetre-gram-second system of units to meteorological measurements give greater force to the desirability of the arrangement. The work is divided into four principal sections, most carefully prepared with due regard to requirements of observers and to decisions of international conferences. Part i. relates mostly to normal climatological stations and to non-instrumental observations. The articles referring to modifications of aqueous vapour and to optical phenomena are especially interesting. Parts ii. and iii. deal with self-recording and additional instruments, special attention being given to the attainment of accuracy in their working. Part iv. contains reduction and conversion tables, including those adapted for the c.g.s. system. An introductory memorandum on the proposed new units, to be used for bringing meteorology into line with allied sciences, is most useful. Certainly the learning of them "does involve a definite effort to begin with," but the proposed regraduation of instruments will, as pointed out elsewhere, probably remove the main objection to the innovation.

Handbuch der Hygiene. Herausgegeben von Prof. M. Rubner, Prof. M. v. Gruber, and Prof. M. Ficker. III. Band 3. Abteilung. Die Infektionskrankheiten. Pathogene tierische Parasiten. (Protozoen, Würmer, Gliederfüssler.) Pp. 392 + plates. (Leipzig: S. Hirzel, 1913.) Price 24 marks.

FOLLOWING upon an introduction of fourteen pages dealing with the general problems of parasitology, the book is divided into three sections dealing with parasitic protozoa (224 pp.), worms (101 pp.), and arthropods (28 pp.), the last section being written by W. von Schuckmann, and the rest of the book by Th. von Wasielewski. Each section is accompanied by reference to the main literature on the subject of which it treats. The book is excellently illustrated by means of thirty-two coloured plates and 192 text-figures, many of which are original.

The section on protozoa deals in the main with the forms which are parasitic in man, the subjects of trypanosomiasis, leishmaniasis, amœbiasis, malaria, and balantidium-dysentery being treated of at length. A short section deals with organisms doubtfully related to protozoa—Spirochæta, Haplosporidia, and Chlamydozoa. The section on worms also deals mainly with the species which are parasitic in man. Compared with these sections the one on arthropoda appears distinctly inadequate, the illustrations being mostly bad and antiquated. The legends to figures of Hæmatopota and Stomoxys (p. 76) are unfortunately reversed. Due credit is given throughout to the sources whence illustrations are borrowed. An annoying custom in bibliographies to German publications may be noted in that "Ders." and "Dies." printed in the same type as authors' names, are used instead of dashes beneath the name or names heading the first title—this is most distracting to the eye.

Prof. von Wasielewski may well be congratulated upon his excellent treatise, which will prove most useful to hygienists, for whom the "Handbuch der Hygiene" is primarily intended.

G. H. F. NUTTALL.

LETTERS TO THE EDITOR.

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

The Pressure of Radiation.

I QUITE agree with Mr. C. G. Darwin's opinion, expressed in NATURE of January 22, that Boltzmann's proof of the fourth-power law, taken as he gave it, or as it is usually given in the text-books, cannot be applied as it stands to each separate frequency, because the adiabatic expansion, employed in performing the cycle, will bring the Doppler effect into play, and cause a small change in the frequency, thus confusing the issue. But I think the reason of this is that the proofs usually given assume too much, and neglect an essential point, expressly emphasised by Carnot himself in the application of his principle to the case of a saturated vapour. According to my view, the application of Carnot's principle to a single frequency should run somewhat as follows.

Since the emission of radiation of constant frequency, independent of the temperature, is a characteristic property of matter, we are justified, for the purpose of argument, in assuming an ideal cylinder and piston of a material capable of emitting only a single frequency, or a narrowly restricted range. Generate a *finite* volume v of radiation in such a cylinder at a constant temperature T and pressure p. The work done on the piston is pv, and the total heat absorbed $E+pv$, where E is the intrinsic energy of the radiation generated. Cool the cylinder at constant volume through an *infinitesimal* range, dT, by abstracting heat CdT, where C is the thermal capacity

of the cylinder and its contents. An infinitesimal proportion of the radiation will be condensed, and the pressure will fall to the equilibrium value, $p-dp$, corresponding to the temperature $T-dT$. There is no change of frequency since the volume is not altered. Complete the cycle by condensing the volume v at $T-dT$, and heating the cylinder to its original temperature. The cycle is reversible, and the infinitesimal CdT may be made as small as we please in comparison with $E+pv$. The external work done in the cycle is $v(dp/dT)dT$, and is equal to the fraction dT/T of the heat absorbed, $E+pv$. Whence $E/v=T(dp/dT)-p$.

I cannot see any escape from this conclusion so long as Carnot's principle is accepted for the definition of the absolute scale of temperature. Still less is there any escape from the conclusion, depending only on the first law, that the quantity measured experimentally is $E/v+p$, and not E/v, as generally assumed. Both conclusions are inconsistent with much of Wien's reasoning, but I have shown that they are not inconsistent with his displacement law. My formula satisfies all three conditions, makes the entropy of the distribution a maximum, and the thermodynamic potential the same for each frequency.

H. L. CALLENDAR.

Imperial College of Science, S.W.

Atomic Models and X-Ray Spectra.

I AM unable to agree with Sir Oliver Lodge (NATURE, January 29, p. 609) that the impossibility of the existence of two coplanar rings of electrons with the same angular velocity is self-evident, though it is proved very simply. For the mutual repulsions of the electrons in different rings are complicated, and their effect on any ring varies very much with the number of electrons. I think the amount of proof given in my letter is necessary, especially since, in discussions of two rings, inequality of angular velocity has not often been mentioned.

Although my illustrative case concerns rings with the same angular velocity, the greater part of the letter relates to rings with different angular velocities, as, of course, in Bohr's theory, the angular momenta of the electrons are equal, thus precluding identity of angular velocity in any two coplanar rings. It must be borne in mind that the portion of Bohr's theory which deals with coplanar rings is admittedly more tentative than that relating to spectra. The point of my letter was that this part of the theory needs modification; and, of course, it is not essential to the other. The variations from circular orbits may be shown to be cumulative, when the orbits are coplanar, and, in fact, it is possible to prove the non-existence of approximately circular orbits from considerations of angular momentum alone, and as this investigation will be published in detail shortly, there is no necessity to enter further upon it now. But, in particular, the nearest possible approximation to a circular orbit for the two inner electrons of Bohr's lithium atom makes their distances from the nucleus in the ratio 12 to 1 for certain positions.

In fact, the only possible arrangement of three electrons with equal angular momenta, in which the orbits are circular, requires all to be in the same circle, and such an atom can be shown by Bohr's method to be as inert as helium. Lithium therefore cannot have a nucleus of strength $3e$, and we cannot retain both Bohr's theory and van den Broek's hypothesis. One at least must be abandoned, and the latter must certainly, for lithium, beryllium, and boron, all of which can be treated very simply on theoretical grounds.

An important argument can be derived from astrophysics. These three elements are, so far as can be judged, practically unknown in celestial spectra, where hydrogen and helium are strong. This seems to imply no great similarity in constitution.

J. W. NICHOLSON.

University of London, King's College.

IN the recent discussion in NATURE on the constitution of the atom, attention has been directed mainly to the electrostatic forces exerted by the positively charged portion of the atom. Prof. Nicholson has been successful in calculating the frequencies of the lines in the nebular and coronal spectra on this basis by employing Rutherford's model atom consisting of a central nucleus surrounded by a ring (or rings) of electrons. Bohr's theory, though not dependent on the usual dynamical laws, involves the calculation by ordinary mechanics of the steady motion of the electron in the electrostatic field of the positive nucleus. In the case of a *simple* nucleus this procedure leads to results as to the frequencies that agree with observation. It may, however, be necessary to suppose, at least in the case of the heavier atoms, that the nucleus produces not only an electrostatic but also a magnetic field. Such a view has recently been developed by Prof. Conway using the atomic model of Sir J. J. Thomson. If we adopt Rutherford's model the expulsion of α and β particles from radio-active substances with large velocities may indicate that the particles possess these velocities *within the nucleus*. If they are in orbital motion a magnetic field would exist outside the nucleus.[1] This hypothesis may be associated with the theory of the Zeeman effect put forward by Ritz, and also with the theories of magnetic action developed by Langevin and by Weiss. According to the latter, there exists an elementary magnet, the *magneton*, which is common to the atom of a large number of different substances.

Prof. Nicholson regards Planck's universal constant h as an angular momentum. According to Bohr's theory the angular momentum of an electron is constant and is $h/2\pi$. Prof. Conway, using a different model, obtains the value h/π. Prof. McLaren identifies the natural unit of angular momentum with the angular momentum of the magneton. It has been pointed out (*Phys. Zeitsch.*, vol. xii., p. 952, 1911) that Planck's constant may be connected with the magnetic moment of the magneton. Suppose that an electron (charge e, mass m) is moving in a circular orbit (radius a) with angular velocity ω. Then its angular momentum is $ma^2\omega$, and the magnetic moment of the equivalent simple magnet is $\frac{1}{2}ea^2\omega$. Thus the magnetic moment is equal to some constant multiplied by he/m. Taking (for illustration only) Bohr's value for the angular momentum, we obtain as the magnetic moment 92×10^{-22} E.M.U. The magnetic moment of the magneton, as given by Weiss, is a quantity of about the same order of magnitude, viz. $15{\cdot}94\times10^{-22}$.

My chief object is to direct attention to the work of Prof. Carl Størmer, of Christiania, on the path of an electron in the magnetic field of an elementary magnet. It would be of great interest if it should prove that his results, originally obtained in connection with cosmical problems, are applicable within the atom. In addition to computing the trajectories corresponding to different circumstances of projection in the field of an elementary magnet, he has investigated the corresponding problem when the electron is also under the action of a central force varying inversely as the square of the distance from the centre of the magnet (*Videnskabs-Selskabets Skrifter*, 1907, Chris-

[1] This view necessitates a larger estimate for the diameter of a complex nucleus than that at present accepted.

tiania; *Comptes rendus*, vol. clvi., pp. 450, 536, 1913). In particular he finds certain remarkable periodic trajectories in the form of circles the plane of which is perpendicular to the axis of the magnet and the centre of which is at some point on that axis. If this point coincide with the centre of the magnet we obtain circular orbits in the equatorial plane of the magnet. Further, there are other trajectories which never get outside closed toroidal spaces in the case of stability, or which approach asymptotically the circle in question in the case of instability. It appears probable that similar results would be obtained in the case of a ring of electrons, and that the outstanding problem of the stability of such a rotating ring when only electrostatic forces are considered might in this way be overcome. Experimentally such stable rings have been obtained by Birkeland by employing a magnetised sphere inside a vacuum tube.

Some of the orbits calculated by Størmer are also suggestive in connection with the wide angle scattering of α particles investigated by Rutherford and by Geiger and Marsden. If the nucleus produce a magnetic field, Rutherford's estimate of its radius may require modification. H. S. ALLEN.

Wheatstone Laboratory, King's College, London.

I HAVE read the letters of Dr. Bohr and Mr. Moseley with great interest, and would like to make a few remarks in reply which may serve to render the meaning of my first letter more clear. Dr. Bohr says that we have no right to consider nNe^2, m, r, and h as independent variables and that we must eliminate r, in which case we find his formula. I am not convinced that this is necessary *a priori*, as Dr. Bohr would seem to consider it. In some cases it leads to conclusions which are obviously erroneous. Supposing, for instance, that we calculate the period of a pendulum by this method. If we eliminate h we find $t = \text{const.}\sqrt{\frac{l}{g}}$, but if we eliminate l we find $t = \text{const.}\sqrt[3]{\frac{h}{mg^2}}$. We have just as much or just as little reason, *a priori*, to eliminate h or r, or any of the quantities involved in one case as in the other. In the case of the pendulum, h can only appear as a corrective term, perhaps of a form similar to $\sqrt{1-\frac{h\nu}{E}}$, where E is the energy. Possibly the same is true in atomic models.

I suggest that Mr. Moseley's frequencies, which can be represented by various equations, do not prove that one must necessarily adopt the formula obtained by eliminating r. But even if it be admitted that r must be eliminated *a priori*, the fact that we then always find a formula which, as Dr. Bohr admits, only differs from his in the constant, seems to me to justify my view that the fact that the frequencies agree with the formula does not necessarily confirm Dr. Bohr's special assumptions. The support to be derived from an agreement in the matter of the constant, however, is not very strong, as, according to Dr. Bohr's theory, it contains a factor of the form $(1/\tau_1^2 - 1/\tau_2^2)$ which obviously gives us the choice of an infinite number of values between O and $2\pi^2(N-\sigma_n)^2$.

Mr. Moseley also adduces arguments only in favour of what he calls the h hypothesis, not of Dr. Bohr's special assumptions. The reasons, however, do not appear to me absolutely convincing. Thus he says $\nu \sim (Fr^2)^2$, where F is the resultant electrostatic force on one electron, and concludes that as $M^{\frac{1}{3}}.L^2T^{-1}$ is constant, ML^2T^{-1} is constant. He thus introduces various hypotheses, such as that the same number of electrons oscillate in every atom, that there exist no other forces than electrostatic, and so on. If one liked, the fact that $\nu \sim N^2$ might just as well be interpreted as $\nu \sim Fr^2$, assuming N electrons to be attracted, whence we could deduce $ML^2.L/T = \text{const.}$, *i.e.* a universal velocity times a universal moment of inertia. Mr. Moseley says no independent natural unit of length is known. It is very easy to imagine atomic models in which one occurs, as, for instance, that proposed by Sir J. J. Thomson at the last meeting of the British Association.

There are one or two other points which do not seem to confirm Mr. Moseley's interpretation of the phenomena which he has observed. Mr. Moseley himself found, I believe, several lines in the characteristic platinum radiation, which are not where they should be according to his hypothesis, *i.e.* about in the region of wave-lengths two octaves shorter than copper, M. de Broglie has shown by means of the ingenious method for photographing X-ray spectra described by him in the *Comptes rendus de l'Académie des Sciences*, November 17, 1913, and completed December 22, 1913, and January 19, 1914, that platinum antikathodes emit at least ten independent lines. Although the whole spectrum was photographed, including the shortest wave-lengths, and although a continuous spectrum was observed in the region in which the lines were to be expected, the lines themselves were not present. Unless we ascribe all the strong lines observed to impurities and introduce a special hypothesis to account for the fact that the expected platinum lines are not observable, this seems to constitute a grave difficulty for the theory of Mr. Moseley. I have misgivings further as to the ring of four electrons being able to emit such strong lines as those observed, as the radius of the ring is about one hundred times smaller than the wave-length, but no doubt Mr. Moseley has considered this obvious objection, and satisfied himself that it is unfounded.

To recapitulate. It seems to me that Dr. Bohr postulates the h hypothesis, and that Mr. Moseley derives it by introducing a hypothetical model. That the h hypothesis does not entail Dr. Bohr's model. That Dr. Bohr's constant as applied by Mr. Moseley contains a factor which varies from 0 to 1, and that $\frac{3}{4}$ the value chosen is entirely arbitrary. Therefore my view is that all that can be said of Mr. Moseley's observations is, that they do not contradict Dr. Bohr's assumptions, not that they confirm them.

F. A. LINDEMANN.

Paris, January 25.

Systems of Rays on the Moon's Surface.

IT is a strange fact that those who have little experience of volcanoes notice a rough resemblance between the irregularities of the lunar surface and terrestrial volcanic vents. However much one juggles with diminished gravity and magnifies volcanic energy in the past history of our satellite, there are still several facts which are overlooked by many theorists. Mr. C. H. Plant points out in NATURE of January 15 (p. 550) that the "volcanic action of the moon was of enormous character"—this would need be so to produce on such a small globe craters of 80 kilometres or more in diameter.

Now all large craters are the result of explosive action, and, in explosive action, only fragmentary ejecta are thrown out by the amount of volatile constituents of the magma, which, if sufficient to excavate a crater, are also sufficient to break up all the igneous magma into scoriaceous or pumiceous materials, and not allow it to issue continuously as a lava stream. When lava rises, subsequent to an ex-

plosive eruption such as excavated these gigantic craters, its first effect will be to fill up the crater before overflowing the edges.

Lateral outpourings can only occur when the cone has been sufficiently rebuilt, above the level of the surrounding country, to give enough hydrostatic force to rend this cone.

The radiating rays around these craters cannot be lava streams, as these only flow out of the crater by its lowest lip. They are not due to landslips of the loose ejecta collected on the slopes of the cone, such as I described and figured in my book on the great Vesuvian eruption of 1906, and which had until then been attributed to water erosion, for the following reason. These ravines, like the depressions around a half-opened umbrella, are straight radially and not sinuously radial as in those surrounding the great craters of the moon.

Were these radial rays lava streams, which originally issued from a cone now truncated by a later explosive eruption, then they would have been obliterated by the enormous mantle of fragmentary materials that would have been ejected.

These rays have more the appearance of erosion valleys, but this we cannot admit if physicists maintain that there is no lunar atmosphere to speak of.

Their greatest resemblance, however, is with the irregular, radial cracks formed around the splash of a missile striking a comparatively hard surface, such as is observable when bullets are fired into soap, hard clay, lead, or half-set plaster, or even steel.

The more I compare the moon's surface with volcanic vents in different parts of this world the less I see a resemblance between the two, and the more does the planetoid and meteorite projectile theory become acceptable. The obviously asymmetrical craters with high, overhanging, narrow lip on one side, and low, broad lip on the opposite side, point to the impact of the meteorite being oblique to the moon's surface. The long, deep furrows, such as the valley of the Alps, &c., are, to my mind, formed by bolides ploughing in a path of high ellipticity the surface of the moon, but at so low an angle as not to penetrate its surface.

I think it a great pity that a good lunar-observing astronomer with one of the most powerful telescopes at his disposal, does not collaborate with a thoroughly practical vulcanologist to examine many of the lunar features without very rigidly fixed preconceived ideas. How often have I wished to be able to study carefully the moon's surface, and no doubt astronomers have often craved for a more extensive vulcanological knowledge.

H. J. JOHNSTON-LAVIS.

Villa Lavis, Beaulieu-sur-Mer, January 26.

The End-product of Thorium.—A Suggestion.

THE chemical composition of thorites and thorianites does not seem to suggest any probable end-product for the contained thorium. It has occurred to us that the only explanation at present available is that the end-product is an isotope of thorium itself. This condition might be brought about by the emission of sufficient β rays.

If this be the case, thorium, as we know it, must be a mixture of two isotopic elements, one of which is radio-active. There is some support in favour of this suggestion to be found in the erratic position of thorium on the Geiger-Nuttall curve (*Phil. Mag.*, October, 1912). According to this curve, the value of λ for thorium, as observed, is too low. Now, if there is a stable component present, this result will naturally arise.

From the position of thorium on the diagram it is possible to estimate the value of λ for the active constituent on the above hypothesis. It comes out approximately as $1{\cdot}0 \times 10^{-16}$ sec^{-1}. The percentage of this active constituent would appear to be about 0·7. It is also possible to estimate the time for this composition to have been attained, starting from the pure active constituent. The time appears to be about $1{\cdot}6 \times 10^{9}$ years.

The view that thorium possesses a radio-active constituent as determined above may, of course, be made the basis of an independent hypothesis.

J. JOLY.
J. R. COTTER.

Trinity College, Dublin, February 3.

A Curious Ice Formation.

I AM taking the liberty of enclosing a photograph of an occurrence which, so far as I am aware, is quite unique for this part of the country, and will no doubt have some interest for your readers.

The water was frozen during the night of December 31, 1913 (on which night at least 14° of frost were registered) into circular floes of ice of varying diameter, which, being encrusted with snow, had the appearance of water-lilies.

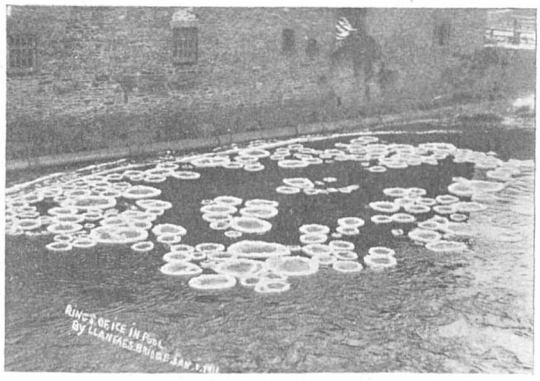


Photo.] [*J. Clark, Brecon.*

The river at this point flows almost due southward, and has just passed under a bridge over a weir, at both ends of which is a whirlpool.

The accompanying photograph shows the east whirlpool as it appeared on New Year's Day.

The river, I may mention, is the Usk, and the photograph was taken at Brecon.

D. J. PHILLIPS.

University College of South Wales and Monmouthshire, Cardiff.

Soil Protozoa.

IN a letter to NATURE (No. 2266, vol. xci., 1913) one of us (C. H. M.) gave an account of a method of obtaining permanent preparations of Protozoa in the state in which they were living in the soil.

The fixative used in this method was picric acid in saturated aqueous solution, but we have since found this reagent to be less serviceable in the case of clay soils than the following mixture:—Saturated aqueous solution of mercuric chloride, 1 pt.; methylated spirit, 1 pt. The soil should be crumbled into this fluid, and mixing is best accomplished by gently shaking the containing vessel, care being taken to avoid making the clay component of the soil pass into suspension.

A delicate film containing Protozoa will appear on the surface of the liquid, and this can be removed by floating cover-slips over it, and stained by the usual methods.

K. R. LEWIN.
C. H. MARTIN.

Lawes Experimental Laboratory, Rothamsted, January 27.

The Eugenics Education Society.

IN NATURE of January 29 there is a letter from Prof. Karl Pearson pointing out that he has been misquoted in *The Eugenics Review*, the word "years" having been substituted for the words "few months."

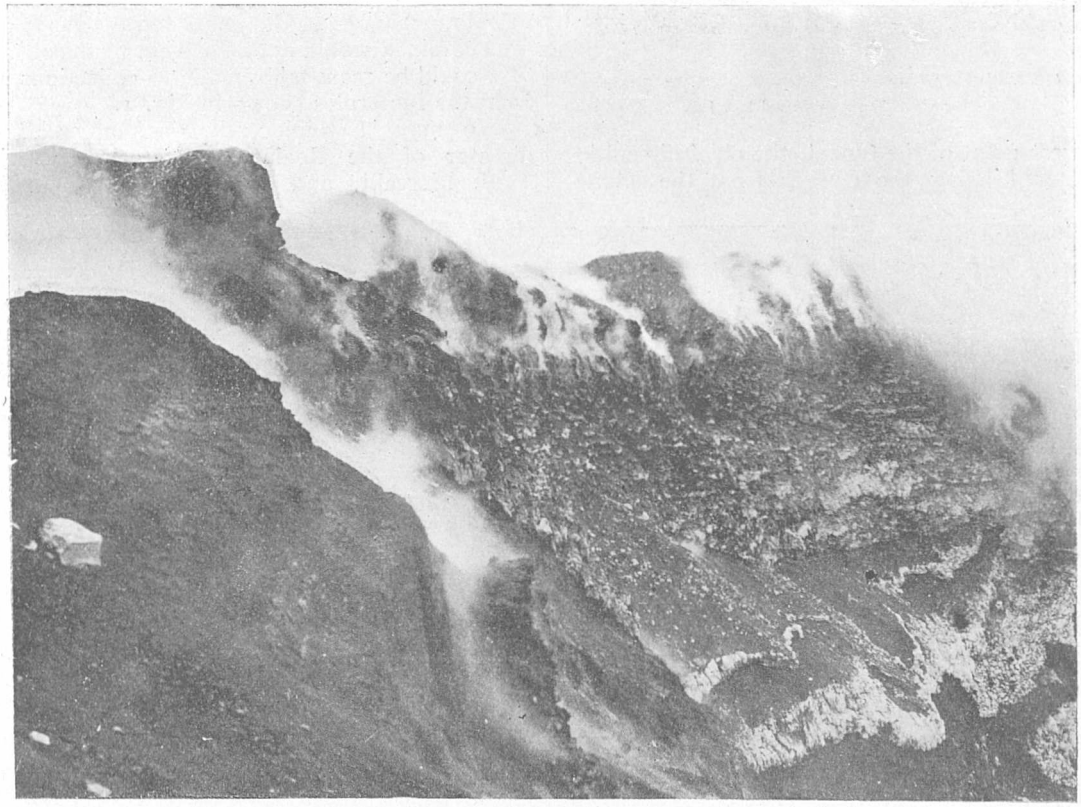
An apology to Prof. Pearson for this purely accidental blunder will appear in the next issue of the review. I should be glad if you would give me space to say through your columns also that we much regret that this mistake was made.

LEONARD DARWIN.
(President.)
The Eugenics Education Society, Kingsway House, Kingsway, W.C., January 31.

OBSERVATIONS AT THE BOTTOM OF THE CRATER OF VESUVIUS.

SINCE the appearance of the interesting memoirs of M. A. Brun, of Geneva, and the publication of his important monograph, no problem has appealed to vulcanologists with greater force than that concerned with the nature and origin of the gases which produce explosive action in volcanoes. That water-gas appears in enormous quantities during explosive eruptions cannot be doubted, for it is condensed in heavy rain-torrents; but it is by no means certain that these abundant watery vapours may not be due, wholly or in large part, to moisture derived originally from the atmosphere. M. Brun regards the long prevalent opinion among geologists—that the hydrochloric acid, sulphurous acid, nitrogen, and other gases, which are undoubtedly present, are quite subordinate to the water-gas—is an erroneous one; he, on the other hand, maintains that his observations prove (alike in the blasts of vapour from volcanic vents, in the distension of molten lava into pumice, and its dispersion as dust) that water plays but an insignificant part as compared with other gases.

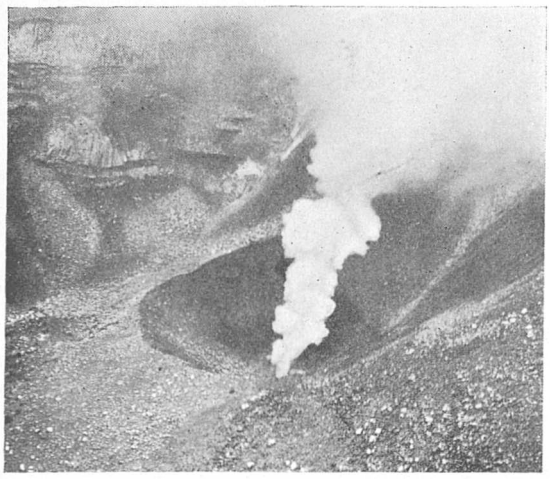
The discovery by Prof. Malladra of a practicable route by which the very lowest point in the present Vesuvian crater can be reached, and its utilisation by Mr. Frederick Burlingham for kinematographic work, promise to furnish a means by which the rival views concerning the nature of the volcanic gases may be put to a crucial test. The floor of the present crater of Vesuvius lies at a depth of about 1000 ft. below the crater-rim; in this floor a funnel-shaped opening 200 ft. deep was opened last July, after the volcano had sunk to the solfataric condition following the great and destructive eruption of 1906; at the bottom of this funnel (1212 ft. from the summit of the volcano) considerable, and apparently increasing, activity is taking place. It remains to be seen whether this activity will eventuate in the formation of a cone rising from the present crater-floor, or in a violent paroxysm that will carry away the crater-floor and increase the depth of the cavity.



Copyright] FIG. 1.—Fumaroles on south-east crater wall, showing steepness of crater-wall inside. [*F. Burlingham.*

By the courtesy of the British and Colonial Kinematograph Company and of Mr. Burlingham, NATURE is able to publish examples of the interesting photographs obtained during their

enterprising undertaking. With two Neapolitans familiar with the mountain, Mr. Burlingham, who is an experienced alpine climber, reached



Copyright] [*F. Burlingham.*

FIG. 2.—Showing "funnel" formed last July.

the lowest point of the funnel, the chief difficulties encountered being the danger from the sliding down of great loose masses and the powerful fumes of hydrochloric acid. The complete films, which are now being exhibited in London, are well worthy of being seen by all interested in science.

Fig. 1 is a view taken on the steep side of the crater, and shows near the top numerous fumaroles, arising probably from rain and snow-water penetrating to the heated materials. The stratified arrangement of the scoriæ and lava ejections is well shown in the photograph.

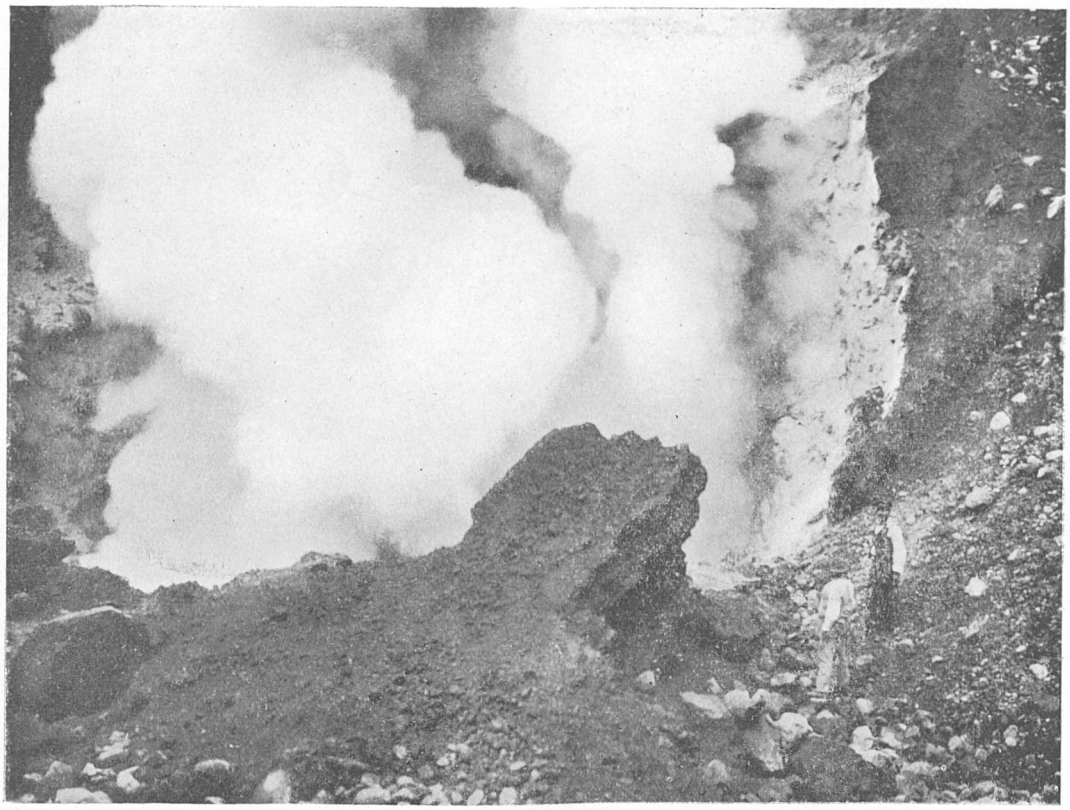
Fig. 2, taken lower down, shows the floor of the crater with the mouth of the funnel, and the vapour column rising out of it as seen from some distance above.

Fig. 3 is the view taken at the bottom of the funnel, with the masses of "incandescent pink vapours, in places exhibiting blue and other tints," rushing up from the bottom vent.

As Mr. Burlingham was able to convey apparatus exceeding 70 lb. in weight to the point shown in Fig. 3, it would seem possible to transport tubes and collecting vessels to the spot so as to obtain samples of the gases for analyses; gases thus obtained would not be subject to the objection that could be reasonably made to collections made from the fumaroles shown in Fig. 1.

We may, I think, rely on the enlightened director of the Reale Osservatorio Vesuviano, Prof. Mercalli, and his enterprising assistants not to lose sight of this opportunity for an important research.

JOHN W. JUDD.



Copyright] [*F. Burlingham.*

FIG. 3.—Where fresh lava was found, 1212 feet down at bottom of funnel, where pink incandescent fumes belch from the mouth which Prof. Mercalli discovered.

MIGRATORY MOVEMENTS OF BIRDS IN 1911–12.[1]

THE report before us forms vol. xxxii. of the Bulletin of the British Ornithologists' Club, and is written on much the same lines as the former reports noticed in NATURE. It affords a considerable amount of valuable information for those who are interested, and they are many, in the fascinating subject of bird-migration. The report is gradually growing, and the instalment for 1912 runs to no fewer than 335 pages. It seems to the writer that certain matter might well, indeed ought, to be omitted. This remark applies especially to the inclusion of practically the whole of the Scottish data for the autumn of 1911, which was published more than a year before by the Misses Baxter and Rintoul.

There are certain species of summer birds—and the marsh-warbler is one of them—about which we have insufficient data regarding the time of their appearance, and we might add departure. The species named is believed to be the latest of all summer migrants to arrive in England, and more information regarding its migrations would be most acceptable. Should not a special effort be made to obtain this? It is also very desirable to know—and this remark concerns all similar reports—on whose authority some of the species recorded are based. For example, who identified the rock-pipits recorded as occurring at the Outer Dowsing lightship in the earliest hours of the morning of March 20? Were wings sent as vouchers, or does the identification rest on the testimony of the light-keepers? Would it not be well to publish a list of all the wings received, or, perhaps better still, to star (*) the species the identification of which has been established by means of wings sent?

There are some *errata* in the report. Among them we note that the Scottish records for the occurrence of the common tern on the remarkably early dates of February 1, 4, and 24 are credited to the little tern! As last words, let us say that those who have not engaged in the preparation of similar reports have no idea of the vast amount of toil entailed. For this the members of the committee deserve our gratitude, in addition to our appreciation of the results of their labours. W. E. C.

SIR DAVID GILL, K.C.B., F.R.S.

DAVID GILL, whose death occurred in London on January 24, was born at Aberdeen on June 12, 1843. At the age of fourteen he was sent to the Dollar Academy, where Dr. Lindsay's teaching imparted to him a fondness for mathematics, physics, and chemistry. He then proceeded to Marischal College and University, Aberdeen, where his love of science increased and developed under the inspiring influence of Clerk Maxwell. He would have liked a scientific career, but his father, a prosperous Aberdeen merchant, wished his son to succeed him. Gill consented with reluctance to enter his father's business, and consoled himself by devoting all his spare time to physics and chemistry.

His special interest in astronomy began in the year 1863, when it occurred to him that Aberdeen was in need of an accurate time standard, like the time-gun which Piazzi Smyth had introduced in Edinburgh. David Thomson, Professor of Natural Philosophy in King's College, Aberdeen, gave Gill a letter of introduction to Piazzi Smyth, whom he visited at Edinburgh, and there made his first acquaintance with an astronomical observatory. On his return to Aberdeen, with Thomson's assistance, an old disused observatory of King's College was refitted. Every clear evening Gill and Thomson went to the observatory and worked with the transit instrument. The observatory possessed a good sidereal clock, and a mean-time clock was obtained, to which contact springs were affixed, so that other clocks, including the turret clock of the college, were controlled by electric currents sent each second from the standard.

When the time-service had become a matter of routine, Gill purchased a silver-on-glass speculum of 12 in. aperture and 10 ft. focus. He himself designed an equatorial mounting, and the heavy parts were made to his working drawings in the workshops of a firm of shipbuilders in Aberdeen. The driving circle, its tangent screw, and slow motion were made by Messrs. Cooke and Sons, but the driving clock with a conical pendulum was made by Gill's own hands. With this instrument he made observations of double stars, &c., and took photographs of the moon. A copy of one of these photographs was recently presented by him to the Royal Astronomical Society, and is of great excellence.

About this time Lord Lindsay (afterwards the Earl of Crawford) was considering the erection of an observatory at Dun Echt. He called upon Gill to examine the instruments and methods he had used in obtaining his lunar photographs. The acquaintanceship soon ripened, and he learned of Gill's wish to devote his time entirely to science. It thus happened that in 1872 the Earl of Crawford offered to Gill the post of director of the observatory which his son was about to erect. Gill had married in 1870, and the acceptance of Lord Crawford's offer involved a considerable pecuniary sacrifice; but neither he nor his wife had any hesitation in gratefully accepting a post which was in such entire accordance with his tastes and interests.

The years 1872–74 were accordingly busily employed in cooperation with Lord Lindsay in the design and erection of the new observatory. Two of the instruments, the transit circle and 15-in. equatorial, were twenty years later presented to the Government, and formed the nucleus of the new Royal Observatory at Edinburgh. A third instrument was the 4-in. heliometer, which was afterwards used to such good purpose at

[1] Report on the Immigration of Birds in the Spring of 1912; also on Migratory Movements in the Autumn of 1911. (London: Witherby, 1913.) Price 6s. net.

Ascension and the Cape. The details of these and other instruments were worked out, domes planned and built, and the telescopes mounted and brought into working order.

Lord Lindsay had arranged to observe the transit of Venus of 1874 in the island of Mauritius, and the task of determining the longitude of his station was assigned to Gill. Aden was connected with Greenwich by telegraph, but for the connection of Mauritius with Aden it was necessary to carry chronometers. No fewer than forty chronometers were taken and carried by Gill single-handed to their destination and back, a task of great anxiety and difficulty, especially at embarkation or landing at places like Suez, Alexandria, Aden, and Mauritius, where only coloured labour was available. A series of excellent determinations of longitude were obtained, and on the return journey the measurement of the base-line for the Egyptian Survey was made, the site selected being nearly in front of the Sphinx.

The expedition to Mauritius was memorable in another way. Though hampered by cloudy weather, Gill and Lindsay determined the solar parallax from a short series of heliometer observations of the minor planet Juno, and demonstrated the high value of this method. This was followed up by an expedition to the island of Ascension to utilise the opposition of Mars in 1877 for the same purpose. Gill having given up his connection with Dun Echt, Lord Lindsay granted him the loan of the 4-in. heliometer; the cordial support of the Royal Astronomical Society assured the necessary financial assistance, afterwards defrayed by the Government Grant Fund of the Royal Society. A delightful account of this expedition is given in "Six Months in Ascension, by Mrs. Gill—an unscientific account of a scientific expedition." An excellent determination of the solar parallax was obtained, and it was shown that for still higher accuracy it would be necessary to utilise the opposition of a minor planet owing to the observational uncertainty in setting on the limb of a planet with a perceptible disc.

On February 10, 1879, Gill was appointed H.M. Astronomer at the Cape. After a few months spent in visiting the principal observatories in Europe, he proceeded to the Cape, arriving there on May 26. The Cape Observatory had, under Gill's predecessors, Fallowes, Henderson, Maclear, and Stone, accomplished valuable work in the determination of the positions of the stars of the southern hemisphere. This important work, which falls naturally to large national observatories, was continued by him. He reduced and published the observations made by Maclear during the years 1849–52 and 1861–70, thus clearing off all arrears in the publication of the Cape observations. During his directorate he published catalogues of the fundamental stars observable at the Cape, of zodiacal stars the positions of which are required in heliometer and other observations of the moon and planets, and of 8560 stars to serve as reference points for the photographs in the section of the international photographic chart and catalogue undertaken by the Cape. He improved and carefully studied the details, such as pivot and circle errors, of the transit circle which had been erected in 1856. But he strongly held to the view that a reversible instrument was necessary for fundamental work of the highest accuracy, and when the purchase of such an instrument had been sanctioned by the Admiralty, threw his whole energy and mechanical and engineering skill into making the instrument the best of its kind. A brief account of its most striking features is given in NATURE for January 15, p. 556. It was only completed at the time of Gill's retirement from the Cape in 1906, but the results obtained by his successor, Mr. Hough, show that it has admirably fulfilled the object of high accuracy and freedom from systematic error.

Knowing what effective use he would be able to make of the 4-in. heliometer, Gill acquired it from Lord Crawford, and took it with him to the Cape. He employed it first in the determination of the parallaxes of nine southern stars which were remarkable for their great brilliancy or the size of their proper motions. In this task he was joined by Mr. Elkin, a young astronomer whose acquaintance he made at Strassburg in 1879. The valuable results obtained by the two observers were published in 1884. After the execution of the work, Gill pointed out to the Lords Commissioners of the Admiralty that a larger instrument was necessary for the further prosecution of research in stellar and solar parallax, and received their sanction for the purchase of a 7-in. heliometer. With the new instrument the parallaxes of twenty-two southern stars were determined with the highest accuracy. The work entailed extremely delicate and careful observations shortly after sunset and before sunrise extending over many months, and, in addition, laborious researches on the values and errors of screws and scale-divisions. This research, in which Gill's personal observations were supplemented by those of Finlay and de Sitter, has been recognised as the high-water mark of astronomical observation, and will probably never be surpassed by visual observations.

For the determination of the solar parallax Gill found that the minor planet Iris would be very favourably situated in 1887, and Victoria and Sappho in 1888. He determined to make observations himself, and secured promises of cooperation from other astronomers who possessed heliometers, and also of meridian observations to secure an accurate framework for the positions of the necessary reference stars. A very extensive programme was carried out, and the observations are discussed in two large volumes of the Cape Annals. The value of the solar parallax was found to be $8''{\cdot}804$, with a probable error of only $\pm 0''{\cdot}0046$. This result has been recently confirmed by the photographic observations of the planet Eros, and still more recently from the spectroscopic observations of the differences of the velocities of stars in the line of sight when the

earth's revolution carries it to or from them. As a corollary to these important researches, the mass of the moon was determined from the displacement of the observer's position, arising from the movement of the earth about the centre of gravity of the earth and moon.

In 1882 photographs of the great comet were taken, under Gill's auspices, with an ordinary camera strapped on an equatorial telescope. Notwithstanding its small optical power, a surprising number of stars were shown in excellent definition over a considerable field. This suggested the possibility of employing similar but more powerful means for mapping the stars. Gill immediately took steps to obtain a suitable lens, and in January, 1885, having obtained 300*l.* from the Government Grant Committee, commenced a photographic *durchmusterung* of the southern sky. Prof. J. C. Kapteyn, of Groningen, volunteered to measure the photographs, and from the cooperation of the two astronomers a comprehensive survey of the sky was made from 19° S. declination to the south pole, containing more than 450,000 stars.

The photographs of this comet were fruitful in another manner. Copies of them, with a short explanatory note, were forwarded to Admiral Mouchez, the Director of the Paris Observatory, and were communicated by him to the French Academy. Their excellence led Admiral Mouchez to encourage the brothers Henry, who were engaged in charting the zodiac, to devote their attention to the construction of astrographic lenses. In this they had signal success, and after further correspondence between Gill and Mouchez, a conference was called at Paris in 1877 for the execution of an international chart and catalogue of the whole sky by photographic means. In this important work Gill took a keen interest and exercised great influence. He attended all the meetings of the Comité permanent in Paris, where he delighted to discuss with his colleagues the details of a great project which has been constantly advanced by his enthusiasm and energy.

Soon after Gill's appointment as H.M. Astronomer of South Africa, he laid before Sir Bartle Frere, who was Governor of Cape Colony and High Commissioner for South Africa, a comprehensive scheme for a geodetic survey of the country. His recommendations included a gridiron system of principal triangulation extending over Cape Colony, the Orange Free State, Natal, and the Transvaal. There were considerable delays at the start, but little by little the great project was carried out always under the unifying direction of Gill. In 1896 he suggested that the progress made in geodetic survey in South Africa should be regarded as a first step in a chain of triangulation which, approximately traversing the thirtieth meridian of east longitude, should extend continuously to the mouth of the Nile. He never lost any opportunity of forwarding this important geodetic project, and had the satisfaction of seeing the great arc of meridian measured from latitude 31° 36′ in the extreme south of Africa so far north as Lake Tanganyika in lat. 9° 41′.

Gill remained at the Cape as H.M. Astronomer for twenty-eight years. In this period he remodelled the fundamental meridian work of the observatory, introduced photographic astronomy, and achieved results of the highest importance with the heliometer. The generous gift of the Victoria telescope by Mr. F. McClean (a 24-in. photographic telescope with objective prisms and spectroscope) enabled work in astrophysics to be added to the activities of the observatory. In addition to the staff of the observatory, a number of astronomers were attracted to the Cape and worked there guided by Gill's counsel and stimulated by his enthusiasm. In this connection the names of Elkin, de Sitter, Cookson, and Franklin-Adams are readily recalled. In 1905 the British Association visited South Africa, and Gill had the greatest pleasure in showing them the great observatory which owed so much to him. The success of this memorable visit was largely due to the great respect and admiration entertained for Gill by the visitors from Europe and their hosts in South Africa.

He left the Cape in October, 1906, and took up his residence in London. His time was very fully occupied in writing the history and description of the Cape Observatory (see NATURE, January 15, p. 556), and in the activities of a number of scientific societies into which he entered with zest. He served on the council of the Royal Society, 1908–9 and 1910–11; on that of the Royal Astronomical Society from 1907–13, being president from 1910–12, and succeeding Huggins as foreign secretary in 1912; and on the council of the Royal Geographical Society, 1908–10 and 1911–12. He was president of the British Association at the Leicester meeting in 1907. He was constantly consulted by astronomers, particularly in the design of instruments. Another subject in which he was greatly interested was the manufacture of optical glass for large telescopes. His interests embraced not only the practical branches of astronomy and geodesy in which his own work had been done; he followed the recent researches in solar and stellar spectroscopy, in gravitational astronomy, and especially those bearing on the extent and movements of the sidereal system.

The signal services which he rendered to science were recognised by his creation as Knight Commander of the Bath, as Knight of the Prussian Order *Pour le Mérite*, and as Commander of the Legion of Honour of France. Honorary degrees were conferred upon him by the Universities of Oxford, Cambridge, Edinburgh, Aberdeen, Dublin, and the Cape of Good Hope. He was corresponding member of the leading academies of Europe and America. He received the Valz medal of the Institut of France in 1882, the gold medal of the Royal Astronomical Society the same year; the Bruce medal of the Astronomical Society of the Pacific in 1900, and the Watson medal of the National Academy of the United States in the same year; a royal medal of the Royal Society

in 1903, and the gold medal of the Royal Astronomical Society a second time in 1908.

No biographical notice of Sir David Gill would be complete without some reference to his striking personality. His force of character enabled him to triumph over difficulties and carry out great projects. His enthusiasm and tenacity of purpose communicated themselves to his colleagues and assistants, and supported them and him in the arduous details inseparable from astronomical enterprise. But he never lost in these details a clear view of the ultimate purpose of his work. As an astronomical observer he was unsurpassed, the pleasure of making every measurement as accurately as he was able counterbalancing the tedium of making observations of similar character night after night. His engineering skill stood him in good stead, and the perfecting of his instruments was a constant source of delight to him. His administrative success was due in large measure to the confidence he inspired in his staff, and their regard for him both as an astronomer and as a friend.

His health had been excellent since his return to London, and his large circle of friends hoped that he would be with them for many years. He was suddenly seized with pneumonia in December, 1913, and passed away on January 24, after an illness of six weeks. We would tender to Lady Gill our respectful sympathy in her sudden bereavement. F. W. D.

Sir David Gill was laid to his rest on Wednesday, January 28, the funeral being at St. Machar Cathedral, Aberdeen. A memorial service was held at St. Mary Abbot's, Kensington, and was attended by a large number of personal friends as well as representatives of institutions of science and learning, among the latter being :—Prof. Forbes (Edinburgh University), Sir William Crookes and Sir Archibald Geikie (Royal Society), Sir Norman Lockyer (British Science Guild), Lady Lockyer (the Hill Observatory, Salcombe-Regis), Dr. F. W. Dyson, Astronomer Royal, Major E. H. Hills (Royal Astronomical Society), Colonel E. E. Markwick (British Astronomical Association), Prof. H. H. Turner (Oxford University, and, with Major MacMahon and Mr. O. J. R. Howarth, the British Association), Mr. H. F. Newall (Cambridge University), Major Leonard Darwin (Royal Geographical Society), Dr. R. T. Glazebrook (National Physical Laboratory and Optical Society), Dr. W. N. Shaw (Meteorological Office), Dr. P H. Cowell (Nautical Almanac Office), M. Jules Baillaud (representing the director of the Paris Observatory), Dr. A. E. H. Tutton (Mineralogical Society), Mr. W. H. Low (Cape Town Caledonian Society), Captain Lyons (the Science Museum), and Prof. Kapteyn (Groningen University).

DR. R. T. OMOND.

THE death of Dr. R. T. Omond at his house in Edinburgh on the morning of January 27 removes from us one whose name will be permanently associated with the famous Ben Nevis Observatory. Under his direct superintendence on that cloud-capped summit, hourly observations of the important meterological elements were taken night and day for about ten years following 1884; and although his health prevented him doing the observational work for the remaining ten years of the great experiment, his whole mind was given to the completion of the undertaking. He continued as honorary superintendent; and devoted his time and energies to the reduction and discussion of the wealth of observations which had accumulated.

Dr. Omond was associated with Dr. Alexander Buchan in the preparation of the earlier of the four quarto volumes (Trans. R.S.E., vols. 36, 42, 43, 44) in which the observations are tabulated; but of the later volumes he had necessarily sole charge, and from the very beginning, indeed, the main labour of tabulation and proof correction rested with him. In addition to the tabulated observations of pressure, temperature, humidity, wind, rain, snow, &c., these volumes contain discussions and papers on various meteorological questions. There is also reproduced in detail the daily log-book of the observers, a fascinating and suggestive scientific document, containing, *inter alia*, descriptions of halos, glories, and coronæ, on which Omond himself contributed two papers to the Royal Society of Edinburgh. His principal scientific papers are published in the Ben Nevis volumes already mentioned, and in the *Journal of the Scottish Meteorological Society*.

Dr. Omond was educated at the Edinburgh Collegiate and at the University of Edinburgh. He did not follow any of the ordinary courses qualifying for degrees, but devoted himself mainly to study of physics under Prof. Tait, and to geology under Sir Archibald Geikie. He was, indeed, Tait's right-hand man in the investigations on the compressibility of fluids which arose out of the testing of the *Challenger* thermometers. He became a Fellow of the Royal Society of Edinburgh in 1884, was awarded the Keith Prize in 1892 for his Ben Nevis work, and served one term (1901–4) on the Council. The University of Edinburgh conferred on him the honorary degree of Doctor of Laws at the summer graduation of 1913. Hampered though he was latterly by a serious malady, he put through an immense amount of work, and retained to the end the bright, cheerful, unselfish spirit which endeared him to his many friends.

C. G. KNOTT.

NOTES.

WE record with much regret the death, on February 1, in his eighty-fourth year, of Dr. Albert Günther, F.R.S., formerly keeper of the zoological department of the British Museum (Natural History).

THE Postmaster-General has appointed a Committee to inquire into systems of high-speed telegraphy and to report thereon. The Committee will consist of Captain Norton, M.P., Assistant Postmaster-General (chairman), Sir John Gavey, C.B., Mr. J. Lee, Mr. W. M. Mordey, Mr. A. M. Ogilvie, C.B., Mr. W. Slingo, and Mr. A. B. Walkley. Anyone desirous of giving evidence before the Committee should com-

municate with Mr. G. O. Wood, Secretary's Office, G.P.O., who has been appointed secretary to the Committee.

A REUTER message from New York states that the Aëro Club has sanctioned a round-the-world aëroplane race, starting from the San Francisco Exhibition in May, 1915, and ending at the same place within ninety days. The first prize will be 20,000*l*. The race will be open to any type of motor-driven aircraft and will be under the auspices of the exhibition and the Pacific Aëro Club. It is announced that 30,000*l*. has already been subscribed, and that it is expected that an additional sum will be secured, all of which will be divided among the competitors.

IT has been decided to prepare for publication a biography of the late Sir William H. White, K.C.B., the eminent naval constructor. Mr. J. B. Capper, to whom the work has been entrusted, will be grateful for any material in the shape either of correspondence or of reminiscence throwing light upon Sir William White's personality or work. Letters will be carefully preserved, copied, and returned. Communications of all kinds should be addressed to Mr. Capper, care of Sir Henry Trueman Wood, secretary of the Royal Society of Arts, John Street, Adelphi, London, W.C.

AN address delivered by Mr. T. A. Jaggar, jun., at a meeting of the Hawaiian Volcano Research Association in Honolulu last December, has been published as a special bulletin of the Hawaiian Volcano Observatory. The address gives a detailed account of the nature and value of the scientific work done at the observatory. We notice that eleven investigators of note have been at Kilauea in the last five years, and have produced four important memoirs, many smaller papers, and a topographic map. A large realistic model of Kilauea is in preparation for the Agassiz Museum of Harvard University; and chemical analyses have been completed in Washington. In 1909 the late Dr. Tempest Anderson was in Hawaii, and secured many photographs. He presented the observatory with one of his ingenious cameras and a battery of three fine lenses. It is hoped, said Mr. Jaggar, that British friends will honour Dr. Anderson's memory by the establishment on St. Vincent, in the Caribbee Islands, of a permanent observatory and laboratory, for the study of the Caribbean volcanoes. This was his field of specially distinguished work in 1902.

THE Journal of the College of Science of the Imperial University of Tokyo was launched in 1887, and the Committee of Publication has recently issued a general index to vols. i. to xxv. (1887–1908). In this index there are fully 300 distinct contributions from about a gross of contributors, of whom twelve are Europeans and Americans. This gives some indication of the scientific activity of the Japanese, for all the contributions are of the nature of research. Every science is represented—mathematics, physics, chemistry, geology, mineralogy, zoology, botany, embryology, seismology, &c. The great majority of the papers are written in English, about two dozen being in German, a few in French, and three or four of the lists of plants in Latin. Many of the memoirs are recognised by those competent to judge as of first-class importance in the development of scientific knowledge. When it is remembered that the papers are to a large extent the result of research work by the teachers, students, and graduates of the College of Science, and in many cases of work done within its walls, the world will recognise that Japan is rapidly repaying her debt to the West, from whom she received her first impulse towards scientific investigation.

ATTENTION was directed in the issue of NATURE for March 6, 1913 (vol. xci., p. 20), to the Napier tercentenary celebration, to be held in Edinburgh on Friday, July 24 next, and following days. The celebration is being held under the auspices of the Royal Society of Edinburgh, on whose invitation a general committee has been formed, representing the Royal Society of London, the Royal Astronomical Society, the Universities of St. Andrews, Glasgow, Aberdeen, and Edinburgh, the University College of Dundee, and many other bodies and institutions of educational importance. The Royal Society of Edinburgh now gives a general invitation to mathematicians and others interested in this coming celebration. The celebration will be opened with an inaugural address by Lord Moulton of Bank, followed by a reception given by the Lord Provost, magistrates, and council of the city of Edinburgh. The historical and present practice of computation and other developments closely connected with Napier's discoveries and inventions will be discussed on the following days. Relics of Napier will also be on view, and it is intended to bring together for exhibition books of tables and forms of calculating machines, which may reasonably be regarded as natural developments of the great advance made by Napier. Individuals, societies, &c., may become founder members on payment of a minimum subscription of 2*l*.; and each founder member will receive a copy of the memorial volume, which will contain addresses and papers read before the congress, and other material of historic and scientific value. Ordinary subscribers attending the celebration may obtain copies of the memorial volume at a reduced price. Subscriptions and donations should be sent to the honorary treasurer, Mr. Adam Tait, Royal Bank of Scotland, St. Andrew Square, Edinburgh.

MR. J. C. DRUMMOND has been appointed assistant to the chemical department of the Research Institute of the Cancer Hospital (Free), Fulham Road, London, S.W.

AT the annual meeting just held of the Zoological Society of New York, it was resolved to cable to the Zoological Society of London the following message: "That the Zoological Society of New York, having been largely instrumental in securing the passage of our national measures for the protection of the birds of the world, by preventing all importations for purposes of fashion or millinery, hereby extends its greetings to its fellow-members of the Zoological Society of London, and expresses the hope that the society, which represents the other great metropolis of the

world, will lend its unanimous support to the Hobhouse Bill, now before Parliament, which is designed to reinforce the protective measures passed by Congress. The effect of the American Bill has been instantaneous and widespread, and is now receiving unanimous support all over the United States. The very passage and enforcement of the Bill has created a sentiment for wild-life protection in many quarters where it did not exist before. The millinery trade has adapted itself to the new conditions, and the law is acknowledged to be most beneficial in its results."

WRITING on December 13, Prof. Ignazio Galli describes a series of sunset-glows which recall those of 1883–84. They were first observed in Rome on July 13, and continued without intermission, though with frequent variations in brightness, until the middle of December. Prof. Galli notices that on June 17, or about a month before their first appearance, there was a very violent explosion of the Asama-yama in central Japan, followed by others on June 20 and 26.

MR. E. O. WINSTEDT has done a piece of useful work by collecting in the Journal of the Gypsy Lore Society, new series, vol. vii., part i., all the references to gypsies in Tudor times recorded in the State Papers. They give, as he remarks, a picture of gypsy life when they travelled far and wide in large bands, some of the leaders of which bore names still well known. A band of 140 persons is recorded in Staffordshire in 1539; eighty in Berkshire, Oxfordshire, and Buckinghamshire in 1576, with a passport forged by a Cheshire schoolmaster. Active measures of repression were put in force by the authorities, an order of the Privy Council in 1542–3 directing certain persons "to avoyde the countrey off a certayne nombre off vagabondes going upp and downe in the name of Egiptians."

THE report of the bacteriologist, Prof. Ward Giltner, of the Michigan State Board of Agriculture for the year July 1, 1912–July 1, 1913, has been received. Soil problems bulk large in the record, and an extensive trial of a serum for hog-cholera is being made, more than 500,000 c.c. of the serum having been issued.

AMONG a collection of Antarctic seals and birds from South Georgia presented to the Scottish Zoological Park by Messrs. Salvesen and Co., Leith, the most interesting specimens are a couple of young elephant-seals, about 6 ft. in length, and a Weddell's seal. The latter is believed to be the first living example of its kind hitherto brought to Europe.

WITH reference to a paragraph in NATURE of December 16, 1913 (p. 457), Dr. W. D. Matthew writes to say that the so-called lions of the Rancho-la-Brea asphalt deposit are the extinct *Felis atrox bebbi*, and not pumas. The use of the term "lion" in this sense is to be deprecated, as it is commonly applied in America to the puma, while *F. atrox* appears to be as nearly related to the tiger as to the lion.

IN vol. xxxv (p. 252) of Notes from the Leyden Museum, Dr. J. H. Vernhout states that specimens of the limpet-like mollusc, *Siphonaria sipho*, have been taken on the coast of Ceram attached to rocks of mica-schist by the apices of their shells, so as to resemble small cups. Such a mode of attachment, so far as the author could ascertain, appears to be unique in the case of limpet-like shells.

THE extinct mammal-like reptiles of South Africa and their relatives in other parts of the world, together with the strata in which their remains are embedded, form the subject of a well-illustrated article by Dr. R. Broom in *The American Museum Journal* for December, 1913. A feature on which the author lays special stress is the powerful development of the limbs in nearly all the members of the group. "How these have been evolved is a matter of doubt, but there can be little question that it was this strengthening and lengthening of the limbs that started the evolution which ultimately resulted in the formation of the warm-blooded mammals."

TO the first part of the "Bergens Museums Aaarbok" for 1913 Mr. J. A. Grieg contributes an exhaustive article of 147 pages, illustrated with two plates, on the aquatic fauna of the Hardangerfjord, including both vertebrates and invertebrates. The second of the two plates is devoted to a life-size figure of the shell of a very large and much elongated form of the whelk (*Buccinum undatum*). In the second part is a systematic catalogue, by Mr. H. T. L. Schaanning, of the birds of Norway, with references to literature ranging from the year 1599 to 1912. The number of species recognised, inclusive of the great auk, is three hundred.

IN 1906 the late Dr. F. Ameghino described certain sharks' teeth from the Tertiaries of Patagonia as the representatives of a new generic type, Carcharoides, the name being given in allusion to the fact that these teeth have the sharply acuminate crowns characteristic of Lamna, associated with the serrated margins of those of Carcharodon. Teeth of a precisely similar nature from the Tertiaries of Victoria are described in *The Victorian Naturalist* for December, 1913 (vol. xxx., pp 142–3), by Mr. F. Chapman. The discovery is of interest as affording additional evidence of the close affinity between the Tertiary littoral faunas of Patagonia, New Zealand, and Australia, and thus lending support to the view that they inhabited different portions of a single sea-bed.

DR. ASAJIRO OKA, in the Journal of the College of Science, Tokyo (vol. xxxii.), describes a remarkable new Japanese compound Ascidian, to which he gives the name, *Cyathocormus mirabilis*. The form in question appears to be closely related to Colella, consisting of a "head" attached by a short stalk, but the head is hollow, with a wide terminal opening, so that the entire colony has the form of a goblet, in the wall of which a single layer of zooids are arranged in double longitudinal rows. The author proposes for the reception of his genus a new family, Cyathocormidæ, which he suggests may form a connecting link between the more ordinary Ascidiaceæ and the aberrant, free-swimming Pyrosoma. He therefore considers it doubtful whether we are justified in separating Pyrosoma from other compound Ascidians, and

placing it along with Salpa and Doliolum in the Thaliacea, as has recently been done by Neumann and by Parker and Haswell.

IT would be difficult to find a better example of the valuable work that can be accomplished by a local scientific society than is offered in the Transactions of the Norfolk and Norwich Naturalists' Society for 1912–13. The presidential address, by Mr. Robert Gurney, is concerned with "The Origin and Conditions of Existence of the Fauna of Fresh Water." He is of opinion that the fauna of the relict lakes of the world show that the isolation of marine fauna does not lead to any great accession to the fresh-water fauna. "It seems that the successful adaptation of a species to fresh water depends essentially on a physiological variation of the organism, without which the most favourable external conditions are powerless to assist immigration." Next comes a very careful, complete, and well-illustrated monograph, by Prof. Oliver and Dr. Salisbury, on the topography and vegetation of Blakeney Point, that hunting ground of naturalists, which has now been brought under the National Trust as a nature reserve. It is followed by Mr. A. Preston's notes on the great flood of August, 1912, which was of such disaster to Norwich. Then comes a very valuable instalment of Mr. C. Morley's "Fauna and Flora of Norfolk." Other shorter papers, well worth study, include those on the growing of wild rice in East Norfolk, on the migrations of birds from Lowestoft and district, and on the record results of the Yarmouth herring fishery of 1912. Altogether, these Transactions do honour to a great society of natural history, in a county favoured by nature and famous in science. Dr. Sydney Long, the hon. secretary of the society, is to be congratulated on the care with which he has edited this collection of monographs.

"THE Geology and Mineralogy of Tin" are the subjects of a bibliography of 1701 entries, accompanied by an index of 167 pages, prepared for the Smithsonian Institution by F. L. and Eva Hess (Miscell. Collections, vol. lviii., No. 2). Since a brief account of the contents of almost all the papers is supplied, this publication will form a standard work of reference. It does not profess to be complete as regards works on the extraction and treatment of the ores, and hence we miss a reference to the ingenious test for cassiterite with hydrochloric acid and zinc, put forward, we believe, in West Australia in 1908.

DR. JOHN BALL, in Paper No. 29 of the Survey Department of Egypt (1913) describes the topography and geology of the phosphate deposits of Safâga. The district lies about 400 kilometres south-south-east of Suez, near the Red Sea. The phosphate deposits occur on either side of the Wadi Safâga at distances of from twelve to twenty-two kilometres inland. The phosphatic series consists of laminated grey clays with beds of calcareous phosphate and chert, lying between Upper Cretaceous limestones above and Nubian Sandstone below. There are three principal phosphate beds, all in the upper part of the series. These beds range from $1\frac{1}{2}$ to 2 metres in thickness, and carry from 20 to 75 per cent. of tricalcic phosphate. The bulk of the phosphatic matter is in the form of loosely agglomerated phosphatic grit, which may have been derived from the breaking up of shells, the calcium carbonate of which has been partially converted to calcium phosphate by the action of soluble phosphate from the decomposition of the soft portions of sharks the teeth of which occur very abundantly. The phosphate content may have been raised subsequently by the leaching out of some of the calcium carbonate. The origin of the chert has not yet been ascertained. The deposits are being worked at the Um el Huetat mines by the Egyptian Phosphate Company.

THE seventeenth *Rapport sur les variations périodiques des Glaciers* (*Zeitschrift für Gletscherkunde*, Band vii., Heft 1, p. 1) was published in September, 1912, with some unavoidable omissions. The supplement now added, Band vii. (1913), pp. 191–202, gives the information which had not then been received. It includes the glaciers on the north side of the Mont Blanc massif, those of the Maurienne, the Tarentaise, and Dauphiné, the Caucasus, the Altai, and North America, chiefly Alaska. In the first region two, Des Bossons and Du Tour, show a marked advance, another one is stationary, and the fourth observed is slightly retreating. Those in the other regions are either stationary or showing slight oscillations, or are still retreating, though not rapidly. The eighteenth *Rapport*, recently published (Band viii., p. 42), shows that, though the cold summer of 1912 has produced some effect, this is local, and comparatively small. Thus the information, as a whole, does not affect the conclusion to which that already received distinctly pointed, namely that the period of retreat, which has now lasted (at any rate in the Alps) for half a century, has not yielded generally, as might have been anticipated, to one of advance. The eighteenth *Rapport* includes the Pyrenees, where the glaciers mostly show signs of advancing, Norway, where the majority are receding, and North America, of which this is also true. Here the retreat is in some cases considerable, notably in that of the Grand Pacific Glacier, which has gone back 25 kilometres in thirty-three years. Besides these, the number contains some notes on Greenland glaciers, which, though necessarily incomplete, are interesting. They also show that the ice has receded in recent years.

WE have received a copy of the U.S. Daily Weather Map for January 1, with the announcement that from that date the U.S. Weather Bureau began the publication at Washington of a weather map of the northern hemisphere, which will be printed on the reverse side of the usual morning weather chart. Although the number of reports is limited at present, and the observations are not all strictly simultaneous, the essential features of atmospheric circulation over that hemisphere are fairly well shown. Prof. Marvin points out that in the latter publication the rational units of the c.g.s. system are adopted; pressures are expressed in millibars (1000 millibars = 29·53 in.), and temperatures in absolute units (the temperature on the Centigrade scale

increased by 273), on the ground that mathematical and dynamic studies of the motions of the atmosphere are possible only when such rational units are employed. It will be remembered that these units are already used in some of our Meteorological Office publications, and that it is proposed to adopt them in others. Also that the Weekly Weather Report now contains small-scale daily charts, including practically the whole of the northern hemisphere, excepting Alaska and the North Pacific Ocean. The action taken by the Washington Bureau will be welcomed as matter of prime importance.

NEW paths of physical knowledge form the subject of an address to the University of Berlin delivered by Prof. Max Planck on his appointment as principal. The address deals with the conservation of matter, space, and time, and the quantum hypothesis; it is printed by the Norddeutscher Buchdruckerei, S.W., Wilhelmstrasse, Berlin.

AN article by Mr. Charles Bright in the January number of *The Quarterly Review* discusses the question of inter-Imperial telegraphy, and the advantages and disadvantages of cable telegraphy as opposed to wireless telegraphy. Whilst in favour of the State taking over control of the Imperial wireless telegraph scheme (Mr. Bright advocated this many years ago), it is pointed out that an inter-Imperial telegraph system would be the most advantageous. The route suggested is from Blacksod Bay, on the west coast of Ireland, to Halifax (N.S.), with an intermediate station at Cape Bauld (Newfoundland), and a branch cable up the Gulf of St. Lawrence towards Montreal. The cost of this line is estimated to be 500,000*l.*, and should be borne by the Empire as a whole. Having laid the Imperial Atlantic cable, it is suggested that the gaps should be filled up in order to complete an all-British cable chain between the Mother Country and her outlying possessions. Attention is directed to the fact that all the existing Atlantic cables are in foreign hands, and it is recommended that steps should be taken to remedy this state of affairs, which, it is argued, would be extremely prejudicial to the British nation in the event of international disputes. It is maintained that a cable has an advantage over wireless telegraphy in its greater secrecy and effective working speed owing to the far less repetition involved, and also owing to its freedom from interruption from "atmospherics," which are still a source of trouble in all wireless work.

IN two papers published in *The Biochemical Bulletin*, vol. iii., No. 9, by Dr. Clayton S. Smith and Messrs. W. A. Perlzweig and William J. Gies respectively, the question of the inhibition of change in fish by cold storage is dealt with. It is shown that bacterial and chemical action can be entirely prevented by efficient cold storage, and that even after two years of such storage practically no change can be detected by chemical means in the nutritive value of the fish or in its taste or palatability.

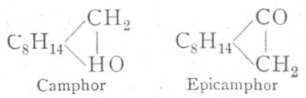
THE January number of *The Popular Science Monthly* contains an article by Prof. Cyril G. Hopkins on the Illinois system of permanent fertility. In this system no potash is added to the soil in the form of purchased fertiliser, but provision is made for the liberation of the necessary quantity from the soil by the action of decaying organic matter ploughed under in the form of farm manure or crop residues, including clover or other legumes. Ground natural limestone is added when needed. Phosphorus is supplied in the form of ground rock phosphate, at least 1000 lb. per acre being added every four years. Special rotations are arranged to suit the case, either of the live-stock farmer or the grain producer, so as to maintain the nitrogen fertility at a maximum. Articles on the present status of cancer research, by Dr. Leo Loeb, and the mechanism of heredity, by Prof. T. H. Morgan, discuss problems which are of general interest.

A PAPER on amalgams containing silver and tin, by Messrs. Knight and Joyner, which appears in the Chemical Society's Journal (December, 1913), is of special interest in view of the widespread use of these amalgams in dentistry. Although solid solutions may be present in large proportions at higher temperatures, these disappear almost entirely below 70°, and the process of amalgamation at room-temperature is substantially that represented by the equation :—

$$Ag_3SN + Hg \longrightarrow Ag_3Hg_4 + Sn.$$

The curious "ageing," by annealing at 100°, which reduces to less than one-half the amount of mercury taken up by the freshly prepared filings of the silver-tin alloy has been further studied. It has been shown that it is not due to oxidation, and that it is accompanied by a change of density, but the real nature of the process is still obscure.

THE Chemical Society's Journal for December, 1913, contains an important monograph by Profs. Bredt and Perkin on epicamphor. This substance, which is related very closely to camphor,



Camphor Epicamphor

differs from it mainly in that the carbonyl group is contiguous to hydrogen on both sides,

$$-\underset{|}{CH}-CO-CH_2-,$$

instead of $-\underset{|}{C(CH_3)}-CO-CH_2-$, and might be expected to produce greater activity in the molecule. Nevertheless it refuses to combine with hydrogen cyanide and brominates in much the same way as camphor itself. The physiological effects of epicamphor are vastly inferior to those of camphor; a favourable effect on the beat of the heart does not become apparent until the dose is four times stronger than in the case of camphor, and even then the effects produced are very transient

MR. A. P. THURSTON gives an account in *Engineering* for January 30 of some experiments carried out by him at the East London College on the resistance of bars, struts, and wires in a current of air. Part of this research was the investigation of the shielding effect of one bar mounted in the direct path of

another bar of identical length, shape, and size. The total resistance when the two bars are in contact is about three-quarters the resistance of one bar alone. As the gap is increased, there is at first a small decrease in the resistance. With a gap equal to the thickness of one bar, the total resistance is the same as when the bars are in contact, and becomes equal to the resistance of one bar alone when the gap is twice the thickness of one bar. With a gap of sixteen times the thickness, the total resistance is only 5 per cent. less than double the resistance of the single bar. It would appear from these experiments that the total resistance of struts, following in the same run of air and more than thirty times the thickness apart, may be assumed to be the same as the total resistance of the separate struts in a clear run of air.

THE Vesterling Organisation Company, Clapham Junction, London, S.W., manufactures a convenient loose-leaf book, which has certain novel characteristics. By the use of a patent device in the back of the book it opens flat at any place. Specially made rings render the filing of new papers, or removal of old, simple and quick. The book will prove of real assistance to lecturers who use copious notes, and to all who have to preserve loose papers in a way which makes ready reference easy.

A 1914 supplement to their "General Apparatus Catalogue, 1910," has been issued by Messrs. Heynes Mathew, Ltd., of Cape Town. The new list of apparatus affords an instructive illustration of recent progress in South African education. The improved methods of teaching geography which have become established in this country, for example, are being taken up in South African schools, and a demand for material for lessons in practical geography is met by a section in the new catalogue being devoted to this subject. Similarly this firm is prepared to supply equipment for practical work in botany and other branches of science.

OUR ASTRONOMICAL COLUMN.

PLANETARY OBSERVATIONS AT THE LOWELL OBSERVATORY.—In *Astronomische Nachrichten*, No. 4710, a telegram is published from Prof. Lowell relating to observations on the satellites of Saturn and on Martian features. With regard to the former it is stated, "Tethys and Dione variable, range quarter magnitudes, periods coincident with revolution." Relating to the latter, the telegram says:—"The full aperture of the 40-in. reflector of the Lowell Observatory only now equipped for visible work shows the canals of Mars as fine direct geometrical lines, thus corroborating the work of smaller apertures. This should dispose of the erroneous idea that [such] apertures do not disclose these remarkable features."

WAVE-LENGTHS OF CHROMOSPHERIC LINES.—It was known soon after the event of the total solar eclipse of August 30, 1905, that Prof. S. A. Mitchell, who was in charge of the numerous spectroscopic instruments which were employed in the United States Naval Observatory eclipse expedition, had secured some most excellent photographs of the spectrum of the chromosphere. It is not until now, however, that the results of their reduction are published, and these are printed in the current number of *The Astrophysical Journal* (December 1913). The photographs discussed were secured with gratings, both parabolic and plane, and the present paper deals with the reduction of one photograph from each instrument for the purpose of giving chromospheric wave-lengths, intensities, &c., "with as great an accuracy as possible." This communication is finely illustrated with plates showing different portions of the photographs, and they are demonstrative of the very fine adjustment of the instrument during use. A very long table shows the wave-lengths compared with Rowland, and the heights of the chromospheric lines, the corresponding elements and intensities according to Rowland, chromosphere, arc, and spark. No fewer than 2841 lines are tabulated in the chromospheric spectrum, and this above many faint lines which were measured; no lines were included unless they were measured in two or more separate measurements. The paper is full of many interesting summaries of these chromospheric lines arranged according to elements, atomic weights, &c. The conclusions arrived at are important, but it is impossible to repeat them all here. Some of them are as follows:—The "flash" spectrum is a reversal of the Fraunhofer spectrum. The "flash" is not an instantaneous appearance, but the chromospheric lines appear gradually, the highest layers first, the lowest last. The "reversing layer," which contains the majority of the low-level lines of the chromosphere, is about 600 km. in height. Wave-lengths in chromospheric and solar spectra are practically identical, the chromospheric spectrum differing greatly from the solar spectrum in the intensities of the lines. The differences of intensity find a ready explanation in the heights to which the vapours ascend. The enhanced lines are especially prominent in the chromosphere, and these are said to become brighter mainly because at the heights to which they ascend the vapours are mixed with hydrogen at reduced pressure.

THE ANNUAL OF THE BUREAU DES LONGITUDES.—The annual published by the Bureau des Longitudes is familiar to all readers of this column, and the present issue for 1914 will no doubt be found as useful for reference as its predecessors. In addition to the usual astronomical, physical, and chemical data embodied in these small pages, will be found articles of astronomical interest. Thus M. Deslandres gives a *résumé* of solar physics, M. P. Hatt contributes a short article on the deformation of images in telescopes, while M. G. Bigourdan writes very fully on the day and its subdivisions, the hour-zones and the international association of the hour. The seventeenth meeting of the International Geodetic Association is described by M. B. Baillaud.

WHAT IS PSYCHO-ANALYSIS?

PERHAPS the most important and startling scientific theory of modern times is that which Prof. Sigmund Freud, of Vienna, has formed to explain the workings of the human mind. Many thinkers, indeed, hail Freud as the Darwin of the mind, and consider that his views are destined to transform the science of psychology. He certainly has succeeded in explaining such obscure and widely differing phenomena as dreams, wit, the seemingly accidental mistakes in speaking and writing which people so often make, the obsessions and other symptoms found in a large class of mental diseases, and the spontaneous likes and dislikes which we all experience and find so puzzling, in terms of one single hypothesis. Put quite briefly, this is the hypothesis of "the unconscious mind," something quite distinct

from that theory of the "sub-conscious," with which we have been so long familiar in psychology.

The unconscious mind is a legacy from our earliest years of childhood, and its mode of working differs very considerably from that of our mind in later life. A little child is dominated by its wishes and desires, and strives blindly and persistently to satisfy them. Many of these wishes are bound up with the intense love which it feels for its parents or its nurse. Later on, under the influence of education and training, it learns to suppress some of these wishes because they are in conflict with other interests and desires of which it is now capable, and which are more in harmony with ethical and conventional standards. It learns to face pain instead of turning away from it, and to abandon its wishes for the sake of higher aims, instead of clinging blindly to them. But the childish wishes have not been destroyed. They continue to exist in the mind, although their owner is no longer aware of them. They form the nucleus of the "unconscious." In later life similar conflicts may occur, and unacceptable wishes may be suppressed. If these happen to be analogous to the earlier ones, they join them, and so are themselves drawn into the unconscious, and continue to exist in the mind with undiminished intensity, although unable under ordinary conditions to come to consciousness. On the other hand, if they do not become associated with corresponding infantile wishes in the unconscious, they remain ordinary memories, and gradually fade away and lose their intensity as such memories do. They do not become unconscious, but merely sub-conscious, or, as Freud puts it, "preconscious."

This distinction between the "unconscious" and the "preconscious" is fundamental in Freud's theory. It is a distinction between two classes of memories. Those memories which, as described above, join the unconscious are said to be "repressed." They cannot return to consciousness unless the repressing force of the mind, which Freud calls the "censor," is overcome. They continue, however, to exist with undiminished vigour like the infantile wishes, and with these latter are the cause of the mystifying experiences of life to which we have already referred. They often cause the slips of the pen and slips of speech which befall us when our attention is distracted. In these cases the censor has been caught napping, as it were, and the unacceptable wish comes for a moment to the surface of the mind. Thus a lady, writing to a girl friend who had recently married a man to whom she herself was attached, ends the letter with the words, "I hope that you are well and unhappy." The malevolent wish here comes to unintentional expression. The symptoms of so-called functional mental diseases, such as hysteria, are invariably caused by repressed tendencies from the unconscious. A young girl suffering from hysteria shows the symptom of a tightly-clenched right hand which she is unable to open. By the method of psycho-analysis, which we have still to describe, the physician discovers that the cause of this is a serious adventure which had happened to the girl in early youth, and which she had persistently refused to tell to her relatives. The determination not to tell, which is now quite unconscious, for the girl no longer remembers anything about the past event or the circumstances connected with it, receives a *symbolic* fulfilment in the clenched hand. As soon as the physician brings back the memory, the hand unclenches and the girl is cured.

It has been suggested, with great show of reason, that Hamlet was a hysteric, and that the so-called mystery of Hamlet is due to the effect of unconscious feelings of love towards his own mother dating from his earliest childhood (of which he is now completely unaware, and his creators—Shakespeare and his authorities—likewise). Hamlet cannot take vengeance on his uncle because he himself in earlier years had wished his father's death, and this persisting wish in his unconscious mind now paralyses his actions. Only in this way, it is thought, can—*e.g.* Hamlet's soliloquy in Act iv., Sc. iv., after he has at last received overwhelming proof of his uncle's crime, be adequately explained:—

> "Now whether it be
> Bestial oblivion or some craven scruple
> Of thinking too precisely on the event,—
> A thought which, quarter'd, hath but one part wisdom
> And ever three parts coward,—I do not know
> Why yet I live to say 'this thing's to do,'
> *Sith I have cause, and will, and strength, and means,*
> *To do't.*"

This inability to act, expressed in the lines italicised, seems to have an adequate psychological explanation in the working of the repressed tendency just referred to, and its concomitant ideas, which Freud calls the "Oedipus complex." In the play of Sophocles, Oedipus unwittingly kills his father, Laius, and marries his mother, Jocasta, and this is a mythical representation of an inner mental tragedy overhanging each one of us, to which the hysteric, through mental weakness, succumbs.

The pleasure and amusement derived from some forms of wit may be explained as due to repressed and forbidden wishes which attain fulfilment in spite of the censor by means of the technique of the joke. Other forms of wit, though not so obviously related to repressed wishes, can likewise be explained in terms of Freud's general theory.

Finally, dreams are, in Freud's view, invariably the disguised fulfilment of repressed wishes. Harmless memories from the previous day, and from earlier periods of life, are manipulated by the dream-activity in such a way that they form a disguise for a repressed wish emanating from the unconscious, enabling the latter to evade the censor and thus come to consciousness during sleep. It would appear that sleep renders the censor less alert than he is during waking life, although if we passed beyond this metaphorical way of putting it we should come to a more profound theory much too difficult to describe, even in outline, here. The dream as it appears to the dreamer is simply a patchwork of memories of apparent unintelligibility, but underlying them are rational dream-thoughts corresponding to the fulfilment of repressed wishes. Often the dream represents the dream-thoughts symbolically, since this is a convenient way of evading the censor.

The method of interpreting any dream is identical with the method of interpreting a hysterical symptom or any other manifestation of unconscious ideas. Indeed, it is the one method whereby Freud has convinced himself of the existence of these unconscious ideas. This method is *psycho-analysis*. The dreamer or patient is asked to put himself into a relaxed and meditative frame of mind, and, starting from different parts of the dream, or different facts in the history of his mental disease, to observe and report faithfully the various ideas that arise spontaneously in his mind in connection with them, suppressing none of them, however objectionable or painful they may be. Experience shows that this method enables ideas in the unconscious to overcome the resistance of the censor and rise to consciousness.[1] In the case of mental disease the bringing back of these repressed memories to consciousness involves the cure of the patient, since they can now be rationally faced and dealt with, and the mental energy that has been locked up in them, "fixated," can be liberated and put at the disposal of the higher conscious self.

Psycho-analysis is a lengthy process, demanding much tact and ingenuity from the psychologist or physician, but its results are of such surpassing interest and value that it should be regarded as one of the most important methods of mental science.

WILLIAM BROWN.

THE SURVEY OF INDIA.[1]

THIS general report for 1911–12, which has lately appeared, states concisely the progress made in the various departments of the Survey of India, the detailed descriptions and discussions of results being present in vol. iii. of the Records of the Survey. In the year under review, Colonel S. G. Burrard, F.R.S., was confirmed as Surveyor-General in succession to Colonel F. B. Longe. Topographical surveys were pushed on in various parts of the country, and work was done to meet some special requirements, of which may be mentioned the large-scale map of the Delhi site, with contours at 5 ft. vertical interval for the use of the town-planning committee. On the Geodetic Survey the astronomical latitudes of eleven stations were determined, and at one of these, Bihar, the largest southerly deflection of the plumb-line as yet found in India was found. Pendulum observations were made over the same region. In the principal triangulation the Sambalpur meridional series was commenced, and carried from lat. 23° to lat. 22°. In Kashmir secondary triangulation was carried along the Hunza and Kanjut valleys to form a connection with the Russian triangulation in the Taghdumbash Pamir.

The field detachments of the Magnetic Survey were employed on the detailed examination of the Deccan trap area in Central India and Hyderabad State, where considerable abnormalities exist. Comparative observations were made at the survey base stations, and a large number of repeat stations were visited for observation. In the Map Publication Office orographic colouring, by means of a series of colour tints from light green through yellows, browns, purples, and red, has been adopted for the one-millionth scale in place of shading as facilitating the provision of information. These sheets differ in size and in the unit (foot) of the vertical measurements from those of the international map, but as they form the key to the whole system of nomenclature and the arrangement of the topographical sheets, they cannot be dispensed with.

A series of "departmental papers" is to be commenced. These will be numbered serially, and will include all papers which, being published for departmental use, do not fall within the scope of the "Professional Papers," and are not of public interest.

Those, however, who are interested in the technical details of surveying will turn rather to the third volume of the Records of the Survey of India, where full accounts of this work will be found. Topographical surveys included triangulation, levelling, traversing, and detailed measurement on various scales from 1 in. to one mile, to 20 in. to one mile in cantonment survey. Many points of interest and modifications in procedure are noticed, among which we may mention the experimental use of Bristol boards instead of drawing paper on the plane-tables used in the field. If these are fastened firmly to the board by one edge only, and loosely by cloth slips on the other sides, the trouble arising from distortion of the sheet when working in very dry climate is greatly reduced. Further experience with these boards is awaited.

In geodetic work the use of a new and more powerful zenith-telescope is reported, and determinations of latitude were made with it at eleven stations. Of these all stations but one, Khajnaur, on the north side of the Siwalik Hills, the attraction of the plumb-line is southerly, the largest value being at Biharas, mentioned above. In the pendulum work, observations were made to the north of the Ganges in a region which showed unusually low density, and it is suggested that Rarachi, situated on the edge of the high plateau which forms the southern edge of the Ganges valley, may be near the crest of a ridge of high density. An important piece of work in this connection was an investigation of the isostatic theory of Mr. Hayford, with respect to a number of Indian stations, and the results obtained for the above-mentioned stations are given. In the account of precise levelling it is mentioned that experiments are being carried out with a new pattern of aluminium staff.

A full account of the magnetic survey and work in the observatories is given, but this calls for no special remark. In an appendix is given a synopsis of geodetic work near Dehra Dun, which is illustrated by a map showing the triangulation and gravity observation stations, as well as the lines of precise levelling. The whole volume forms a valuable contribution to the literature of high-grade surveying.

H. G. L.

[1] General Report on the Operations of the Survey of India during the Survey Year, 1911–12. Prepared under the Direction of Colonel S. G. Burrard, F.R.S., Surveyor-General of India. (Calcutta: pp. vii + 36 + 12 maps, 1913.) Price Two Rupees or Three Shillings.

"Records of the Survey of India." Vol. iii., 1911–12. Prepared under the direction of Col. S. G. Burrard. Pp. 176+12 maps. (Calcutta.) Price 4 Re. or 6s.

THE ASSOCIATION OF TECHNICAL INSTITUTIONS.

THE twenty-first annual meeting of the above association was held at the Clothworkers' Hall, Mincing Lane, on January 30 and 31 last, and was attended by upwards of 120 delegates representing all the important technical institutions in the United Kingdom, of whom about ninety-seven are enrolled in the association.

The new president, Sir Alfred Keogh, K.C.B., on taking the chair, delivered his inaugural address, in which he dealt with the report of the Royal Commission on the reconstitution of the University of London, and especially with that part of it concerned with technological studies. He expressed great satisfaction with the position accorded to the faculty of technology in the proposals of the Commission, particularly with respect to the methods of administration and with the prominence assigned to the sphere of utility in educational questions.

The Commission recommended the establishment of a self-governing faculty of technology in the University, such faculty to embrace all branches of applied science. He dwelt upon the extreme importance of bringing the specialisation of science well within the sphere of the University, and expressed gratification that entrance to the University would be made more accessible to the fit student with greater freedom for the teacher.

Various questions of considerable importance to the well-being of technical institutions were considered. Amongst them, the registration of teachers and the proposals of the newly established Teachers' Registration Council. Great satisfaction was expressed with the happy solution of this extremely difficult question by means of which the profession of teacher had been unified, and it was unanimously agreed that it was desirable that all eligible members of the teaching staffs of technical institutions should seek enrolment.

The new regulations of the Board of Education dealing with junior technical schools were the subject of considerable discussion, and the view was generally expressed that all forms of specialised teaching should come within the scope of the new regulations, and that all limiting conditions as to the pupil's future outlook should be entirely removed from the regulations.

Special consideration was given to that section of the report of the Royal Commission which dealt with the examination of the external student desirous of proceeding to the degrees of the University of London. It was agreed that access to the examinations of the University should continue to be, as in the past, effectively provided for with such improvements in method as experience would suggest, but that no steps should be taken which should in any way diminish in standing or importance the quality of the degree awarded to the external student, or which should impair the position of the external as compared with the internal student. It was further strongly urged that there should not be, as proposed, any exclusion of unattached students from the examinations in technology, including engineering, in view of its disastrous effect upon higher technological education, and that it was of the utmost importance that the relations hitherto subsisting between the London polytechnics and the University of London should be maintained, and the recognition of eligible teachers in these institutions be continued.

The question of the new and important regulations for the establishment of technical bursaries by the "1851" Exhibition Commissioners with a view to the assistance of eligible graduates of the universities desirous of proceeding immediately to industrial employment was fully considered, and it was agreed that the Commissioners should be asked to consider the desirability of including within the list of accepted universities other qualified technical institutions.

The very important question of compulsory continued education in respect of children who had left the elementary schools to enter into employment with a view to their further education, both vocational and general, was carefully considered.

It was urged that having regard to the vast expenditure of public money, amounting now to upwards of twenty-four millions sterling per annum, and with a view to conserve the results of this expenditure, not only should "half-time" be abolished, but all regulations by means of which a child may be relieved of attendance at school before he reaches the age of fourteen, and that there should be enacted a law under which children leaving the elementary school at fourteen should be required to attend within the usual hours of labour a continuation school, which shall include in its curriculum not only vocational subjects, but such subjects of a general character as shall conduce to his effective preparation for the duties of life, and that the responsibility for the due observance of the law be laid upon the employers. It was shown that only a mere fraction of the children leaving school for employment continued their education, the figures being, for those between fourteen and seventeen years of age, only 300,000 out of a total of 2,335,000, or 13 per cent., with the result that there was a most serious economic and moral loss to the nation.

It was further shown that the German Government, realising this great loss to the German nation, had for some years established compulsory day continuation schools for children in employment throughout the empire, with most satisfactory results. There was a general consensus of approval. In the city of Berlin in 1910–11 there were 68,000 students of both sexes enrolled in continuation schools, of whom 32,000 were students in compulsory schools. J. H. R.

ANCIENT PIGMENTS.

IN *Archaeologia*, vol. lxiv., pp. 315–35, Prof. A. P. Laurie, of the Royal Academy of Arts, presents us with the chief results of an important research on the historical and local succession of the use of "ancient pigments." His material has been drawn almost entirely from western Europe, Chinese, Persian, and Indian painting not being discussed. His conclusions, derived mainly from the optical and microchemical examination, necessarily much restricted, of valuable illuminated MSS., amplify rather than correct those of previous investigators, such as Sir Humphry Davy, Marcelin Berthelot, and other chemists of the nineteenth century, but synthetic experiments have in some cases been utilised. The story more nearly approaches completeness in some sections than in others. The lakes, for example—pink, lilac, red, crimson, and purple—have not as yet, in all cases, revealed their origin. Perhaps the series and sequence of blue pigments may be cited as a characteristic example of Dr. Laurie's fuller treatment of his subject. Of the six blues included in the early list—indigo, Egyptian-blue, the mineral azurite or chessylite, real ultramarine from lapis lazuli, blue verditer and smalt—the most interesting is without doubt Egyptian-blue. To this remarkable pigment Prof. Laurie has devoted much attention, having finally determined its composition and properties, and also the *optimum* temperature for its production (see Proc. Roy Soc., vol. lxxxix. A, pp. 418–29). Although these six pigments were not all in use everywhere and at the same time they cover the early centuries and the period between classical times and the close of the sixteenth century. Later additions to blue pigments comprise Prussian-blue, near the beginning of the eighteenth century; cobalt-blue, and artificial ultramarine in the first quarter of the nineteenth century; and cœruleum about the year 1870. This dating of pigments and of their use is of the highest importance in connection with questions as to the provenance and authencity of works of art. For full details Prof. Laurie's paper, with the annexed tables, must be consulted. A few typographical errors in this important memoir should be noted; Robertson on p. 321 should be Roberson; sulphur not silver should appear in the second line from the bottom of p. 331; and the name of the mollusc from which the Irish monks prepared the Tyrian purple employed in their illuminated MSS. is not quite accurately given in the earlier of the tables appended to the memoir. It may be suggested that this purple pigment, which is a dibromoindigotin, ought to be identifiable where its presence is suspected by means of its high content of bromine.

A. H. C.

CELLULOID AND ITS DANGERS.

THE Departmental Committee on Celluloid, appointed by the Home Secretary some fifteen months ago to consider the precautions necessary in the storage and use of this substance, has recently issued its report (Cd. 7158, 1913). From this it appears that the product accepted as "celluloid" in the report consists essentially of gelatinised nitrocellulose and camphor, the proportion of nitrocellulose usually varying from 70 to 75 per cent. in ordinary celluloid articles, and from 80 to 90 per cent. in kinematograph films. It ignites very readily, and burns with great rapidity and fierceness; moreover, in certain circumstances it may take fire without the direct application of flame. If submitted to a moderately high temperature for some time it suddenly decomposes with evolution of considerable heat and the emission of inflammable and poisonous gases

—chiefly carbon monoxide and nitric oxide, with small proportions of hydrocyanic acid. Mixed with air in suitable quantity, the evolved fumes are highly explosive; but the Committee found no evidence to confirm the opinion that celluloid itself is liable to spontaneous ignition at ordinary temperatures or is explosive in ordinary circumstances.

A number of experiments were carried out at the Government laboratory for the information of the Committee. It was found that the "fuming-off" test devised by Prof. Will was the simplest and one of the most trustworthy methods for ascertaining the relative stability of various kinds of celluloid towards heat. No definite relation between chemical composition and stability to heat could be detected, though a small proportion of mineral matter appears to have a distinct stabilising effect. Celluloid contains sufficient oxygen to support its own combustion, and once ignited will continue to burn in the absence of air; chemical fire extinguishers using carbonic acid gas are, therefore, of little use, and water alone is the best means of extinguishing the substance when burning. The Committee makes a number of recommendations as to the storage and working of celluloid, with the view of lessening the danger from fire; for these the report itself should be consulted.

WIRELESS TELEGRAPHY.[1]

WHEN Mr. Marconi first came over to England in 1896, Mr. Swinton was the means by which he was introduced to Sir William Preece, and the latter, having just then come to the conclusion that his methods of inductive and conductive telegraphy—with which he had been attempting to effect communication with lightships—were unworkable, set the Post Office to work with Mr. Marconi, Sir John Gavey having charge of the experiments. It might seem strange, as Prof. S. P. Thompson had pointed out in NATURE, that Sir William Preece missed the possibilities of Sir Oliver Lodge's Hertzian-wave experiments, but took up Mr. Marconi with practically the same system. But Sir William Preece had always been particularly sympathetic to the young, and Sir Oliver Lodge had not approached him directly.

Next, quoting from an article which Sir William Crookes contributed to *The Fortnightly Review* in 1892, Mr. Swinton showed that Sir William Crookes had in those days fully realised the possibility of telegraphy by means of Hertzian waves. He clearly described how messages might be sent in Morse alphabet by means of apparatus tuned to special wavelengths and receivable only by apparatus similarly tuned. Mr. Crookes also referred to experiments made by Prof. Hughes in 1879, where wireless signals were transmitted over several hundred yards, at which experiments he had assisted. There seems to be no doubt that Hughes discovered Hertzian waves and noted their effects some years before Hertz rediscovered them, but, unfortunately, Sir George Stokes told Hughes, apparently quite erroneously, that the results could be explained by known induction effects, and Hughes was so much discouraged that he never published anything on the matter.

Then, with reference to Sir Oliver Lodge, Mr. Swinton said that he would always regard him as the original inventor of wireless telegraphy, because Sir Oliver Lodge in his Royal Institution lecture in 1894, and later at the Oxford meeting of the British Association in the same year, had first publicly sent signals, rung bells, and deflected galvanometers over a distance by means of Hertzian waves. It had been said that Sir Oliver Lodge did not make clear the telegraphic application of his experiments, but Mr. Swinton was present at Lodge's Royal Institution lecture, and was so much impressed with the telegraphic capabilities it suggested, that he had next morning discussed with his then assistant, Mr. J. C. M. Stanton, the possibility of setting up communication between his residence in Jermyn Street and his office in Victoria Street by Lodge's method. This experiment was never tried, as they had thought that too many large buildings intervened, but preliminary experiments were made in Mr. Swinton's office, and signals on a bell were successfully transmitted and received through several walls with a large Tesla high-frequency coil used as transmitter, and as receiver a coherer consisting of a heap of tintacks. This was two years before Mr. Marconi arrived in this country, but in making these statements Mr. Swinton did not wish in any way to belittle the great work that Mr. Marconi undoubtedly accomplished in making wireless a practical and commercial success by long-continued and arduous labours.

Passing to his experiments, Mr. Swinton stated that finding a difficulty in reading wireless messages by ear, he had devoted attention to automatic recording apparatus. A simple arrangement that he had devised was to employ a sensitive or manometric flame, such as can be made exceedingly sensitive to minute sounds, the flame greatly shortening and roaring the moment the smallest sound reaches it.

Different descriptions of these flames respond more readily to sounds of different pitches, and they also can be tuned to some extent, so that different flames would discriminate between signals of different acoustical pitch even of the same electrical periodicity. All that was necessary was to place the receiving telephone in proximity to the sensitive portion of the apparatus producing the flame, and if a screen were placed in front of the latter hiding the flame when it was shortened, photographic records of Morse signals were easily obtained by throwing by means of a lens a small image of the flame when visible upon a moving strip of photographic paper. Another method of recording the signals employed by the lecturer was to arrange a quick-period mirror galvanometer with the movable portion oscillating between adjustable stops, the oscillations being recorded on a strip of moving photographic paper by projecting on the latter the reflection in the oscillating mirror of a bright point of light proceeding from a pinhole in an opaque box, containing an electric lamp.

Operating, as he did, at his own house, with a very small aërial, Mr. Swinton, in order to magnify the signals, made use of several relays of the types invented by Mr. S. G. Brown. He showed three of these relays connected in series, actuated by signals received on a temporary aërial that Messrs. Gamage had kindly erected on the roof of the Institution of Electrical Engineers. The relays operated a Kelvin siphon-recorder, as well as a loud-speaking telephone, which could be heard by everyone present. At a quarter to nine o'clock a special congratulatory message was received. This was sent by Commandant Ferrié, a vice-president of the society, from the Eiffel Tower. Not only could every signal be clearly heard throughout the Lecture Hall, but it was also received on the siphon-recorder. Further, the motions of the siphon were made visible to the audience, being optically projected on a screen with the aid of an Epidiascope, kindly lent by Messrs. Leitz and Co. The dots and dashes were easily read, both audibly and visibly, though the Admiralty in London was accidentally during part of the time sending radio-telegraphic signals, which were likewise made audible by means of the loud-speaking telephone. The message from

[1] Abstract of the presidential address delivered to the Wireless Society of London on January 21 by Mr. A. A. Campbell Swinton.

the Eiffel Tower consisted of thirty-four words, and occupied about seven minutes. A congratulatory message was also received and rendered audible to the audience from the London Telegraph Training College at Earl's Court.

Mr. Swinton also showed the working of an ordinary Morse inker by means of wireless signals from a distance. For this he employed the three Brown relays with a Siemen's Post Office relay in addition. The inker was modified by turning the magnets upside-down, so that when energised they pulled the inking wheel away from the paper tape, and the signals were recorded when the magnets let go of the armature instead of when they attracted it, as is the usual arrangement. Mr. Swinton had devised this method to get over the difficulty of the extra current, due to the relay breaking the magnet circuit, sending a wireless signal back to the whole apparatus. With the modified arrangement this extra signal took place while the main signal was being received, so it could only accentuate the latter and do no harm, whereas before the modification was effected, when once started, the Morse inker went on working by itself like an electric bell.

Next the lecturer showed how it was possible to receive wireless signals on a phonograph. In the ordinary way, records made by this method were not loud enough to be heard by an audience, but a small microphone had been mounted on the repeating diaphragm, and connected to a loud-speaking telephone, and by this means signals from the Eiffel Tower and from the Admiralty, which had been recorded on the phonograph, were made audible throughout the hall.

Once an arrangement of relays that would work a Morse inker was provided it became possible to operate almost any kind of apparatus, and wireless signals sent by the British School of Telegraphy at Clapham were made, by means of the relays and an electromagnet, to work an air-valve in connection with a source of air pressure and an organ pipe, which latter gave forth in long and short blasts the signals of the message. Mr. Swinton said that the same apparatus worked a motor-horn very effectively, but the horn could not be used indoors, as its noise upset the relays.

Next it was explained how a Poulsen telegraphone could be used as a recorder; and that on the Poulsen-Pedersen system an Einhoven "string" galvanometer was employed for this purpose. With this instrument a signal containing energy to the extent of only one billionth of a watt could be registered, which is about the same sensibility as what is obtainable with a Bell telephone receiver. On the assumption that a 12 candle-power light, radiating one watt in the form of visible electromagnetic waves, was visible at a distance of five miles, and that the aperture of the eye was one-fifth of a square inch, then the amount of power reaching the eye would be about one-sixth of one billionth of a watt, so that natural detectors like the eye, and artificial detectors, such as the Einhoven galvanometer, had about the same order of sensitiveness, and were much more sensitive than any photograph process for instantaneous effects, although photography had the advantage that cumulative effects could be obtained by long exposures. Some years ago Lord Rayleigh found that the human eye and ear were of the same order of sensitiveness.

Another matter mentioned by the lecturer was that the Eiffel Tower aërial, as also those at Poldhu and at other large stations, gave out loud sounds when messages were being transmitted, this being probably due to the air particles being electrified and repelled, as in a Brush discharge.

In his concluding remarks, Mr. Swinton speculated on the future of wireless. The chief difficulty at present with regard to wireless telephony is to get a microphone that would carry sufficient current without burning up, while there is also the necessity for switching over, when changing from receiving to transmitting, which renders conversation troublesome. These are, however, difficulties that should be got over, and it was probable that in the not far distant future, we should have statesmen wirelessly addressing numerous audiences simultaneously, while wireless receiving stations would be set up in connection with halls where people would be able to go and hear *viva voce* all the prominent speakers of the day. Further, wirelessly operated column printing telegraphs would tell the latest news to all the nation, as also to any newspapers which continued to survive this much more rapid method of disseminating intelligence. Again, if we are ever to have Transatlantic telephony, it would probably be wireless, with which the difficulties due to the capacity and self-induction of the cables are avoided.

Mr. Tesla and Prof. Pedersen even believe in the possibility of wireless transmission of power, and in this connection it must be remembered that practically all the power on our planet comes from the sun in the form of electromagnetic waves, and amounts, on a clear day, to no fewer than 4,500,000 horse-power per square mile of the earth's surface. This is, at any rate, good evidence that enormous amounts of power can be transmitted over prodigious distances by means of electromagnetic waves, but it is difficult to imagine how efficiency could be obtained.

Finally, Mr. Swinton appealed to the romance attendant on the spectacle of great liners hurrying across the ocean to the assistance of a ship from whom they had just heard in wireless whispers the S.O.S. signal of distress.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The General Board of Studies will shortly proceed to appoint a University lecturer in mathematics and a Cayley lecturer in mathematics in succession to Dr. Baker, the new Lowndean professor, who held both of these posts.

Mr. A. H. Cooke, of King's College, and Mr. H. H. Thomas, of Sidney Sussex College, have been approved by the General Board of Studies for the degree of Doctor of Science.

The council of the Senate have issued an important report on the admission to University lectures and laboratories of men who are not members of the University. The success of the diplomas in agriculture and in tropical medicine and in other subjects, has led to a considerable increase in the number of students, not members of the University, who are using the University laboratories and lecture-rooms. It is proposed in future to keep a register of such students and to charge each of them a small fee.

MR. L. G. SUTTON has given a donation of 1000*l.* to the fund which is being raised to provide adequate buildings and laboratories for the agricultural and other departments of University College, Reading.

THE sixteenth annual dinner of the City and Guilds College Old Students' Association will be held at the Trocadero Restaurant, Piccadilly Circus, W., at 7.30 p.m., Saturday, February 21. Dr. G. T. Moody, president of the association, will occupy the chair. Tickets may be obtained by any old student of the college from Mr. G. W. Tripp, 4 Fairfield Road, Charlton, Kent.

THE legacies of the late Lord Strathcona include the following to educational institutions:—St. John's Col-

lege, Cambridge (in addition to 10,000*l.* given during his lifetime), 10,000*l.*; the Royal Victoria College, Montreal (under deduction of any payments made during his lifetime, and in addition to the college buildings and site provided by him at a cost of about 80,000*l.*), 200,000*l.*; Yale University, Connecticut, U.S.A., 100,000*l.*; the University of Aberdeen for chair of Agriculture, 5000*l.*; Queen's University, Kingston, Canada, extension fund, 20,000*l.*; the principal Church of Canada Presbyterian College, Montreal, 12,000*l.*

THE second volume of "Statistics of Public Education in England and Wales" for 1911–12–13 has been published by the Board of Education (Cd. 7204). It is concerned wholly with financial statistics. The first table in the volume shows that the total expenditure of the Board of Education in 1912–13 out of the Parliamentary vote amounted to 14,329,551*l.*, as against 14,302,859 for 1911–12. During 1912–13, 11,748,331*l.* was spent on public elementary schools, 749,359*l.* on secondary schools, 585,871*l.* on technical schools and classes, and 583,127*l.* on the training of teachers. Among other grants made by the Board during the financial year mentioned were 41,647*l.* to university institutions in respect of technological work, 35,000*l.* to the Imperial College of Science and Technology, as compared with 20,000*l.* in 1911–12, 17,790*l.* to the Science Museum at South Kensington, 20,590*l.* to the Geological Survey, and 2202*l.* to the Committee on Solar Physics.

THE annual report of the distribution of grants for agricultural education and research in the year 1912–13 (Cd. 7179, price 8½*d.*), recently issued by the Board of Agriculture and Fisheries, shows a very satisfactory advance on the older state of affairs. The new scheme made possible by the establishment of the Development Fund has now been in operation for a sufficient number of months to prove that it is in the main very satisfactory, and can accomplish the work it was intended to carry out. The general plan is set out very lucidly in an introduction by Mr. T. H. Middleton, and a number of details are given in the appendix, so that the reader can form a sufficient idea of the scheme and its working. For the first time scientific research is recognised as the starting point, and the sum of about 30,000*l.* per annum is, or will be, available for the research institutes that have been set up; in addition 3000*l.* per annum is granted for special investigations not quite falling within the scope of the research institutes. These institutes are not charged with the investigation of specific local problems or with the elaboration of technical details; their business is to elucidate the fundamental principles underlying the relationships of the soil, the plant, and the animal, and they have a perfectly free hand in the management of their affairs. They are:—Imperial College of Science and Technology, for plant physiology and pathology; Agricultural Department, Cambridge University, for animal nutrition and for plant breeding; Rothamsted Experimental Station, for soil problems and plant nutrition; Bristol University, for fruit growing; Royal Veterinary College, for animal pathology; University College, Reading, for dairying; University of Birmingham, for helminthology; University of Manchester, for economic entomology; University of Oxford, for agricultural economics.

THE annual general meeting of the Royal College of Science Old Students' Association was held at the college on January 31, the president (Dr. A. E. H. Tutton, F.R.S.) in the chair. Prof. H. E. Armstrong, F.R.S., was elected president for 1914, his place as one of the vice-presidents being filled by the election of Mr. A. T. Simmons. Mr. J. Allen Howe and Mr. T. Ll. Humberstone were re-elected treasurer and secretary respectively. After the regular business, the report of the Royal Commission on University Education in London was discussed, with special reference to the recommendations relating to the college, and the following resolutions were adopted unanimously:—(1) That the Imperial College of Science and Technology should be organised as a federation of colleges under a common government, each college being managed by a special committee; (2) that the Royal College of Science, the Royal School of Mines, and the City and Guilds (Engineering) College should be included in the federation, together with a fourth college devoted to higher teaching and research in Technology; (3) that if, and when, the Imperial College is linked more closely with the University of London, the Royal College of Science, London, should, while remaining in the proposed federation of colleges, become a "constituent college" of the University in the faculty of science. The committee was empowered to make representations under these resolutions. The annual dinner of Old Students was held in the evening at the Criterion Restaurant, Dr. Tutton presiding. Sir John Rose Bradford, Sec.R.S., proposed the toast of the evening, "The Royal College of Science, London, and the Old Students' Association," and Sir William Ramsay, F.R.S., and Prof. S. J. Truscott replied for the guests. The guests also included Dr. Herringham (Vice-Chancellor of the University), Sir Alfred Keogh, K.C.B., Mrs. Ayrton, Prof. Bateson, F.R.S., and Dr. Frank Heath.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 29.—Sir William Crookes, O.M., president, in the chair.—Prof. O. W. **Richardson**: The origin of thermal ionisation from carbon. In a paper recently communicated to the society by Dr. J. N. Pring, experiments bearing on this subject were described. The smallness of the observed currents and the variation of them with the pressure and nature of the gas, led Dr. Pring to the conclusion that considerable doubt was thereby cast on the theory of the emission of electrons from hot solids, and that these effects were to be attributed to chemical action. In the present paper the magnetic field due to the large heating currents employed by Dr. Pring are shown to curl up the paths of the electrons, and so prevent them from reaching the electrode. It is shown that with the larger currents none of the electrons could reach the electrode in these experiments, and owing to the complexity of the apparatus it is impossible to say what proportion would reach it at the lower temperatures. In the opinion of the author of this paper, the conclusions referred to cannot be regarded as established by the experiments under consideration.—Prof. W. H. **Bragg**: The X-ray spectra given by crystals of sulphur and quartz. A crystal of quartz is found, on examination by the X-ray spectrometer, to contain three interpenetrating hexagonal lattices of silicon atoms and six of oxygen. The angles of reflection in a number of important planes all agree, within 1 or 2 per cent., with the calculated values. Sulphur contains eight interpenetrating lattices, each of the kind formed by placing an atom at each corner of a rectangular parallelopiped and in the centres of two opposite faces. The edges of the parallelopiped are in the known ratios of the crystallographic axes. —Prof. L. N. G. **Filon**: The temperature variation of the photo-elastic effect in strained glass. The experiments described in this paper were undertaken to see whether the double refraction produced in glass by stress was at all affected by change of temperature. The results show that the refractive indices for rays polarised in and perpendicular to the line of stress are

unequally affected, but seem increased on the whole by rise of temperature. One of these, however, shows a permanent residual change even after cooling. This is important as showing that this property of the glass is affected by previous temperature treatment.—J. H. **Shaxby** and Dr. E. Emrys **Roberts**: Studies in Brownian movement. Paper i., The Brownian movement of the spores of bacteria.—Dr. R. **Whiddington**: The transmission of kathode rays through matter.—Ezer **Griffiths**: The variation, with temperature, of the specific heat of sodium in the solid and liquid state; also a determination of its latent heat of fusion. The specific heat of sodium (melting point 97·6°) was investigated at various temperatures in the range 0° to 140° by the electrical method. The range of temperature through which the metal was heated was about 1·5°, thus enabling the actual specific heat at each particular temperature to be determined. In the solid state the specific heat is considerably influenced by the nature of the previous heat-treatment, and two distinct specific heat-temperature curves are obtained for the annealed and the quenched state. The increase in the values of the specific heat in the solid state is very marked as the melting point is approached. In the molten state the specific heat decreases with temperature, the relation between specific heat and temperature from 100° to 140° being linear. The latent heat of fusion was found to be 27·52 gram calories.—Dr. G. **Green**: Natural radiation from a gas. The investigations of Planck have established the result that the total energy emitted from a black body at any temperature consists of discrete quanta, all equal and similar. If we identify the "energy quantum" as the energy contained in the light pulse emitted each time a molecule undergoes structural change, the determination of the form of this light pulse might lead to useful information regarding the constitution of the molecule. In this paper the form of pulse, in which the energy per wave-length is the same as that required by Planck's law of radiation at any temperature, is first derived. This form accordingly represents the total radiation from any black body at any temperature. The radiating body is now taken to be a gas. By decomposing the above pulse we obtain an infinite succession of wave-trains emitted by the various groups of molecules obtained by arranging the total number according to speed.—Dr. T. E. **Stanton** and J. R. **Pannell**: Similarity of motion in relation to the surface friction of fluids. The paper deals with an experimental investigation of the existence of the similarity of motion in fluids, of widely differing viscosities and densities, in motion relative to geometrically similar surfaces, which has been predicted from considerations of dynamical similarity by Stokes, Helmholtz, Osborne Reynolds, and Lord Rayleigh.—A. E. **Oxley**: The influence of molecular constitution and temperature on magnetic susceptibility.—N. **Eumorfopoulos**: The boiling point of sulphur on the thermodynamic scale.

Challenger Society, January 28.—Sir John Murray in the chair.—C. Tate **Regan**: A bathypelagic angler-fish (*Melanocetus johnsoni*), from the North Atlantic, having inside it a Scopeloid fish (*Lampanyctus crocodilus*) three times its own length. The specimen was taken at the surface of the sea, and it was supposed that the struggles of the captured fish, before it was completely swallowed, had brought the captor up from the depth at which it normally lives. Curiously enough, the only other examples of Melanocetus in the British Museum, two in number, were of nearly the same size (3 in. long), and each contained a Lampanyctus of 8 or 9 in.—G. P. **Farran**: The Copepoda of a set of serial tow-nettings from the west coast of Ireland. In gatherings taken over a series of years at ten-mile intervals on a line running sixty miles west of co. Kerry, out of eighty-five species that occurred, four were neritic and showed a uniform decrease both in numbers and frequency of occurrence at every ten miles from the shore. Sixty-six were oceanic, and showed a uniform increase seawards over the same stations, while twelve species varied irregularly and seemed to be euryhaline.

MANCHESTER.

Literary and Philosophical Society, January 13.—Mr. F. Nicholson, president, in the chair.—W. **Cramp**: Some notes on the measurement of air velocities, pressures, and volumes. The author described the instruments generally used, and the results he obtained with a special apparatus he set up for testing them. His results were summarised as follows:—(1) For accurate tests of fans, &c., a Brabbée tube and a micromanometer, or a good facing gauge with a side gauge having its orifice flush with the pipe wall and used with a micromanometer, are far more accurate than the older methods. (2) The pneumometer may be specially useful where the air is laden with dust, &c. (3) The Nipher collector is very inaccurate. (4) In ordinary round or square pipes the coefficient of contraction is rarely less than 0·9.

PARIS.

Academy of Sciences, January 26.—M. P. Appell in the chair.—The **President** announced the death of Sir David Gill, correspondant for the section of astronomy.—G. **Bigourdan**: The determination of the thermometric coefficient of the wire micrometer. The method recently devised by M. Lippmann for the autocollimation of a telescope can be utilised for the rapid and accurate determination of the focal length of the objective of the telescope, and this, combined with the measurement of the linear value of one turn of the micrometer screw and the coefficient of the wire gives a solution of the problem.—G. **Humbert**: Some remarkable numerical functions.—H. **Deslandres** and A. **Perot**: Contribution to the realisation of high magnetic fields. Concentration of the ampere-turns in a very small volume. The method is partly based on the use of a stream of petrol cooled to −30° C. by a liquid ammonia machine, for cooling the wire carrying the current of the electromagnet, and partly on a modification of the winding of the electromagnet. The field thus obtained was 51,500 Gauss, with a current of 24 amperes.—E. **Roux**: Remarks on antigonoccic vaccines. A reference to the work of P. Mayoral and P. Grandez bearing on the recent publication of C. Nicolle and M. Blaizot on the same subject.—M. **Gambier**: Bertrand's curves and curves of constant curvature.—E. **Keraval**: A family of triply orthogonal systems.—H. **Andoyer**: New fundamental trigonometrical tables.—Th. **Anghelutza**: The left symmetrical nucleus in the theory of integral equations.—Ernst **Lindelöf**: Conformal representations.—Georges **Rémoundos**: The convergence of series of analytical functions.—A. **Châtelet**: Congruences of higher order.—G. **Armellini**: The analytical solution of the limited problem of three bodies.—M. **Swyngedauw**: The resistance of safety spark-gaps.—Eugène **Darmois** and Maurice **Leblanc**, jun.: The possibility of an alternating arc in mercury vapour. It was shown by Cooper-Hewitt that the mercury arc in a vacuum acts as a valve for an alternating current, and this has been utilised for conversion of alternating into continuous current. The authors describe conditions under which it is possible to maintain an alternating arc in mercury vapour for low frequencies and moderate voltages.—G. **Moreau**: Flames containing chlorides giving an electromotive force.—MM. **Hanriot** and **Lahure**: The minimum temperatures of annealing. The time during

which the metal is heated to a given temperature has a considerable influence on the softening of the metal. The experiments were carried out on zinc and silver.—Marcel **Delépine**: The iridium chlorides.—Michel **Longchambon**: The rôle of magnesia in sedimentary cycles.—Maurice **Durandard**: The ferment of *Rhizopus nigricans*. The mycelium of this mould contains a very active ferment: its action on milk is a maximum at 50° C.—Raoul **Combes**: The presence of yellow pigments capable of being transformed into anthocyanine in leaves and flowers not forming anthocyanine.—Henri **Piéron**: The decrease of the ratio of the latent period to the period of total establishment for luminous sensations as a function of the intensity of stimulation.—Henri **Bierry** and Albert **Ranc**: The proteid sugar of the blood plasma.—M. **Lécaillon**: The analogies of structure which exist betweent the ovary of certain insects and that of certain Branchipodids (*Chirocephalus stagnalis*).—L. **Joleaud**: The geology of the Filfila djebel (Algeria).—J. **Repelin**: The geological constitution of the septentrional part of the department of Var.—René **Nicklès**: The section of the Lias, the Infralias, and the Trias of Lorraine in the boring of Bois Chaté. This boring was made for coal, and penetrates to the Upper Permian. No coal-bearing strata were found.

BOOKS RECEIVED.

Forty-second Annual Report of the Local Government Board, 1912–13. Supplement containing the Report of the Medical Officer for 1912–13. Pp. lxx+412. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4*s*.

A Text-book of Domestic Science for High Schools. By M. G. Campbell. Pp. vii+219. (London: Macmillan and Co., Ltd.) 4*s*. net.

Descriptions of Land. By R. W. Cautley. Pp. ix+89. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*. net.

Annuaire pour l'an 1914, publié par le Bureau des Longitudes. Pp. vii+502. (Paris: Gauthier-Villars.) 1.50 francs.

Ueber Gedächtnis, Vererbung und Pluripotenz. By Prof. V. Haecker. Pp. 97. (Jena: G. Fischer.) 2.50 marks.

Indian Administration. By Prof. V. G. Kale. Pp. iv+298. (Poona: Arya Bhusham Press.) 1.4 rupees.

Der Fischerbote. vi. Jahrgang. No. 1. (Hamburg: L. Friederichsen and Co.)

Zur Frage der Entstehung maligner Tumoren. By Prof. T. Boveri. Pp. 64. (Jena: G. Fischer.) 1.50 marks.

The Religious Revolution of To-day. By Prof. J. T. Shotwell. Pp. ix+162. (Boston and New York: Houghton, Mifflin Co.) 1.10 dollars net.

Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band xlviii. Pp. vii+347+iv plates. (Zürich: Zürcher und Furrer.)

Finlandisch Hydrographisch-Biologische Untersuchungen. No. 12. Jahrbuch 1912. Enthaltend Hydrographische Beobachtungen in den Finland Umgebenden Meeren. Edited by Dr. R. Witting. Pp. 130+vi plates. (Helsingfors.)

R. Osservatorio di Catania. Catalogo Astrofotografico 1900, 0 Zona di Catania. Vol. iv., Parte 1. Pp. 153. (Catania.)

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. ii., part 9. (Sydney: W. A. Gullick.) 2*s*. 6*d*.

Columbia University in the City of New York. Publication No. 7 of the Ernest Kempton Adams Fund for Physical Research. Neuere Probleme der Theoretischen Physik. By Prof. W. Wien. Pp. 76. (Leipzig und Berlin: B. G. Teubner.)

The Cancer Problem. By C. E. Green. Third edition. Pp. 98+plates. (Edinburgh and London: W. Green and Sons.) 5*s*. net.

Experimentaluntersuchung zur Messung von Erderschütterungen. By Prof. L. Grunmach. Pp. 102. (Berlin: L. Simion, Nf.) 5 marks.

Report of the Department of the Naval Service for the Fiscal Year ending March 31, 1913. Pp. 128+plates. (Ottawa: C. H. Parmelee.) 10 cents.

A Manual for Masons, Bricklayers, Concrete Workers and Plasterers. By Prof. J. A. van der Kloes. Revised and adapted to the Requirements of British and American Readers by A. B. Searle. Pp. xii+235. (London: J. and A. Churchill.) 8*s*. 6*d*. net.

A Handbook of Wireless Telegraphy. By Dr. J. Erskine-Murray. Fifth edition. Pp. xvi+442. (London: Crosby Lockwood and Son.) 10*s*. 6*d*. net.

An Algebra for Preparatory Schools. By T. Dennis. Pp. viii+155. (Cambridge University Press.) 2*s*.

The Reform of the Calendar. By A. Philip. Pp. xiii+127. (London: Kegan Paul and Co., Ltd.) 4*s*. 6*d*. net.

Das Susswasser-Aquarium ein Stück Natur im Hause. By C. Heller. Zweite Auflage. Pp. vi+186. (Leipzig: Quelle und Meyer.) 1.80 marks.

Leitfaden für Aquarien- und Terrarien-Freunde. By Dr. E. Zernecke. New edition. By C. Heller and P. Ulmer. Pp. ix+456. (Leipzig: Quelle und Meyer.) 7 marks.

Methodik und Technik des naturgeschichtlichen Unterrichts. By Prof. W. Schoenichen. Pp. xiv+611+30 plates. (Leipzig: Quelle und Meyer.) 12 marks.

The Principle of Relativity in the Light of the Philosophy of Science. By P. Carus. Pp. 105. (Chicago and London: The Open Court Publishing Co.) 4*s*. net.

The Mechanistic Principle and the Non-Mechanical. By P. Carus. Pp. iv+125. (Chicago and London: The Open Court Publishing Co.) 4*s*. net.

Allen's Commercial Organic Analysis. Fourth edition. Edited by W. A. Davis and S. S. Sadtler. Vol. viii. Pp. x+696. (London: J. and A. Churchill.) 21*s*. net.

The Examination of School Children. By Prof. W. H. Pyle. Pp. v+70. (London: Macmillan and Co., Ltd.) 2*s*. net.

Zellen- und Gewebelehre. By Prof. K. von Bardeleben. Zweite Auflage. Pp. 96. (Leipzig und Berlin: B. G. Teubner.) 1.25 marks.

Entwicklungsgeschichte des Menschen. By Dr. A. Heilborn. Pp. viii+87. (Leipzig und Berlin: B. G. Teubner.) 1.25 marks.

Das Mikroskop. By Prof. W. Scheffer. Zweite Auflage. Pp. vi+100. (Leipzig und Berlin: B. G. Teubner.) 1.25 marks.

Das Meer: seine Erforschung und sein Leben. By Prof. O. Janson. Pp. iv+113. (Leipzig und Berlin: B. G. Teubner.) 1.25 marks.

Handbook of Photomicrography. By H. L. Hind and W. B. Randles. Pp. xii+292+plates. (London: G. Routledge and Sons, Ltd.) 7*s*. 6*d*. net.

Lectures on the Icosahedron and the Solution of Equations of the Fifth Degree. By Prof. F. Klein. Translated by Dr. G. G. Morrice. Second edition. Pp. xvi+289. (London: Kegan Paul and Co., Ltd.) 10*s*. 6*d*. net.

Ambidexterity and Mental Culture. By Dr. H. M. Jones. Pp. 102+plates. (London: W. Heinemann.) 2*s*. 6*d*. net.

The Birmingham Country. Its Geology and Physio-

graphy. By Prof. C. Lapworth. Pp. 53+maps. (Birmingham: Cornish Bros., Ltd.) 2s. 6d. net.

Yorkshire Type Ammonites. Edited by S. S. Buckman. part xii. (London: W. Wesley and Son.) 3s. 6d.

Contour Hand Maps. Coloured. Surrey, Glamorganshire, Hertfordshire, Kent, London, Middlesex, Northumberland, Oxfordshire. (London: G. W. Bacon and Co., Ltd.) 2d. net each.

Transformisme et Créationisme. By Prof. J. L. de Lanessan. Pp. 349. (Paris: F. Alcan.) 6 francs.

Incandescent Electric Lamps and their Application. By D. H. Ogley. Pp. x+107. (London: Longmans and Co.) 2s. 6d. net.

The Trail of the Sandhill Stag. By E. Thompson Seton. Pp. 93. (London: Hodder and Stoughton.) 3s. 6d. net.

An Account of the Morisonian Herbarium in the Possession of the University of Oxford, together with Biographical and Critical Sketches of Morison and the two Bobarts and their Works, and the Early History of the Physic Garden, 1619–1720. By Prof. S. H. Vines and G. C. Druce. Pp. lxviii+350. (Oxford: Clarendon Press.) 15s. net.

The Observer's Handbook for 1914. Edited by C. A. Chant. Pp. 72. (Toronto: Royal Astronomical Society of Canada.)

Heaton's Annual. The Commercial Handbook of Canada and Boards of Trade Register, 1914. Pp. 590. (Toronto: Heaton's Agency; London: Simpkin and Co., Ltd.)

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 5.

ROYAL SOCIETY, at 4.30.—The Conduction of the Pulse Wave and the Measurement of Arterial Pressure: Prof. F. Hill, J. McQueen and M. Flack.—Report of the Monte Rosa Expedition of 1911: J. Barcroft, M. Camis, C. G. Mathison, F. Roberts and J. H. Ryffel.—Some Notes on Soil Protozoa. I: C. H. Martin and K. Lewin.—The Development of the Starfish *Asterias rubens* L: J. F. Gemmill.—The Floral Mechanism of *Welwitschia mirabilis* (Hook): Dr. A. H. Church.

ROYAL INSTITUTION, at 3.—Types and Causes of Earth Crust Folds: Sir Thomas H. Holland, K.C.I.E.

LINNEAN SOCIETY, at 8.—The Vegetation of White Island, New Zealand: W. R. B. Oliver.—Lantern-slides of Cape Plants, mostly in their Native Habitats: W. C. Worsdell.—The Range of Variation of the Oral Appendages in some Terrestrial Isopoda: W. E. Collinge.

FRIDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 9.—The Mechanics of Muscular Effort: Dr. H. S. Hele Shaw.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual Meeting.—President's Address: The Wearing Down of the Rocks. II.: Dr. J. W. Evans.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Ancient Surveying: R. C. S. Walters.

MONDAY, FEBRUARY 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Our Present Knowledge of the Antarctic and the Problems that Remain to be Solved: Prof. Edgeworth David, C.M.G., F.R.S.

TUESDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 3.—Animals and Plants under Domestication: Prof. W. Bateson.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Psychology of Magic: Prof. Carveth Read.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The New Harbour Works and Dockyard at Gibraltar: A. Scott.

WEDNESDAY, FEBRUARY 11

ROYAL SOCIETY OF ARTS, at 8.—The History of Colour Printing: R. A. Peddie.

THURSDAY, FEBRUARY 12

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Chemical Action that is Stimulated by Alternating Currents: S. G. Brown.—The Effect of the Gangetic Alluvium on the Plumb-line in Northern India: R. D. Oldham.—Note on the Origin of Black Body Radiation: G. W. Walker.—The Transmission of Electric Waves along the Earth's Surface: Prof. H. M. Macdonald.—Transparence or Translucence of the Surface Film Produced in Polishing Metals: G. T. Beilby.—A Method of Avoiding Inaccuracy due to Weight Errors in "Fixing" a Gold Coinage Standard Trial Plate: A. O. Watkins.—A Thermomagnetic Study of the Eutectoid Transition Point of Carbon Steels: Dr. S. W. J. Smith.—Note on Osmotic Pressure: W. R. Bousfield.

ROYAL INSTITUTION, at 3.—Types and Causes of Earth Crust Folds: Sir Thomas H. Holland, K.C.I.E.

CONCRETE INSTITUTE, at 7.30.—The Differential and Integral Calculi for Structural Engineers: W. A. Green.

ROYAL SOCIETY OF ARTS, at 4.30.—Khorasan: the Eastern Provinces of Persia: Major Percy M. Sykes.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Some Railway Conditions governing Electrification: R. T. Smith.

FRIDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 9.—Production of Neon and Helium by Electric Discharge: Prof. J. Norman Collie.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 8.—The Moving Coil Ballistic Galvanometer: R. Ll. Jones.—Vibration Galvanometers of Low Effective Resistance: A. Campbell.—Vacuum-tight Lead-seals for Sealing-in-wires in Vitreous Silica and other Glasses: Dr. H. J. S. Sand.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.—Presidential Address: Some Points and Problems in Geographical Distribution: Rev. A. H. Cooke.

ALCHEMICAL SOCIETY, at 8.15.—Some Notes on the Doctrine of the First Matter, with Special Reference to the Works of Thomas Vaughan: Sijil Abelul-Ali.

SATURDAY, FEBRUARY 14.

ROYAL INSTITUTION, at 3.—The Electric Emissivity of Matter. I.: The Metals: Dr. J. A. Harker.

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SUPPLEMENT TO "NATURE."

COAL IN INDIA.

The Coalfields of India. By the late Prof. V. Ball, F.R.S. Entirely revised and largely re-written by R. R. Simpson. Pp. 147+xliv. (Calcutta: Published by order of the Government of India, 1913.)

THIS work constitutes volume xli. of the memoirs of the Geological Survey of India, and its publication will rank high on the already long list of works upon the economic mineralogy of India, for which we are indebted to the Indian Geological Survey. Unlike many others, the authorities responsible for the geological survey of the Peninsula have realised the full importance of the economic side of their work, and have devoted much attention to it, to the manifest advantage of the Indian mineral industry. The present work is the more opportune because in spite of the rapidly increasing importance of the coal production of India, no connected account of the Indian coalfields, as they now exist, was anywhere available, and information concerning individual coalfields or collieries had to be collected from a very miscellaneous series of publications; how widely scattered this information is may be gathered from the bibliography appended to the present treatise, which covers no fewer than twenty pages of the book.

The only work dealing with the Indian coalfields as a whole is that upon which the present one is based, though in reality little more than the framework of the original is to be found in the present book; the original work was the volume on economic geology, written by the late V. Ball, forming volume iii. of the "Manual of the Geology of India," published so far back as 1881. Not only has this book long been out of date, but it has also been out of print for many years. How completely it is necessarily out of date is evident from the fact that in the year when it was published the total coal production of India was under one million tons, practically the whole of which came from Bengal, with the exception of a small output from the Central Provinces; in 1910 the total production was more than twelve millions of tons, and although Bengal is still responsible for some 90 per cent. of the total, no fewer than seven other States and provinces contribute to it.

The opportunities for obtaining additional information regarding the coalfields of India had thus increased enormously in the interval, whilst a still greater increase had taken place in the number of investigators capable of taking advantage of these facilities; for many years the officers of the Geological Survey merely devoted to the coalfields such portions of their time as could be spared from other more strictly geological work, and, of course, they were necessarily geologists and not mining engineers; with the increasing importance of coal mining, it was found necessary to devote special attention to this branch, and the survey authorities appointed a mining specialist. This was the appointment held by Mr. R. R. Simpson, and in the course of his duties he travelled widely over the Indian coalfields, and thus accumulated the information of which he has made such excellent use in the present volume. It need only be said that he has given a clear and concise description of the various Indian coalfields, which, without being over-laden with detail, nevertheless summarises very completely all the information that is likely to be of use to the general student of the subject, whilst his very complete bibliography will enable any inquirer interested in any special field to supplement the information here given with all known details.

The brief sketch of the geology of the Indian coalfields, that serves as an introduction to the more detailed descriptions, may be selected as worthy of special commendation. On the other hand, a little more information concerning the labour conditions would have been welcome, and the very important question of colliery accidents has not even been referred to. It is quite true that the object of the book is in the main to supply geological information respecting the coalfields, but it would have been as well to supplement this with a sufficient amount of economic information to enable the reader to form a clear picture of Indian coal-mining conditions. Mr. Simpson has given a good deal of such information in a short but useful chapter upon the output, conditions of railway transport, selling price, markets, &c., but his reference to labour occupies only one short paragraph. It must not be supposed that this constitutes a serious blemish upon a volume that in all other respects is a highly satisfactory and very welcome piece of work, for which everyone interested in coal-mining will be grateful to the survey authorities no less than to the author himself.

H. L.

THE PHYSICAL TRAITS OF SCHOOL CHILDREN.

Pedagogical Anthropology. By Maria Montessori. Translated from the Italian by F. C. Cooper. Pp. xi+508. (London: William Heinemann, 1913.) Price 14*s.* net.

A VERY general remark which followed the appearance of "the Montessori Method" was that that work provoked thought, and led teachers in infant schools and kindergartens to

reconsider both their methods and the principles underlying them. In that work Dr. Montessori made reference to the importance of accurate physical records, and gave testimony to the influence these had had in leading up to the system in use in the children's houses. The translation of her lectures on anthropology as applied to education has therefore been awaited with great interest, and the result is a book which must lead all responsible for the physical welfare of the school-child to take stock of their data and their conclusions.

This volume, comprising the lectures given by the author to students of education and medicine in the University of Rome, should prove of interest to the lecturers on school hygiene at training colleges, who might with advantage incorporate into their syllabus some of the methods suggested. The volume should also be read by the school medical officers as containing many items relative to the diagnosis, and to some extent the prognosis of abnormal children. A biographic and biometric record should be kept of every child, since the study of the individual should indicate the particular form of education required.

The respective parts which Dr. Montessori considers should be played in the application of pedagogical anthropology are perhaps revealed by the direction that a *bad* child should be taken to see a *physician* because it is almost certain that he is a sick child in whom anomalies of character may coincide with morphological variations. But the treatment of such maladies is very often mainly pedagogical; curative pedagogy, however, must absolutely abolish punishment. By the general use of the biographic charts the observer is able to see in every social class "those individual variations in physical and physiological condition which contribute to the development of the intelligence and to the manifestations of sentiments which play an active part in practical life."

In the children's houses the teachers and doctors are able to study every aspect of the families, economic, social, medical, and moral, and so can collect the data which will be needed for any rational efforts at reform. It is as idle to expect to cure the body politic until the roots of the social evils have been probed to the utmost as it would be to expect to cure a patient by a random selection of nostrums without first employing the ordinary methods of diagnosis. The author regards the introduction of biographic charts in schools as nothing less than a reform of science as a whole, upon which pedagogy, medicine, jurisprudence, and sociology may alike lay new foundations. These are stirring suggestions, which ought to bear fruit in this country, if anywhere, since by now every elementary-school child has its medical and pedagogical progress recorded, and the vast stress of information concerning family circumstances of an economic and social character collected by the untiring efforts of the teachers and of the working members of care committees could be correlated therewith. Such work should be general, and not confined to one or two areas and laboratories, and would be a worthy task for our larger education authorities or a department of State.

The value of the particular physical and mental measurements recommended by Dr. Montessori and the precise method of investigation to pursue may be matters of dispute; many of the data and standards cited in the text will be regarded by the anthropologist as invalid when applied as tests elsewhere than in Italy, but none can dispute the stimulus to be derived from a perusal of this book, and still more of an effort to apply the general reasoning employed to the needs of particular children or groups of children, with due corrections for their urban or rural environment, the comfort or poverty of their homes, and the racial and social status of their ancestry. The result might help to hasten the dawn of that biological liberty which the author postulates as the very essence of the newest pedagogy, which will prepare each pupil for that form of employment which is best suited to his individual temperament and tendencies.

THE PHENOMENON OF ANAPHYLAXIS.

Anaphylaxis. By Prof. Charles Richet. Authorised translation by J. Murray Bligh. Pp. xii+266. (Liverpool: The University Press; London: Constable and Co., Ltd., 1913.) Price 3*s.* 6*d.* net.

THIS translation of Prof. Richet's excellent little manual on anaphylaxis will be very welcome to English readers. In 1902 Richet and Portier found that previous injection produced increased sensitivity to the poison extracted from the tentacles of actinaria. This being the opposite to the immunity following successive injections of most toxins, which has been so much studied of recent years, Richet gave the name "Anaphylaxie" to the phenomenon.

Indications of the existence of hypersensitivity to a second injection of protein substances had been previously recorded by Majendie, Theobald Smith, Behring, and others. The occurrence of the phenomenon was, however, inconstant, and remained unexplained. Exact knowledge of it dates from Richet and Portier's experiments. They found that, with the poison they were working with, the phenomenon was constant, provided a definite interval were allowed to intervene be-

tween the injections. In other words, an essential condition of anaphylaxis is that a considerable interval—three or four weeks—elapse between the first and second injections.

Afterwards it was discovered that the subcutaneous injection of almost every form of protein foreign to the particular species of animal experimented upon, is capable of giving rise to this peculiar condition, and that, as extremely minute quantities are required for the first or sensitising dose, it is a delicate test for the presence of a particular protein. The reaction is so specific that proteins from a horse can be distinguished from those from an ox, and by means of it the presence of horseflesh in a sausage can be determined or a human bloodstain identified.

The manifestations of anaphylaxis, which may be generally described as those of collapse or shock, differ somewhat in different animals, but for the same animal are much the same whatever the protein used for injection. The symptoms develop within a few minutes; recovery, if it occur, is sudden, and for some time afterwards the animal has lost its sensitivity to the particular poison.

During the last few years anaphylaxis has occupied the attention of a large number of investigators, and hundreds of papers have been published dealing with its nature and the conditions determining its occurrence, but it cannot be said to be even yet completely understood.

The great merit of Richet's book is that he has analysed the voluminous data and rendered them into a clear exposition of the subject so far as it is known up to the date of publication. This, only one who was himself intimately acquainted with the subject and had actively participated in its development could possibly do.

The book is delightfully written, and the translation has been well and faithfully performed. The translator has increased the usefulness of the English edition by adding some of the more important papers published during 1912 to the literature cited in the original. C. J. M.

AN INTRODUCTION TO CARTOGRAPHY.

Maps and Survey. By A. R. Hinks, F.R.S. Pp. xvi + 206 + xxiv plates. (Cambridge University Press, 1913.) Price 6*s.* net.

STUDENTS of geography will find in this book an extremely useful account of those methods of earth and land measurement which provide the foundation on which most of their work is based. The procedure and the general results of various operations in surveying are described, but no attempt is made to furnish detailed instructions for executing a survey. These are to be sought in manuals of surveying. On the other hand, the author has provided a clear and comprehensive account not only of the simpler methods of topographical surveying, but also of the more elaborate operations which are requisite where large tracts of country are concerned, and, moreover, of those refined operations which aim at determining the precise shape and size and the physical character of the earth.

Passing from the methods of measurement, the graphical expression of them in the form of maps is very fully dealt with, and especially the various methods of representing relief of surface by means of line, shading, and colour.

The use of maps being more widely practised than the land measurement which provides the data for their compilation, the first two chapters deal especially with maps, and a clear and concise account is given of the most suitable ways in which communications and the relief of the surface can be expressed in maps of various scales, as well as of the various conventions which are required to express geographical information clearly and concisely.

A very instructive chapter is that in which a series of topographical map sheets, both British and foreign, are analysed to show the methods employed for presenting different classes of geographical data, and many coloured examples of these maps are included. We look forward to see this portion of the book further extended in future editions, so as to discuss the representation of other classes of geographical data and phenomena, besides settlements, communication, and relief, with the view of showing them to the best advantage, perhaps as special maps, without their being masked by other detail, as not infrequently is the case at present.

The general account of surveying methods, both the elementary and the more elaborate and precise, occupies the greater part of the book, which is to be recommended to all students of geography as providing them with descriptions of different methods of work, of which the special advantages and the limitations are clearly explained. The view held by many military topographers in this country, that the plane-table should be kept as simple as possible in form and equipment, is noted as having undergone some modification of late, and telescopic alidades with parallel rule attachment are now much used. It should be the local conditions of work in each case that should determine the form of plane-table as of any other instrument, and not a fixed rule, for the trained surveyor should continually modify both his methods and his equipment so as to produce work of the neces-

sary precision most economically. The short account of geodetic work will be useful to many, and the reference to the determination of longitude by the aid of wireless telegraphy directs attention to a means of transmission of time signals which has already proved valuable and effective in exploratory surveys. H. G. L.

A PRACTICAL VISIONARY.

The Works of John Caius, M.D., Second Founder of Gonville and Caius College, and Master of the College, 1559–1573. With a Memoir of his Life by Dr. John Venn. Edited, at the request of the Governing Body of the College and of the President and Fellows of the Royal College of Physicians, by E. S. Roberts, Master. In commemoration of the four hundredth anniversary of the birth of John Caius in 1910. Pp. xii+828. (Cambridge University Press, 1912.) Price 18*s.* net.

OWING to various circumstances, this important volume has not received earlier notice; but we may hope that in the case of a work of permanent value there may be some advantage in a later notice which shall recall attention to a standard volume which otherwise, in the flood of books from the press, might be temporarily forgotten. Its contents and the occasion of its appearance are sufficiently recorded in the title, and the names of its editors—including some not titular editors who collaborated in its production—are a strong guarantee of its faithfulness: names such as the late Master of Caius, Dr. Venn, the late Dr. Payne—a learned coadjutor who was lost to the world of letters and of medicine during its preparation—and Dr. Norman Moore.

John Caius, Second Master of Gonville and Caius College and sixteenth Master of the foundation, was born at Norwich, October 6, 1510. He was a personal friend of Gresham, and Martin's Bank has been the College bank in London ever since Gresham's day. Caius was in close friendship with Vesalius, and graduated at Padua. He seems even then to have been a man of some affluence, as, besides his leisurely education, he travelled widely and formed friendships with many other great men of science of that period, such as Gesner, for whom he wrote his "History of Englishe Dogges."

If it cannot be pretended that Caius was a man of any great intellectual originality, but he seems to have been intensely interested in scientific pursuits, and was equipped with wide, if rather old-fashioned, learning. His treatise on the Sweating Fever, if not profound, is the first original authority on this epidemic. But his claim to remembrance rests rather on his remarkable character and achievements than on his literary works. Not a genial man, "sad and stern," Dr. Venn calls him, and of weak bodily health, he seems to have lived much of an inner life, dwelling in ideas of dignified, studious, and austere foundations, such as colleges, whether academic or of crafts and mysteries; happily for us, both in Cambridge and in the College of Physicians he pursued these ideas with a devotion undaunted by temporary and worldly animosities and disappointments. His admiration of public service and of learning is seen in his honour to the memory of Linacre. Loving symbolism as he did, he was attached to the ancient forms of religion, and partly for this attachment, partly for his rigorous rule, he was treated in his Cambridge college with what nowadays we should call savage brutality, and in any age base ingratitude. Still, he never blenched, never for the raging of wicked men did his ideals fade or fall. Even to the last, when driven by turbulent youths from the College which he had re-founded, and almost on his deathbed, his eyes fixed with a noble faith on the future, he continued to provide his college with additional endowments and statutes. Unhappily, although if he could see his college now his spirit would rejoice, yet for centuries after his death his wise rules were neglected, and the provisions he had especially made for medical studies set aside and perverted. But Caius has long come to his own; the household of his famous College, and we who reap what he sowed, are nurtured in perpetual thankfulness to the great idealist whose devotion and far-seeing wisdom, in spite of heavy discouragements, never lost his faith and his hope, but bountifully bestowed upon future generations the blessings so ill-requited by his own. C. A.

CERAMIC CHEMISTRY.

A Treatise on Quantitative Inorganic Analysis. Being Vol. i. of a Treatise on the Ceramic Industries. By Dr. J. W. Mellor. Pp. xxxi+778. (London: C. Griffin and Co., Ltd., 1913.) Price 30*s.* net.

THE ceramic chemist has waited many years for a thorough and comprehensive treatise on the quantitative analysis of the materials with which he has had to deal, and here at last is what he had so long and so urgently needed. Dr. Mellor states that "this book is to be considered as the first volume of a treatise on the ceramic industries," but the range of mineral substances used by the modern potter is so wide that Dr. Mellor has found it necessary to cover practically the whole field of inorganic analysis. At the same time, particular attention is given to the analyses usually required in the pottery industry; and here we may

mention specially the chapter on the rational analysis of clays as not only thoroughly sound in itself, but as typical of the comprehensive and judicious treatment of the subject which is so characteristic of this author's work.

The book is a very full compendium of special methods, with careful references to their original publication and an impartial summing-up of the advantages and disadvantages of each, generally followed by a minute description of the method used by the author himself and the data and working out of an actual analysis or estimation. It need scarcely be pointed out that all this is of the very greatest value to the student and to the industrial analyst; and, in fact, the personal note throughout the book is one of its most noticeable and valuable features. Innumerable suggestions and instructions in connection with analytical difficulties here given for the first time are due to the personal outlook of the author and to the methods of work adopted with his own students.

In the same spirit the book is fully and admirably illustrated by reproductions of photographs of the apparatus actually in use in Dr. Mellor's laboratory, and descriptions of the construction, principles, and use of the various appliances are unusually detailed, complete, and illuminating. Special attention may be directed to the chapters on filtration and washing, on sampling, on abbreviated analyses and analytical errors, and to the description of electrolytic methods for the determination of the metals.

Part iii. on the analysis of glasses, &c., is particularly valuable, dealing as it does with a very difficult branch of analytical work and in a most lucid and helpful manner. The tables given in the appendix, some of which have been compiled especially for this work, add greatly to the usefulness of the book. We look forward to the publication of the second volume, which, if it carries out the promise of this first, will complete a very notable and important work on the ceramic industries.

DAIRYING.

(1) *British and Colonial Dairying: For School, Farm, and Factory.* By G. S. Thomson. Pp. xi + 464. (London: Crosby Lockwood and Son, 1913.) Price 5*s.*

(2) *Farm and Creamery Butter-making and Student's Reference Book.* By C. W. Walker-Tisdale and T. R. Robinson. Pp. 194. (London: John North, 1913.) Price 3*s.* 6*d.* net.

(1) THE aim of the author, one learns from the preface, is "to put into plain, practical language information that will assist to correct errors which are preventing development of important phases of the dairying industry." A careful perusal of the book leads to a favourable verdict upon the results of his labours, but the feeling that some of the subject-matter might have been omitted without much loss must be recorded.

One finds that the term dairying has been used in its most extended meaning, and has been made to cover a very large number of subjects, *e.g.*, breeds of cattle, dairy education, bacteriology, milk record keeping, poultry raising, analysis of dairy products, etc. All these matters and many more certainly enter in some way or other into dairying, and we are glad to have information about them, but they tend to make the volume more encyclopædic than is desirable. On reading these pages one feels, however, that they are written by a man who has first-hand knowledge of what he writes about, and the frequent personal recommendations give an added value to the book.

The scope of the volume has not been limited even to the British Empire, as the title suggests, for dairying in Denmark, Sweden, and Siberia are treated of, as well as the making of cheese in France. The dairying laws of America, Holland, Switzerland, Denmark find place alongside those of Great Britain, and will be most useful for reference. The chapters dealing with diseases of cattle and with bacteriology are written in clear and not too technical language. The section on the analysis of dairy products is confined to an account of the composition of the various substances discussed. The volume is extremely well printed and produced.

(2) The new edition of this well-known handbook is the third revision, and there has been added a chapter dealing with the utilisation of dairy by-products. This addition is very welcome for the profitable disposal of separated milk and buttermilk is often a serious problem to the dairyman. Where the requisite attention can be given to poultry, experience shows that the use of separated milk for fattening purposes is one of the best means of disposing of it. Alternative suggestions are also made in this chapter.

The section dealing with the construction of the dairy is very sound, and is particularly to be recommended where a new building is contemplated; an ornamental exterior and a lavish use of white tiles for the internal walls do not necessarily provide the degree of cleanliness and ventilation that is necessary where such a delicate article as butter is being made. High praise can also be given to the sections on the production of cream, cream percentages for churning, cream ripening, and to the careful detailing of the various operations of butter-making. The novice

will find this latter part most helpful, and the old hand will be glad to have it for reference.

In the chapter dealing with butter-making in the creamery there are full details of the appliances, fittings, &c., required in a modern creamery, also an estimate of costs. One feels on reading these chapters that if the large amount of practical information that they contain could be used as the basis of a separate volume on the subject, it would be welcomed by many creamery managers. It is perhaps doubtful, however, if there would be a sufficient demand in the British Isles for such a book. The chief regulations of the Tuberculosis Order, and the laws relating to the use of preservatives, the composition of milk, &c., are also printed, and these, together with a glossary of terms used in dairying, will be of much assistance both to students and those in practice.

POPULAR, PRACTICAL, AND SCIENTIFIC NATURAL HISTORY.

Messmates: A Book of Strange Companionships in Nature. By Edward Step. Pp. xii + 220 + 48 plates. (London: Hutchinson and Co., n.d.) Price 6*s.* net.

(2) *The Infancy of Animals.* By W. P. Pycraft. Pp. xiv + 272 + plates. (London: Hutchinson and Co., n.d.) Price 6*s.* net.

(3) *Injurious Insects: How to Recognise and Control Them.* By Prof. W. O'Kane. Pp. xi + 414. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 8*s.* 6*d.* net.

(4) *The Moorlands of North-Eastern Yorkshire: Their Natural History and Origin.* By Frank Elgee. Pp. xvi + 361 + plates + maps. (London, Hull and York: A. Brown and Sons, Ltd., 1912.) Price 12*s.* 6*d.* net.

THERE is a certain want of coherence in the chapters, and of arrangement in the subject-matter, which suggest that Mr. Step's book on messmates (1) is composed of a series of originally disconnected articles. If these had been properly welded together, the volume, which is well and interestingly written, and has the advantage of combining botanical as well as zoological instances of organic cooperative association, would, with the addition of one or two important cases that are omitted, have held the field for a long time as a popular up-to-date exposition of the subject it deals with. After reading the first chapter, which describes the association of bacteria with the Leguminaceæ, of Zoochorella with Convoluta, of fungi with algæ, and similar cases, the reader will be somewhat disconcerted to be told at the beginning of chapter ii. that "so far we have dealt with those animals who not only meet at meal-times, but occupy the same or adjoining dormitories." This chapter, indeed, seems to be misplaced in the book; but it is by no means the only instance attesting lack of editorial supervision. Since, moreover, Mr. Step has evidently taken great pains to get his facts together, it was surely a mistake on his part to omit in the main quotation of the books he consulted. A bibliography adds little to the bulk, but much to the value of a book of this kind. A good idea of its scope may be gathered from the chapter headings—"Sponges and their Guests"; "Sea Anemones and Corals and their friends"; "Molluscs as Hosts and Lodgers"; &c.

Mr. Pycraft's volume on the infancy of animals (2) is one of the same series as the last. Like nearly all popular books on natural history, which purport to deal with the entire animal kingdom, it is open to the criticism of giving wholly inadequate space to the invertebrated classes. Roughly speaking, for example, fifty pages are devoted to mammals, one hundred to birds, eighty to reptiles, amphibians, and fishes combined, and only thirty to the invertebrates. No doubt the author was restricted in the matter of space, and had to sacrifice groups considered to be of small popular interest. But whatever may have been the reasons for the sacrifice, it was, we think, a mistake; for the tale of the growth and metamorphosis of the invertebrates, if properly told, is one of surpassing interest to the layman, and tells of a subject about which he does not know where to go for information. The birds, moreover, might, without detriment, have been disposed of in about half the space allotted to them, for no one would consult a book of this description for facts about the palatal structure of the skull and Huxley's opinion as to its systematic importance. This and a good deal more which Mr. Pycraft, unless we are mistaken, has already published elsewhere, seems to be out of place in the volume. In fact, the author seems to have allowed, in places, his own predilections to obscure his judgment as to what was germane to his subject and likely to be interesting to his readers. These blemishes apart, however, the book, so far as it goes, is a very readable account of the differences between the young and the adults of the species dealt with, and of the generally accepted reasons for these differences, the care of the parents for their young, and the changes the latter undergo when passing from youth to maturity.

As its title suggests, Prof. W. O'Kane's volume on injurious insects (3) is a work on entomology treated from the point of view of

economics. The subject-matter is divided into three parts. Part i. is a brief and concise account of the structure, habits, and classification of insects; part ii. deals with sprays, fumigants, insecticides, and other means of controlling or destroying injurious insects. Part iii. is devoted to the insect pests themselves, and takes up nearly three-quarters of the volume. In this section the insects are grouped as follows:—(1) Pests of garden and field crops, including all injurious species commonly found on such plants as corn, potatoes, cucumbers, wheat, and the like, as well as those that occur in conservatories. (2) Pests of apples, currants, strawberries, and other orchard or garden fruits. (3) Pests of the household which destroy preserved foodstuffs, and those which infest domestic animals.

It may be noticed that under this heading are included some species of Acari, like the cattle-tick, and the sheep-mite, which, strictly speaking, should have been omitted, since they are not insects. In other parts of the work, too, Acarine plant pests, like Ericphyes, Tetranychus, and Bryobia, find a place. This is not, however, a matter of any real importance, but half a page of chapter vii., entitled "How Insects are classified," might with advantage have been given to the Acarine Arachnida.

In the chapters devoted to the pests of garden and field vegetables and fruit, the various species are arranged according to the place where they are found at work, like root-feeders, bark-feeders, leaf-, fruit-, or flower-feeders and borers. A great feature of this practically useful volume is the number of excellent illustrations of the insects and their work it contains. Of these there are more than six hundred inserted in 379 pages of text.

Although this book is especially written as an aid to fruitgrowers and agriculturists in North America, it will be to all intents and purposes equally serviceable on this side of the Atlantic on account of the close similarity between the edible plants and the insects which infest them in the United States and in Europe.

Mr. Elgee's volume describing the moorlands of north-eastern Yorkshire (4) is an expansion of several papers issued five or six years ago in local natural history periodicals. It is an extremely useful and thorough piece of scientific work, the publication of which was made possible only by the generous support of subscribers. It is also well written and well illustrated, not only with photographs showing the general aspects of moorland scenery and some of the principal plants and animals, but also with maps exhibiting the distribution of several of the genera and species in other parts of the world. It is claimed by the author, and, so far as we are aware, justly claimed, to be the first English book which deals with the moors of a district from a scientific point of view, and treats of their varied phenomena as a coherent whole; and it differs mainly from the innumerable volumes on the moors of Great Britain and the Continent in that it considers not only the botany, but also the zoology and geology of the particular moorlands described in their relationship and interdependence. Amongst other interesting questions connected with this subject, Mr. Elgee discusses the evidence supplied by the peat beds as to primitive woodland on the moors; the relationship of the glaciation of the district to its fauna and flora; the conditions which determine the existence of moors; the origin of the flora and of some of the characteristic species of animals, such as the red grouse, and the Lepidoptera. The book will be welcomed by all naturalists who live within reach of moors and heaths. R. I. P.

SCHOOL GEOGRAPHY.

(1) *A Geography of the British Empire.* By W. L. Bunting and H. L. Collen. Pp. v+159. (Cambridge: University Press, 1913.) Price 3*s.* 6*d.* net.

(2) *Preliminary Geography.* By E. G. Hodgkison. Pp. xvi+225. (London: W. B. Clive, 1913.) Price 1*s.* 6*d.*

(3) *History of Geography.* By Dr. J. Scott Keltie and O. J. R. Howarth. Pp. ix+154. (London: Watts and Co., 1913.) Price 1*s.* net.

(4) *Principles and Methods of Teaching Geography.* By F. L. Holtz. Pp. xii+359. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 5*s.* net.

(5) *Das Mittelmeergebiet; seine Geographische und Kulturelle Eigenart.* By A. Philippson. Dritte Auflage. Pp. x+256+15 plates. (Leipzig and Berlin: B. G. Teubner, 1914.) Price 6 marks.

(1) BY the teaching of the geography of the Empire apart from its world setting, there is always a danger of giving a distorted view, but with this reservation we have seldom seen a better or more educative book than that of these two authors. It is full of ideas, ably expounded, and the geographical treatment is never lost sight of among the many aspects touched on, nor are the causal relations ever allowed to become vague and speculative. The use of an atlas is insisted on throughout, and there are numerous questions, well devised and full of suggestion. They alone make the book

of considerable value. Communications and questions of distance and comparative areas are treated in a full and original manner, which obviates to some extent the usual drawbacks attendant on a geographical study of Empire. Presuming, however, that this book is not intended for beginners, we think that the brief physiographical introduction might have been omitted. A few points call for revision in a future edition. "A map is a picture of the earth's surface or any part of it" is not a happy definition, nor is that of isotherms as "contours of heat." The term fjord is several times used in a sense that includes ria. The Falkland Islands merit more than a casual reference, and Antarctica should be mentioned as one of the continents. There are many excellent sketch maps and a number of well-chosen pictorial illustrations. The book is a sound one, and deserves wide use.

(2) Despite the wide and varied experience in teaching geography which Mr. Hodgkison claims, we cannot congratulate him on a satisfactory volume. Facts and definitions there are in abundance hurled one after another at the reader, but of explanation and correlation there is little, and of description scarcely any. An attempt has been made to compress too much into a small space, so that the book is heavily overloaded with facts, and uninteresting for pupils of eleven to fourteen for whom it is intended. The physical geography is best, but the human and economic is poor and scrappy, and in places reminiscent of the old-fashioned lists of the text-books of last generation. Thus the significance of the position of important centres of population is generally lost sight of, the bare fact of the existence of towns being deemed sufficient in most cases. The treatment of the British Isles, however, is fuller, and, being less laconic, is more satisfactory. The volume certainly contains few mistakes, but there are some statements that are inaccurate or misleading. On p. 24 it is stated that "the greatest and most magnificent (glaciers) in the world are in Central Asia." Of lakes the author says (p. 25): "Sometimes the water is salt, and may be even much salter than the water of the ocean." Are children expected to understand this without explanation? The description of a fjord on p. 27 is incomplete, and the explanation of the monsoons on p. 50 smacks of the old "central Asian" fallacy. Most of the maps are crude. With the capable teacher this book might be of help to a pupil, but more probably it would give him a distaste for geography.

(3) Dr. Keltie, with the assistance of Mr. Howarth, has essayed to write a history of geography within the small compass of a shilling volume, and he has ably fulfilled his difficult task. It is largely a history of exploration, but other aspects of geography are not neglected. The book is well proportioned and commendably accurate, besides being written in a most agreeable style, which makes it easy reading, despite the many names of men and places which it contains. A misprint with regard to the date of the discovery of Spitsbergen appears on p. 75, and while the work of Dr. J. Rae is mentioned, he does not receive credit for his discovery of the fate of the Franklin expedition. We miss also any reference to the late Lieut. Boyd Alexander. There are a few useful illustrations of old maps, a short bibliography, and a full index. The volume deserves a wide sale, and might profitably be used in the higher classes of schools.

(4) This thoughtful volume should be a great help to any teacher of geography, for although it sometimes dwells unnecessarily on the perfectly obvious, and is not free from repetition, it is full of suggestions and practical hints, such, for example, as the simple geographical issues involved in shops and streets in everyday life. Mr. Holtz emphasises the importance of dwelling on the human aspect of geography, and he would subordinate physical geography to this in lower classes. He rightly says that while causal relationships in human geography may be beyond the grasp of young children, the simpler ones are easily understood, and the explanation of others may come later. We are glad to read his advocacy of descriptive geography for young children. Increased attention might be paid to that in this country without prejudice to more advanced scientific study of the subject in higher classes. The warning note against pushing geographical determinism too far should receive attention. The chapters on cartography and the history of geography are the least satisfactory by reason of their brevity, but the book is a stimulating one, written by one who is evidently a geographer as well as a teacher of geography.

(5) This is the third edition of a work first published in 1904, and is based on a course of lectures delivered to teachers. It is a treatment of the geographical conditions of the Mediterranean region as a whole, and their influence on man and his history. The purpose is well kept in view, and, despite a certain amount of unequalness in treatment, the book is a most interesting one. Evidently the author prefers not to confine himself to physical limits, but rather to take the less defined racial and cultural boundaries of the Mediterranean region. The treatment includes Mesopotamia. There are a number of outline maps, besides several illustrations. R. N. R. B.

THURSDAY, FEBRUARY 12, 1914.

A GERMAN INTRODUCTION TO THE STUDY OF MIMICRY.

Mimikry und Verwandte Erscheinungen. By Dr. Arnold Jacobi. Pp. ix+216. (Braunschweig: F. Vieweg und Sohn, 1913.) Price 8 marks.

THE scope of the work before us is sufficiently indicated by a list of its main sections. A brief general introduction is succeeded by a division of the subject under nine heads:—(i.) Protective Colouring; (ii.) Protective Resemblance; (iii.) Warning Colours; (iv.) Mimicry or Protective Imitation; (v.) The Imitation of Aculeate Hymenoptera, or "Sphecoidie"; (vi.) The Imitation of Ants, or "Myrmecoidie"; (vii.) The Imitation of Beetles; (viii.) Mimicry in Lepidoptera; (ix.) The General Characteristics of Mimetic Lepidoptera. Some of the principal memoirs in the literature of the subject are named in a short list at the end of the volume, but anything like a complete treatment is manifestly impossible in a work of this size.

Protective colouring (Schutzfärbung) and protective resemblance (Schützende Aehnlichkeit) are the terms employed by the author for the two kinds of cryptic colouring which have been called general and special protective resemblance. In the first the animal seems to melt into its surroundings; in the second it resembles some actual object. No mention is made of Thayer's interesting combination of the two principles in animals with a general obliterative colouring upon which are represented the details of the normal environment. Nor is there any reference to the same naturalist's brilliant interpretation of the white under-sides of animals.

The criticism, urged on p. 8, that we do not *know* whether the cryptic appearance is truly advantageous and really exists for the eye of the insect-eater can only be fully met by increased knowledge. In the meantime it is obvious that certain birds do hunt for their prey over tree-trunks that are not swept bare, even after many months of intermittent searching, but still harbour sufficient pupæ to keep up the average numbers of the species. We know too that birds will assemble in order to feed, when insects which must ordinarily be searched for are driven out by a grass fire or by "Driver" ants on the raid. And no one who has watched the pursuit of a cryptically coloured moth by birds in the immediate neighbourhood can doubt that it would have been attacked when at rest if only it had been seen.

The resemblances of the Membracidæ to thorns, bark, &c., is dismissed by the author (p. 15) as examples of "Museum Mimicry," for the very inadequate reason that these Homoptera are "mighty jumpers," and when disturbed "disappear after the manner of the flea." Well-concealed species are generally swift in their movements when they are disturbed. Furthermore, W. A. Lamborn has shown that the dark, bark-like West African Membracids are ant-attended when found on green stems. Companies of individuals are always found on old bark, as are females engaged in egg-laying—a very prolonged operation, lasting from thirty-six to forty-eight hours, during which the insect clings tenaciously to the egg-mass and is with difficulty disturbed (Trans. Ent. Soc., 1913, pp. 494–7). The author admits the wonderfully ant-like appearance of some tropical American Membracids, but rejects an interpretation based on the theory of mimicry because ants run and Membracids jump. The idea of a second line of defence does not seem to have occurred to him; and yet in nearly all the examples he accepts there *is* a second line, depending on powers of flight very different from those of the model.

The author has evidently taken considerable pains in studying the work that has been done in this country and expresses regret that his compatriots have not taken a larger share in it. There is, however, one subject which has escaped him, viz., the power of individual adjustment to the colours of the environment as exhibited by insects. On this power he can find nothing in English except "a meagre experiment . . . on butterfly pupæ"! (p. 25). The present writer is, moreover, bound to disclaim the honour of having influenced some of the names that are here set down—for example, the late Thomas Belt, whom he never had the pleasure of seeing, but to whom, for the "Naturalist in Nicaragua," he owes a deep debt of gratitude. Although the author writes with generous appreciation of British work, and appears to agree with its general tendency, he differs strongly from many conclusions on special points, and offers criticisms which it will be a pleasure to attempt to meet on some future occasion.

It is satisfactory to find the recognition, on p. 35, of a fact often forgotten—"that even the protective adaptation which is apparently the most perfect does not give security against detection—that creatures thus equipped have their special foes which can find them out, at least when driven by hunger." Similarly the polymorphism of the leaf-butterflies, Kallima, &c.—a stumbling-block to