THURSDAY, NOVEMBER 28, 1912.

SCIENTIFIC WORTHIES.

XXXIX.—Prof. Jules Henri Poincaré, For.Mem.R.S.

IT has only happened on one or two occasions that the subject of an article in our series of Scientific Worthies has had to be referred to in the past tense; and we deplore that such should be the case now. Many men of science continued to make important additions to the monument of natural knowledge long after contemporary contributors to this series had paid tribute to their achievements, and fortunately some are still with us. A testimony to good and faithful work has its interest vastly increased when it can be accompanied by the thought that past performances may be equalled, or even excelled, by future accomplishments. This satisfaction is denied us when *Finis* has to be written against a man's work; and though the coral-rock represented by it may be strong and beautiful, it lacks those qualities of activity and growth which were once manifest on its summit and are essential attributes of the scientific spirit.

A great man of science builds not so much for his own generation as for the generations which follow him. As M. Berthelot once said:—"If each of us adds something to the common domain in the field of science, of art, of morality, it is because a long series of generations have lived, worked, thought, and suffered before us." For workers of to-day and to-morrow M. Poincaré not only opened new fields, but pointed the way to discovery by those who follow him. Mathematics, physics, astronomy, philosophy, and other domains of intellectual activity have all been extended and illuminated by his genius. The search for truth was for him a passion, and all his work was animated by it. His "Science and Hypothesis" represents an examination into the solidity of the foundations upon which scientific reasoning is based. To the superficial reader the work may appear iconoclastic, but many of the images it destroys should never be set up in the temple of scientific belief; and if they cannot stand before the strong rays of relentless logic, science is better without them. For in nature

> "Beauty is truth, truth beauty; that is all
> Ye know on earth, and all ye need to know."

That such a brilliant and original thinker as M. Poincaré should have died, on July 17 last, at the relatively early age of fifty-eight is a cause of world-wide regret. It would take several articles to do justice to his work and scholarship, but we must here limit ourselves to appreciative mention of a few prominent points of a remarkable career.

M. Poincaré was born at Nancy on April 29, 1854, and commenced his studies at the Lycée there. He afterwards passed successively through l'École Polytechnique and l'École nationale supérieure des Mines, receiving his doctor's degree in mathematical sciences from the University of Paris in 1879. He then began his career as instructor in mathematical analysis at the University of Caen, from which position he was called in 1881 to occupy the chair of physical and experimental mechanics at the Sorbonne (University of Paris). Later he occupied the chair of mathematical physics, and, after the death of M. Tisserand, he passed to that of mathematical astronomy and celestial mechanics. M. Poincaré was elected a member of the Paris Academy of Sciences in 1887, and a member of the French Academy in 1908. He was president of the Academy of Sciences in 1906, and of the Bureau des Longitudes in 1899 and 1909. He was also an honorary member of most of the leading scientific societies of the world, and received honorary degrees from the Universities of Oxford, Cambridge, Glasgow, Christiania, Stockholm, and Brussels. In 1901 the first award of the Sylvester medal of the Royal Society was made to him in recognition of his many and important contributions to mathematical science.

The first volume of a series entitled "Savants du Jour," published in 1909 by Messrs. Gauthier-Villars, of Paris, is devoted to M. Poincaré, and it contains a list of more than four hundred of his publications relating to mathematical analysis, analytical and celestial mechanics, mathematical physics, and philosophy of science. But the value of Poincaré's work is not to be estimated merely by its bulk, although that is unusually large; he never wasted words or wrote on trifles, and his shortest notes, like those of Hermite, are always worth attention. Again, the range of his topics was very wide; arithmetic, probability, function-theory, dynamics, mathematical physics are all indebted to him for results of interest and often of the greatest importance. Finally, he had, in the highest degree, the gift of literary style; few of his scientific compatriots can rival him in directness, simplicity, and grace. There is a story that Clifford, during a walk with a friend, made him understand the gist of Abel's theorem; it is easy to imagine Poincaré, in similar circumstances, suc-

cessfully expounding the nature of the Fuchsian functions.

Many must be able to recall the delight with which they read those famous memoirs in the early volumes of the *Acta Mathematica*, and the eagerness with which they turned to each new part, in the hope of finding more of this enchanting *causerie*. Few formulæ, and short ones at that; just a succession of brief, almost conversational, sentences opening up a new and vast domain in which even such a subject as elliptic modular functions took a place like that of reciprocants in the general theory of differential invariants; new vistas and new problems presenting themselves on every side. It is easy enough to trace the lineage of the automorphic functions. Immediately suggested by Fuchs's work on differential equations, and actually a generalisation of modular functions, they are historically the outcome of Gauss's memoir on the hypergeometric series, and Riemann's paper on the P-function. To say this is no detraction from Poincaré's merits: the fact is that, like Lejeune-Dirichlet, he won many of his highest triumphs by his extraordinary power of seizing the main points of an existent theory, simplifying it by an appropriate analysis, and then extending it beyond all expectation. Compare, for instance, the present positions of the theories of modular functions and of Fuchsian functions. In the former, apart from further application to arithmetic and the like, the one main problem that still remains is to find out, if possible, the arithmetical characters of all the sub-groups of the modular group; in the latter there are difficulties at the outset, arising from the fact that in certain families of Fuchsian groups there are conditions of inequality which involve troublesome relations connecting the constants of the generating substitutions. In this and in other matters Poincaré did not go into detail: but he pointed out the way for others by his distribution of the functions into families, and by his geometrical method with its non-Euclidean interpretation. Perhaps the crowning result of his work in this direction is his theorem that the coordinates of any point on an algebraic curve can be expressed as one-valued Fuchsian functions of a parameter. This is analogous to the representation of a point on a circle by $(\sin\theta, \cos\theta)$, and is to be distinguished from the Puiseux-Weierstrass representation of an element of the curve.

A more definite example of Poincaré's power of dealing with a classical problem is afforded by his work on rotating fluid masses. Long ago it was shown by Jacobi that an ellipsoid of three unequal axes was a possible figure of relative equilibrium: but it was reserved for Poincaré to take up the problem afresh, and develop the solution into what may fairly be called (apart from details) its final and definite form. He shows the existence of whole families of figures of equilibrium, including as particular cases those already known; gives analytical criteria for stability; and proves that when, by varying the parameter that generates a particular family, we pass from stability to instability, the critical surface is one of "bifurcation," that is, it simultaneously belongs to two distinct families. In some respects this is analogous to the way in which a curve $f(x, y, \mu)=0$, by variation of μ, acquires a double point, and then alters what may be called its connectivity; and in any case, without pressing the analogy, Poincaré's results here seem typical of what happens, with regard to stability, in the variation of dynamical systems. The value and originality of these researches was recognised by Sir G. H. Darwin in his address to the Royal Astronomical Society, when its gold medal was presented to Poincaré (Feb. 9, 1900).

The contributions of Poincaré to celestial mechanics not only brought new life to a subject which showed signs of becoming stale, but undoubtedly opened up a fresh line of investigation. Starting with an idea due to G. W. Hill, who, in his turn, was indebted to Euler, he brought the whole range of his great knowledge and power of analysis to bear on a problem which has baffled the ingenuity of mathematicians for more than two hundred years. That he did not succeed in solving it, either in the old or the modern sense, is no criticism on his achievements; it is sufficient to say that he opened the way and explored a new region by routes which may ultimately lead to the final goal—a demonstration of the stability or instability of the solar system.

His investigations on the general problem of three bodies are principally contained in the three volumes entitled "Les Méthodes Nouvelles de la Mécanique Céleste," which form a natural sequence to the earlier prize essay of 1889. The foundation of the work is the now well-known periodic solution of a set of differential equations. Hill had developed one such solution arising in the motion of the moon round the earth; Poincaré considers periodic solutions of any class of differential equations, examining their general properties and the conditions for their existence. He then takes up the special properties of the equations of dynamics and, descending still further

into details, the applications to the problem of three bodies and to restricted cases of this problem. No general method for finding the solutions, nor for discovering the full number of them, is obtained, but these needs are being supplied by the researches of Darwin, Moulton and others into the possible orbits which may be described in various circumstances.

The periodic orbit only represents a particular solution of the equations of motion. Poincaré obtains a general solution within a limited range of the arbitrary constants by considering those differing slightly from the periodic solution. In this connection arise the "characteristic exponents" which may be somewhat loosely taken to give the various periods present in the general solution. These exponents form the bridge which enables him to enter into such questions as the existence of integrals, the analytic forms of possible solutions and the convergence or divergence of the series thus formed. His proof that there cannot exist any algebraic or transcendental integral of the problem of three bodies (under a restriction as to the magnitude of the masses) beyond those known is an important advance on Bruns' result—that no new algebraic integral exists, although the latter is true for any values of the masses.

Not less important is his examination of the older methods from the logical point of view. His presentation of these is nearly always fresh and novel; he is rarely content with previous methods of arriving at the results. This change is perhaps necessary, for he has a different object in view; nevertheless, the reading of them frequently gives the impression that Poincaré simply took the premises and the conclusions and found it less difficult to work out the latter from the former in his own way than to go fully into the author's work. Perhaps the most startling result was his discovery that the majority of the series which have been used to calculate the positions of the bodies of the solar system are divergent. This fact, of course, required an examination into the reasons why the divergent series gave sufficiently accurate results: hence arose the theory of asymptotic series now applied to the representation of many functions.

The crux of the problem is the divergent series. The functions are only represented in the numerical sense by series, and we do not know their limits. Can we argue one way or the other as to the stability of the system? In other words, is the ultimate divergence peculiar to the functions, or is it merely due to our inability to obtain expressions from which a conclusion can be deduced? The question remains unanswered. Gylden believed that he had overcome the difficulty, but Poincaré has shown that it still exists.

Whilst the greater part of Poincaré's researches are thus confined to the logical side of the problems in celestial mechanics, we have occasional papers in which he developed methods useful for actual calculation, in addition to those chapters of the "Méthodes Nouvelles" which are devoted to this part of the subject. Amongst them may be mentioned one on the lunar theory, in which he developed a method with rectangular coordinates which appears to be of value for obtaining algebraic expressions for the coordinates of the moon. There are also two papers dealing with librations in planetary systems which open a way to the more extensive treatment of this complex subject. They have received less notice on account of their narrower range of application; they are incorporated with other matter in his "Leçons de Mécanique Céleste." The recently published volume on cosmogony is of a different nature. It is chiefly a presentation, given originally in a course of lectures, of the works and theories of others, but he does not hesitate to express his own opinions as to their importance in a discussion of the evolution of solar and stellar systems.

A pure mathematician might be pardoned for doubting whether the world, as a whole, benefited by Poincaré's appointment to a chair of mathematical physics. The redactions of his early lectures on electricity and optics have to be read with a certain amount of reserve; he is not yet sure of his ground, and is assimilating the ideas of others. It is difficult to conjecture what he might have done if he had been able to follow up his original bent, which was undoubtedly pure analysis; it would certainly have been something very great. On the other hand, he popularised the Maxwellian theory of electricity, and ultimately mastered it, as well as more recent developments, so that he was able to make contributions to the theory of electrons and that of diffraction. And even in a bare outline, such as this, of his best work, we ought not to pass over his masterly papers on potential and similar subjects, which form the bridge, so to speak, between Neumann and Fredholm.

Poincaré did not disdain to write for a popular audience. "La Science et l'Hypothèse" has deservedly had a wide circulation, and affords a

good view of the author's personality. With all his genius, Poincaré was an orthodox thinker by nature; in the case of non-Euclidean geometry, which he fully appreciated, his criticisms are acute and valuable; his sceptical attitude towards Cantor's theory of transfinite numbers is amusing, but not altogether surprising, and is perhaps the only instance of his shutting his eyes to a great mathematical discovery. Kelvin's long opposition to the electromagnetic theory of light is another illustration of the same sort of thing.

To give a just estimate of the value of the researches of Henri Poincaré is not possible at the present time, nor is it necessary. The almost immediate recognition they obtained, the increasing impression of their fundamental importance, and the numbers of students who have followed and expanded the ideas which he laid down with so sure a hand are the best testimony of their worth. We do not know what further contributions he would have made to mathematical science, had he lived, but we do know that what he achieved gives him a permanent place in the history of the subject.

THE PHYSICS OF THE UNIVERSE.

Lehrbuch der kosmischen Physik. By Prof. W. Trabert. Pp. x+662. (Leipzig and Berlin: B. G. Teubner, 1911.)

THE primary justification of a treatise on cosmical physics is to be sought in the principle that economy of communication is of the very essence of science. The author of such a book cannot hope to deal so competently with the individual subjects as the experts to whose writings he must have recourse for his own knowledge, but his work will be a real contribution to the progress of science if he succeeds in imparting unity to his treatment of subjects which have been developed by different workers, each more or less superficial in his knowledge and appreciation of the work of those outside his own branch. Judged from this point of view Prof. Trabert's book is successful. It has been developed according to a definite and well-ordered scheme.

A natural impulse is to compare the book with the masterly treatise with the same title which Arrhenius published ten years ago. The principal difference between the two works is in size and order. The older book covers 1000 pages, of which about 400 are devoted to meteorology; the new one contains 650 pages, of which only about 100 can be spared for meteorology. Arrhenius starts with the "Physik des Himmels," the stars, the sun, the planets, and proceeds from that to the "Physik der Erde," the form and constitution of the earth and the sea, the tides and the ocean currents. He deals finally with the "Physik der Atmosphäre," meteorology, atmospheric electricity, and terrestrial magnetism. Trabert begins with an introductory chapter on the fundamental ideas of the physical concept of the universe. He then deals in order with the form of the earth and its place in the universe, the phenomena of motion—the motion of the sun, the stars and the earth, and tidal and earthquake phenomena, the processes of radiation, with especial reference to the earth's atmosphere, the exchange and transformation of energy, and finally with the development of the universe. Position, motion, energy, result, may be taken to represent briefly the order adopted.

A feature of the book is the care with which the historical development of the principal methods and ideas has been treated, and the retrospective chapters at the end of each section are especially interesting. Thus in the first section the determination of the distances of the sun and moon is traced from its earliest beginnings with Aristarchus and Hipparchus, down to the first exact measurements by Lacaille and Lalande, and the results of Newcomb and Gill. In the second section the different arguments for the rotation of the earth are set forth, including the observed deflection of the wind towards the right; we may commend to those who are sceptical of the effect of the earth's rotation upon motion along the surface the account, on p. 129, of the effect produced on the Hamburg-Harburg railway prior to 1877. In the account of seiches which is given in this section, no mention is made of the work of Chrystal and Wedderburn, and in dealing with star-streams no reference is made to Schwarzschild's hypothesis and the later developments. Such omissions, if they stood alone, might be regarded as incidental to the character of the book, but they indicate a lack of appreciation of recent developments which becomes astonishing when one finds no direct reference to the most important development of Prof. Trabert's own subject in recent years, *i.e.*, the discovery of the stratosphere and its explanation, with the concurrent development of our knowledge of atmospheric radiation and dynamical meteorology.

Apart from this blemish the book appears to be excellent. The use of mathematical formulæ has been avoided as much as possible, but wherever a mathematical demonstration affords the simplest and readiest proof of a result or is necessary for the strict development of the subject, the author has not hesitated to use it; frequently, however, he has given the general outlines of the reasoning in the text, and added the formal proof as a footnote.

The chief characteristic of the book is the broad view of the subject which the author has taken, and it is no doubt due to his desire to give an unbiassed treatment that he has dealt so sparingly with meteorology. That appears to have been an error of judgment, but the result is preferable to a book overloaded with unnecessary details.

E. GOLD.

FOODSTUFFS.

(1) *The Chemistry of Breadmaking.* By James Grant. Pp. viii+224. (London: Edward Arnold, 1912.) Price 5*s.* net.

(2) *Cocoa and Chocolate: Their Chemistry and Manufacture.* By R. Whymper. Pp. xi+327. (London: J. and A. Churchill, 1912.) Price 15*s.* net.

(3) *Cocoa: Its Cultivation and Preparation.* By W. H. Johnson. Pp. ix+186. (Imperial Institute Handbooks.) (London: John Murray, 1912.) Price 5*s.* net.

(4) *Foods: Their Origin, Composition and Manufacture.* By Dr. William Tibbles. Pp. viii+950. (London: Baillière, Tindall and Cox, 1912.) Price 18*s.* net.

(1) MR. GRANT'S preface implies that he set out to write a book suitable for the use of persons actually engaged in breadmaking, who have not had a scientific education and yet are desirous of knowing something about chemistry, physics and mycology in their relation to this industry. The book therefore covers a good deal more ground than is indicated by its title. Mr. Grant, in fact, attempts too much in the space at his disposal. As a result his descriptions are often so condensed and so full of unexplained scientific and technical terms as to be difficult reading to the special class of students indicated in his preface, even if they take his advice and study it "in conjunction with some simple text-books on chemistry, physics, mechanics, and the elements of biology and botany."

To students who have had some training in science or are studying breadmaking under a competent teacher at a trade school, the book will be quite useful, giving, as it does, a concise and trustworthy account of the whole subject. It is to be hoped that students using the book will not acquire Mr. Grant's habit of assigning unusual meanings to well-known words. Such a direction as "dry, desiccate and weigh" is a little puzzling when the word "desiccate" is taken in its ordinary sense.

(2) Mr. Whymper is a cocoa enthusiast, and the introduction to his book has about it faint suggestions of the mural literature so copiously devoted to this "grateful and refreshing beverage." He divides his subject-matter into three parts, dealing first with the botany and cultivation of the plant and the preparation of the beans, then with the manufacture of cocoa preparations, including chocolate, and lastly with the chemistry of cocoa. Though nearly everything that Mr. Whymper says in the first of these three parts is sound, this portion of the book, merely on account of its brevity, is scarcely up to the standard of the other parts. Thus, under preparation there is no reference to the fact that much of the Gold Coast cocoa is marketed in an unfermented condition, nor is it stated that some manufacturers in the United Kingdom prefer "unwashed" cocoa, alleging that it is of better flavour than the washed article. The statement that "claying" cocoa provides an additional protection against mould and fungoid growths may be true, but, in view of the fact that this practice easily degenerates into mere "weighting" of cocoa, it should have been mentioned that many manufacturers prefer cocoa that has not been "clayed."

Mr. Whymper's main object, however, is to discuss the manufacture and the chemistry of cocoa, and these sections of the book are very well done. The manufacturing processes are described clearly and concisely, and the changes in composition occurring at each stage of manufacture are carefully and thoroughly discussed. Analysts who have to deal with cocoa and its products will be grateful for the comprehensive and critical survey of the chemistry of cocoa provided in the third section. The book is well produced and the illustrations of plantation scenes and of machinery are very good.

(3) Most of the books on the cultivation of cocoa that have appeared so far have been written with a bias in favour of the practice of some particular area. Mr. Johnson escapes the temptation to err in this direction for the reason that, although his experience has been acquired chiefly in the Gold Coast, he has also had the opportunity of investigating cocoa cultivation in San Thomé, Ceylon, and the British West Indies, and has thus seen the industry carried on under widely different conditions. In discussing such important matters as the selection of a site and the formation of a plantation, he first states the climatic and soil requirements of the plant. The planter, using these data as a guide, is thus placed in the position of being able to select or modify methods to suit his local conditions, instead of being asked to follow blindly some particular practice, which gives good results elsewhere. The preparation of cocoa for the market, and especially such fundamental matters as fermentation, washing, and "claying," are very well discussed, not only from the planters'

point of view, but also from the more important one of the requirements of different markets. Two chapters are devoted to diseases and pests affecting the plant, and the appropriate preventive or remedial treatment for each is indicated. The volume is the second in the series of "Imperial Institute Handbooks," prepared with special reference to the requirements of British West Africa. It should prove especially useful in the Gold Coast, where cocoa is now the principal article of export.

(4) Dr. Tibbles's book is divided into five sections. The first deals with the nature, characters, and classification of the constituents of foods, and, though much condensed, serves to give a clear idea of the remarkable complexity of food, when considered in terms of the chemical compounds forming it. The second section covers foodstuffs of animal origin, meat and meat preparations, game, fish, cheese, butter, and other materials of this class being considered in turn. The commercial sources of each product, its manufacture and composition, and the characters which distinguish sound from unsound material are discussed, and notes are added regarding the advantages or disadvantages of each product as a food. The third section deals in like manner with foods obtained from plants. In the last two sections spices and condiments and beverages are discussed, the latter including tea, coffee and cocoa, as well as malt liquors and spirits.

The chemist who uses this book will find some of the data which especially concern him rather antiquated, and some of the statements so condensed as to be not strictly accurate. These and other defects of the same kind are, however, relatively unimportant in a book like this, which brings together for the first time a mass of carefully selected and classified information concerning foodstuffs. Dr. Tibbles is to be congratulated both on the courage which led him to undertake this task and the success with which he has achieved it.

TECHNICAL, POPULAR AND ECONOMIC ZOOLOGY.

(1) *Le Zebre.* Studio Zoologico Popolare. By Dr. Achille Griffini. Pp. xxviii+298; illustrated. (Milano: Ulrico Hoepli, 1913.) Price 4 lire.

(2) *La Pêche au Bord de la Mer.* By Lucien Jouenne et J.-H. Perreau. Pp. 311. (Paris: J.-B. Baillière et Fils, 1912.) Price 4 francs.

(3) *Bees shown to the Children.* By Ellison Hawks. Pp. xii+120; illustrated. (London and Edinburgh: T. C. and E. C. Jack.) Price 2*s.* 6*d.* net. (The "Shown to the Children" Series.)

(4) *A Hand-list of British Birds.* With an account of the distribution of each species in the British Isles and abroad. By Ernst Hartert, F. C. R. Jourdain, N. F. Ticehurst and H. F. Witherby. Pp. xii+237. (London: Witherby and Co., 1912.) Price 7*s.* 6*d.* net.

(5) *Liverpool Marine Biology Committee: L.M.B.C. Memoirs on Typical British Marine Plants and Animals.* Edited by Dr. W. A. Herdman, F.R.S. XX. Buccinum (the Whelk.) By Dr. Wm. J. Dakin. Pp. viii+115+8 plates. (London: Williams and Norgate, 1912.) Price 4*s.* 6*d.*

(6) *Das Tierreich.* 31 Lieferung: Ostracoda. By G. W. Müller. Pp. xxxiii+434. (Berlin: R. Friedländer und Sohn, 1912.) Price 32 marks.

THOSE interested in zebras and quaggas will find an excellent account of these animals in Dr. Griffini's little book (1), which is one of the series of useful manuals edited and issued by Ulrico Hoepli, of Milan. That he has thoroughly grasped the conclusions of the most trustworthy recent authorities is shown by his discussion and rejection of the claim that the existing striped Equidæ can be logically entitled Hippotigris, by his adoption of the view that four, and only four, species, namely, *Equus grevyi, E. zebra, E. foai* and *E. quagga,* the latter including as subspecies all the so-called *burchelli* forms, can be admitted, by his summary of the evidence supporting the relative significance of the coloration, and of the evidence favouring the view that the pale, and not the dark, bands are in reality the "stripes." Writing as an expounder rather than as an original researcher, Dr. Griffini is, of course, aware that his classification and synonymy of the local races of *E. quagga* must be regarded as tentative instead of final; but, considering the difficulties of the question, his attempts at its settlement, although not above criticism, do credit to his perspicacity. We have only one serious fault to find with the book. It has no index. In the place where the index should be is a complete list of the author's contributions to zoology, which show that his time has been mainly devoted to the study of systematic entomology. Perhaps it is to the training thus acquired that is to be attributed his masterly handling of the subject-matter of this volume.

Shore-fishing in all its branches, from the finding of cockles in the mud, the extraction of congers and crabs from rock-clefts, and the capture of mackerel with spinner or net, to the more refined art of fly-fishing, is fully dealt with in "La Pêche au Bord de la Mer" (2), one of the volumes constituting the "Bibliothèque des connaissances utiles." If translated into English, the book

ought to have a ready sale on this side of the Channel, because the marine and estuarine animals it describes and illustrates are those with which all shore collectors and amateur fishermen are familiar. To these the book may be recommended without reserve.

(3) The gift of writing science for children is much rarer than is usually supposed. If it can be acquired, Mr. Ellison Hawks has much to learn in the use and disuse of words and in the handling of subject matter before he can hope to qualify for a place in the small band of authors endowed with the gift. Apart from this defect and a few of less moment, his book on bees is quite good in its way, and holds all about the structure, habits, and practical keeping of honey-bees that the ordinary layman is likely to want.

Not without misgivings on the score of the probable suppression or transference of long-cherished and familiar names did we look through the new "Hand-list of British Birds," by Messrs. Hartert, Jourdain, Ticehurst and Witherby (4). That our fears were justified in a measure is shown by the appearance of some strange, often uncouth, terms, like *borin* for *hortensis* for the garden warbler, by the transference of *musicus* from the song thrush to the redwing, and by a most disconcerting shuffling of the names of our owls. The barn owl, for example, so familiar as *Strix flammea,* is now *Tyto alba,* its generic name *Strix* going to the tawny owl and its specific name *flammea* to the short-eared owl! We are forced to admit, however, that until systematic zoologists agree on the question of exempting certain names from the law of priority, conscientious compilers of catalogues are compelled to put it in force. On the other hand, we welcome the suppression of many generic names, and rejoice that the blackbird is still a Turdus, that the rook finds a place in Corvus, and that the kestrel, gyrfalcon and merlin are associated with the peregrine under Falco. The volume, which deals with distribution and migration as well as with names, is useful and carefully compiled, and will have to be seriously reckoned with by all writers on British birds, despite the protests to which its nomenclature is sure to give rise.

(5) In Mr. Dakin's memoir on the whelk (Buccinum) zoological students will find an admirable and well-illustrated treatise on the anatomy of this common gastropod, supplemented by brief accounts of its embryology, distribution and economics.

(6) Like all the volumes of "Das Tierreich" which deal with obscure groups, Dr. Müller's monograph of the Ostracoda is a colossal piece of work. More than nine hundred species of these minute Entomostraca are tabulated and classified. It will give a fresh impulse to the study of the group, but cannot be regarded as final, since something like six hundred named species have to be set aside, through no fault of the author, as *dubiae.* What a benefit it would be to the study of such orders as this if specialists would abandon for a time the description of new species and seriously address themselves to the task of classifying properly those that have already been described!

R. I. P.

OUR BOOKSHELF.

Biologische und morphologische Untersuchungen über Wasser- und Sumpfgewächse. By Prof. H. Glück. Dritter Teil:—Die Uferflora. Pp. xxxiv+644+viii plates. (Jena: Gustav Fischer, 1911.) Price 33 marks.

PROF. GLÜCK has produced a portentous volume on the riparian flora, forming the third instalment of his work on water and swamp plants. Frankly, we do not find justification for the 600 or more pages of his book, and we fancy most readers who have been in the habit of using their eyes when observing or collecting plants will find but little to reward them for the trouble of its perusal.

There are many examples, often of very moderate interest, adduced to illustrate the fact that submerged forms are apt to differ from the terrestrial representatives of a given species. Here and there, however, interesting observations are recorded, *e.g.*, the very different water and land forms of *Veronica Beccabunga.*

The author claims many new "forms," *e.g.*, *Veronica Beccabunga forma submersa,* Glück. Many of these are already known, though possibly not recorded, nor even dignified with a Latin name.

Species undergo fission, as they are apt to do in the hands of those who concentrate attention on variable forms. It is, however, fair to say that many of these rest on the authority of other writers before Glück, but it would have been of more general interest had the claims to specific or even mutational rank been experimentally settled.

No doubt a work of this kind possesses some value, but, as it appears to us, it excellently illustrates the truth of the saying that the secret of dullness lies in the attempt to write all one knows. Prof. Glück gives the impression (perhaps unjustly) that he has written all he knows about his subject, and certainly he has jotted down a good deal that is already very familiar to others.

The Teratology of Fishes. By Dr. James F. Gemmill. Pp. xvii+73+xxvi plates. (Glasgow: James MacLehose and Sons, 1912.) Price 15*s.* net.

DR. GEMMILL'S memoir is mainly a very complete and well-illustrated account of the structure of the major abnormalities, or double, triple, and

cyclopean monstrosities, in salmon and trout. The author tells us that the bony fishes are specially important for the study of teratological variation; oviparity and the abundance of eggs ensure plentiful material at all stages for observation and experiment, and although the major types rarely live after the yolk has been absorbed, at this time nearly all the organs, except the bony skeleton, have attained their adult form and relations.

Double monsters, and especially those that are double at the anterior end, are so numerous and variable that they require detailed classification, and in his arrangement Dr. Gemmill differs from his predecessors by taking into consideration the internal structure.

In addition to the chapters on the major abnormalities, which form a valuable original contribution to vertebrate teratology, there is one on minor abnormalities, which aims at facilitating the task of the future worker by introducing him to the literature of the subject, and should be very useful for this purpose. C. T. R.

Über die krankhaften Erbanlagen des Mannes. By F. Lenz. Pp. iv+170. (Jena: G. Fischer, 1912.) Price 4.50 marks.

THIS is an interesting discussion of the inheritance of hæmophilia and other sex-limited conditions in man and animals, and their bearing on the determination of sex. In the case of hæmophilia the author believes that an affected man never transmits the disease, even through his daughters to his grandsons, and supposes that this is due to non-viability of spermatozoa bearing the factor for the affection. This conclusion is difficult to accept when hæmophilia pedigrees are compared with those of other sex-limited affections. He also concludes that the apparent abnormalities of the sex-ratio in affected families, and the excess of affected members over unaffected, are likewise due to incompleteness in the records. In his examination of sex-limited inheritance in general the author has read widely, but sometimes misunderstands those whose writings he discusses. His hypothesis of the mode of inheritance and of sex-determination seems to differ more in form than in substance from previously suggested factorial schemes. The work as a whole is one more illustration of the fact that for the solution of the problem further investigation is needed rather than discussion of what is already known.

New "Contour" Wall Map of the Mediterranean Lands. 40×76 inches. Scale 1: 4,067,712, or 64·2 miles to one inch. (London: G. W. Bacon and Co., Ltd.) Price 16*s*.

THIS is an effective wall map which will be useful for class purposes. Two editions—with and without land names—are available. The map includes all the countries which at any time formed part of the Roman Empire, and both ancient and modern names are given, when these are shown. It is somewhat a disadvantage that the scheme of colouring to show land relief is not that usually adopted, and the blue stippling used to indicate areas with less than ten inches of rainfall can be seen only by a person standing near the map.

The map is constructed on a secant conical projection, and it may be obtained on cloth, with rollers, and varnished; or on cloth cut to fold.

Leather Chemists' Pocket-Book. A Short Compendium of Analytical Methods. Edited by Prof H. R. Procter, assisted by Edmund Stiasny and Harold Brumwell. Pp. xiv+223. (London: E. and F. N. Spon, Ltd., 1912.) Price 5*s*. net.

THIS handy little volume is intended as an adjunct to the "Leather Industries Laboratory Book," by Prof. Procter, which was published in 1908. The pocket-book is based upon the manuscript laboratory sheets, giving the course of analysis essential to the practical student, in use in the authors' laboratory in the University of Leeds. The book should be particularly useful to students in evening classes studying the science and technology of the leather trades.

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.*]

X-rays and Crystals.

IN his discussion of Dr. Laue's diagrams Dr. Tutton (NATURE, November 14, p. 309) invites me to consider their physical aspects in the light of the crystallographical details which he supplies.

The rule which I gave in a previous letter to NATURE (October 24, p. 219), and which Dr. Tutton has in mind, is independent of all but the simplest facts of crystallography. It gives a numerical method of finding the positions of the spots on the diagrams, and its effect is merely to show that the positions of the spots give no information concerning the wave-length of the incident radiation.

In a paper read recently before the Cambridge Philosophical Society my son has given a theory which makes it possible to calculate the positions of the spots for all dispositions of crystal and photographic plate. It accounts also for the form of the spots and other details, and amongst other things it explains my numerical rule. It is based on the idea that any plane within the crystal which is "rich" in atoms can be looked on as a reflecting plane; the positions of the spots can then be calculated by the reflection laws in the ordinary way. In this extended treatment the facts of crystallography are of importance, but it would take too long to discuss the matter in a letter.

I should like to refer to one other point. Dr. Tutton suggests that the new experiment may possibly distinguish between the wave and the corpuscular theories of the X-rays. This is no doubt true in one sense. If the experiment helps to prove X-rays and light to be of the same nature, then such a theory as that of the "neutral pair" is quite inadequate to bear the burden of explaining the facts of all radiation. On the other hand, the properties of X-rays point clearly to a quasi-corpuscular theory, and certain properties of light can be similarly interpreted. The problem

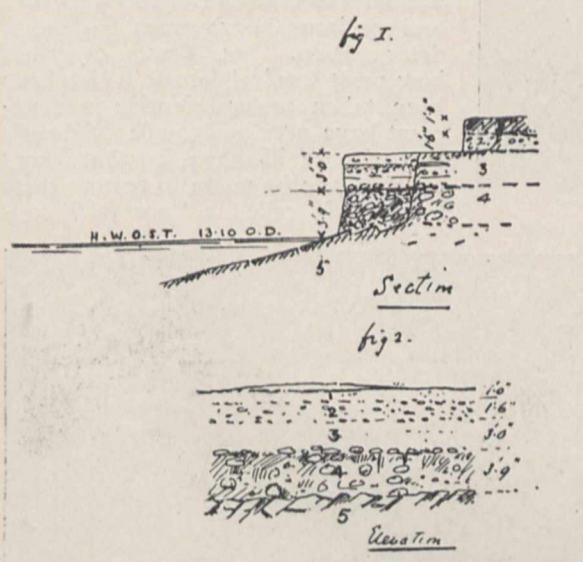
Supplement to "Nature" Nov 28th 1912.

Poincaré

then becomes, it seems to me, not to decide between two theories of X-rays, but to find, as I have said elsewhere, one theory which possesses the capacities of both. W. H. BRAGG.

Worked Flints obtained from "the 25-foot Raised Beach" near Holywood, co. Down.

THE 25-foot raised beach is well marked all round the northern and eastern coast of Ireland, and is also recognisable on the opposite coast of England and in the Isle of Man. This post-Tertiary beach is contemporaneous with the Upper Estuarine Clays of the Belfast sections,[1] and is certainly not later than early Neolithic. At different times worked flints have been obtained from this beach, notably from Larne, co. Antrim, and have been discussed, but no clue to their date or dates has been found. I have lately had the opportunity of carefully examining the section



(Fig. 1 and 2) near Holywood, co. Down. From a 350-ft. exposure 683 worked flints were obtained.

Description.		Per cent.	Notes.
Scrapers	Concave 70, Convex 17, Straight 76 ...	29·6	Chipped on non-bulbous face only. 4 Le Moustier type.
Knives	"Parrot-beaked" 39, Straight 80	21·6	All with tang. Worked on non-bulbous face only. 20 per cent. with shoulder (Les Eyzies).
Simple flakes	110	20·0	85 per cent. showing central ridge.

Punches, adzes, chisels, celts, cores, borers, microliths, about 4 per cent. each class.

No polished specimen was obtained, and all were of Palæolithic form, generally chipped on one face only. From the surface of the Boulder Clay specimens were obtained which had been subject to rolling before settlement of the land took place. Eight specimens showed re-chipping. Three prickers made from the ulna of deer were found. I submit that, considering the evidence of late Palæolithic work in Scotland in a similar horizon, the geological evidence, and the form and working of the flints found in this beach, they should be described as Mesolithic.

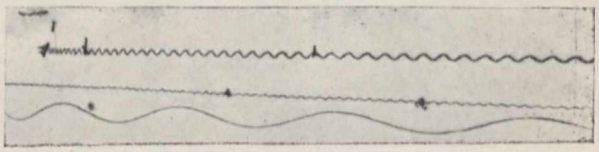
HENRY HOME.

Bellevue, Holywood, co. Down.

[1] Praeger, Proc. Roy. Irish Acad., vol. iv., 1897.

Note on the Upper Partials of a Tuning-fork.

IT is well known that a smoked dropping plate can be used to find the pitch of a fork if the value of g is known, and the method is described in most of the text-books on sound. But so far as the writer is aware no attention has been directed to the fact that the existence of some of the upper partials can also be demonstrated with it and their frequency obtained. The method is simpler and more convincing to a student than the method of using resonators.



As an example the traces of the fundamental and the first two upper partials are shown in the diagram, which is a copy of the photograph of the traces on the dropping plate. The fundamental frequency of the fork used was 29·5, and the frequency of the first two upper partials should be (see Barton, "Text-book of Sound," §211) 185 and 518, while the numbers obtained from a single observation were 184 and 512 respectively. No attempt was made to obtain other partials, but doubtless the next two could have been obtained. F. H. PARKER.

Woolwich Polytechnic, November 9.

The March of Science.

IN a school text-book, published in 1846 at Philadelphia, from which I was instructed in 1848—it was a geography, but contained five lessons in astronomy—is the following information about the sun:—

"In former times, it was supposed that the sun was a great ball of fire. Many learned men, however, are of opinion that it is a world like our own, containing continents, oceans, mountains, and plains.

"It is supposed that the rays of light which illumine the Solar System, proceed from an atmosphere, or air, of a peculiar nature, that surrounds the sun. The rays of the sun are called solar rays.

"When mingled with the atmosphere on the surface of the globe, it is thought that these rays produce the warmth and animation which render the earth habitable.

"This appears probable, from the fact that the summits of high mountains are always covered with ice and snow, while at their base, and in the valleys, the heat is oppressive. If heat proceeded from the sun, as from a body of fire, the higher we ascend from the surface of the earth, the greater the heat would become."

As I was only seven years old at the time I studied the book, the information did me no harm.

E. S.

Brookline, Mass., U.S., November 9.

FOREST CULTIVATION IN TROPICAL REGIONS.[1]

THE author of this book has done well to restrict it to the sylviculture of tropical forests instead of attempting the wide subject of forestry, of which, however, sylviculture is the most important branch. His definition of sylviculture is "the art of applying the knowledge of the requirements of different trees, in tending and regenerating existing woods, or in rearing fresh woodland crops and in working them to the best advantage of the forest owner," so that it is the cultivation of forest crops in distinction to arboriculture, which is the cultivation of individual trees.

FIG. 1.—Arid zone deciduous forest in the Sudan; *Acacia Verek* trees. From "Sylviculture in the Tropics."

The personal experience which has fitted Mr. Broun to write about tropical sylviculture has been gained only in India, Ceylon and the Sudan, the countries in which he has served as a Government forest officer, and this has to be remembered, because the kinds of forest of which he treats are only to be found in those countries. In his preface, however, he expresses the hope that what he has written may not be found to disagree with the experience in other tropical regions. It might perhaps have been better to have called his book "Tropical Sylviculture in India, Ceylon and the Sudan," and so to have avoided the more general but somewhat misleading name actually adopted.

The chapter on soil is a general one, but that on climate applies strictly to the belt of the earth's surface contained between the two tropics. In this belt the zones of forest vegetation naturally differ according to the greater or less dampness, so that the five of which he treats vary from the "desert zone," where the average annual rainfall is under 4 in., to the "wet zone," where it is above 75 inches. The Sudan forests, a good idea of some of which is given by the picture here reproduced, come chiefly into the arid zone (rainfall 4–16 in.), while those of India and Ceylon are distributed in all the zones, the most important one for valuable forests being the "moist zone" (40–75 in.), illustrated at p. 23 by a picture of a Ceylon Mimusops forest. It is a pity that there is no picture of a forest of the Indian teak.

Perhaps the most interesting chapter in the book, at any rate for the forester, is chapter viii, which treats of natural regeneration, and describes the reproduction of forest by natural means as distinct from artificial. Works of planting and sowing are, it is true, very fully described, but in the vast areas which have to be treated in most tropical regions it must be on natural reproduction chiefly that a forester has to depend to ensure continuance of forest growth and continued improvement instead of deterioration. Mr. Broun describes how most tropical forests which have been taken under scientific management have previously suffered during centuries of ill-usage, so that every effort has to be made to restore them to what is called a "normal" condition, fit for regular systematic working tending to the production of a permanent and regular annual yield.

FIG. 2.—Moist zone evergreen forest in Ceylon; *Mimusops hexandra* in foreground. From "Sylviculture in the Tropics."

[1] "Sylviculture in the Tropics." By A. F. Broun. Pp. xviii+309. London: Macmillan and Co., Ltd., 1912.) Price 8*s.* 6*d.* net.

The question of works for the protection of forest from fire naturally has to be carefully gone into, and Mr. Broun's chapter on this subject is interesting and instructive, as also is the last chapter, in which the measures necessary for the fixation of unstable soils, whether of blown sand or of precipitous slopes, are described.

The book is illustrated by excellent wood-cuts, as well as by photographic reproductions of forest scenes, and these have chiefly come from Ceylon, representing a more or less wet country, or the Sudan, representing a dry one. We should have liked to see more reference to Indian experience and practice, for although no doubt the efforts of experienced foresters like Mr. Broun have done a great deal for Ceylon and the Sudan, the far greater and longer-continued work in India must now be certainly placed in the forefront of tropical forest experience.

The book is very well printed, illustrated and bound, though rather too heavy for a forester's wallet; and it contains a large amount of valuable and most interesting information which should make it a useful guide to foresters, especially in those countries which are chiefly referred to.

DR. RAMSAY H. TRAQUAIR, F.R.S.

WE regret to record the death of Dr. R. H. Traquair, F.R.S., of Edinburgh, which occurred early in the morning of November 22 after a long period of failing health. Born at Rhynd, Perthshire, on July 30, 1840, Dr. Traquair received his early education in Edinburgh, and at the age of seventeen became a student of medicine in the University of that city. In 1862 he graduated as M.D., and was awarded a gold medal for his thesis on the asymmetry of the flat-fishes, which was published four years later in the Transactions of the Linnean Society. He had studied medicine, not with a view to medical practice, but merely because this course seemed most likely to afford him an opportunity of gratifying an early ambition to devote his life to biological science, which had attracted him since childhood.

After obtaining his degree, Dr. Traquair accordingly remained at the University as prosector to Prof. Goodsir, and from 1863 to 1866 he was demonstrator of anatomy. After serving for a few months as professor of natural history in the Royal Agricultural College, Cirencester, he removed to Dublin in 1867 as professor of zoology in the newly founded Royal College of Science. Finally, in 1873, he was appointed keeper of the natural history collections in the Museum of Science and Art (now the Royal Scottish Museum) in Edinburgh, where he remained until his retirement in 1906.

Though interested from the first in all branches of natural history, Dr. Traquair soon began to devote most of his energy to the study of fossil fishes, which became the absorbing pursuit of his long and active life. While still a boy he had found part of a Palæoniscid fish in an ironstone nodule on the beach at Wardie, near Edinburgh, and the impossibility of interpreting what he saw, even with the aid of the standard works of the time, led him to begin the long series of researches which have revolutionised our knowledge of Palæozoic fishes and thrown light on some of the most fundamental problems of ichthyology.

Beginning in this manner with material which he had himself collected, Dr. Traquair worked out in detail the osteology of several Carboniferous fishes, and with these he compared the imperfectly known fishes from the Scottish Old Red Sandstone. The first important result of these researches was reached in 1877, when he published the preliminary part of his "Monograph on the Ganoid Fishes of the British Carboniferous Formations" in the Palæontographical Society's volume for that year. He showed that the Palæoniscidæ and Platysomidæ, which had until then been compared with the existing Lepidosteus, were really primitive Chondrostean fishes closely related to the modern sturgeons. He thus proved that the nature of the scaly covering of fishes was of little importance in classification compared with that assigned to it by Agassiz; and he was the first to point out the more fundamental characters of the internal skeleton which have subsequently been recognised as unfailing guides to a natural classification. In short, he made it possible to distinguish between the phenomena of parallelism or convergence, and the marks of natural affinity in the early fishes.

While studying the Palæoniscidæ, Dr. Traquair also devoted much attention to the Crossopterygian and Dipnoan fishes, and published many exact descriptions of their osteology. He showed that the Devonian Dipterus and Phaneropleuron were closely related to the existing Ceratodus, while his interpretations of Crossopterygian skulls now prove increasingly important for comparison with the newly discovered skulls of the early Labyrinthodonts.

In his later years, Dr. Traquair made another important contribution to our knowledge of fishes by his numerous descriptions of the Upper Silurian Ostracodermi discovered by the Geological Survey in southern Scotland. He demonstrated that the armour-plates of such genera as Pteraspis and Cephalaspis are formed by the fusion of simple granules of shagreen with each other and with hard tissue developed in a deeper layer of the skin. He thus proved the truth of the theory of the origin of the vertebrate exoskeleton, which had already been formulated from the study of comparative morphology.

Apart from the successive instalments of his palæontographical monograph, Dr. Traquair's last work was his memoir on the Wealden fishes of Bernissart, Belgium, published in 1911 by the Royal Museum of Natural History, Brussels. This was to him a new subject, and involved much labour for several years, but it was eventually produced with his usual thoroughness, and will long remain a standard work of reference.

Dr. Traquair was an artist as well as a naturalist, and he made a large proportion of the beautiful drawings which illustrate his published works.

His numerous restored figures of the fishes he described are especially important, combining artistic style with the most minute accuracy, and left incomplete wherever there is the least doubt as to structure. Both in writing and in drawing, indeed, he always aimed at such precision that his publications were often delayed for a long period by hesitation, and his correspondents were accustomed to regard his dilatory methods with impatience. Even so unique a fossil as the Lower Devonian Palæospondylus was in his possession upwards of ten years before he ventured upon its description, and he only published an account of it when specimens seemed likely to fall into less competent hands. Dr. Traquair was, in fact, a genuine student, anxious only to make sure of the truth, and a large circle of friends will mourn the loss of one whose kindly spirit endeared him to all who came in close contact with him.

Dr. Traquair was elected a fellow of the Royal Society in 1881, and received the honorary degree of LL.D. from the University of Edinburgh in 1893. He was awarded the MacDougall-Brisbane medal of the Royal Society of Edinburgh, and also the Lyell medal of the Geological Society of London, in 1901, and a Royal medal of the Royal Society of London in 1907. A list of his writings and an excellent portrait of him accompany a biographical notice published in *The Geological Magazine* for June, 1909. A. S. W.

W. F. KIRBY.

WILLAM FORSELL KIRBY, whose death on November 20 we regret to announce, was the eldest of the five sons of Samuel Kirby, banker, of High Street, Leicester. He was born at Leicester, January 14, 1844. When a boy of seven Kirby was taken to London, and saw the British Museum and Gould's collection of humming birds, and, while still very young, when the family moved to a house two or three miles from Leicester, his mother suggested that he should collect butterflies, and thus aroused his first interest in entomology.

Kirby was privately educated by tutors. He always believed that exclusion from the life and experiences of a public school was a permanent disadvantage to him.

Samuel Kirby died in 1854, and the family moved to Burgess Hill and to Brighton (1857–60). Kirby, although still quite a boy, joined the Brighton and Sussex Natural History Society, and began to publish notes in *The Entomologist's Weekly Intelligencer*. He went to London in 1860, joined the Entomological Society in 1861, and soon became acquainted with all its leading members—with Westwood, Hewitson, Stainton, Knaggs, and Perceval Wright. In 1866 he married Johanna Maria Kappel, daughter of J. W. Kappel, of Hilden, near Düsseldorf. Their only child, now W. Egmont Kirby, M.D., was born in 1867. Mrs. Kirby interested herself in all her husband's work, helping him in every possible way, and her death in 1903 darkened the last years of his life.

From 1867 to 1879 Kirby was an assistant in the museum of the Royal Dublin Society, afterwards the National Museum of Science and Art. On the death of Frederick Smith, in 1879, he moved to London, and entered the zoological department of the British Museum.

It is impossible on the present occasion to do more than allude to the series of volumes by which W. F. Kirby helped to stimulate and spread an interest in natural history. Among the numerous works which he wrote for the student of insect systematics special mention must be made of the "Synonymic Catalogue of Diurnal Lepidoptera" (1871). Few books have done more for their subject than this careful and accurate work, which was suggested to the author by the sight of H. W. Bates's MS. lists.

Between 1869 and 1884 Kirby wrote the reports on Lepidoptera, and later on the greater part of the insects for the "Zoological Record"—a work for which he was specially qualified by his wide knowledge of languages. Kirby's publications also deal with Scandinavian and Finnish folklore, a subject which deeply interested him. He was for a time one of the hon. secretaries of the Entomological Society, and was honoured by foreign scientific societies. He was ever ready to put his great knowledge at the disposal of other workers.

E. B. P.

NOTES.

THE anniversary meeting of the Royal Society for the election of council and officers will be held on Saturday next, November 30, at 4 o'clock p.m. There will be no meeting of the society to-day.

FULL particulars of the meeting, held at the Mansion House on October 23 last, to consider the whole question of the proposed memorial to Lord Lister were given in an article in the issue of NATURE for October 31 (vol. xc., p. 254). The meeting unanimously decided that the most suitable form of memorial would be:—(1) A tablet with medallion and inscription in Westminster Abbey; (2) the erection of a monument in a public place in London; (3) the establishment of an International Lister Memorial Fund for the advancement of surgery, from which either grants in aid of researches bearing on surgery, or awards in recognition of distinguished contributions to surgical science, should be made, irrespective of nationality. To carry out these proposals a large sum of money will be required, and the executive committee is appealing for donations to all persons who wish to pay a tribute to the memory of a great man of science and a great surgeon. Before the issue of this appeal subscriptions had been received amounting to something like 2700*l*., and we notice that the first list of donations includes 500*l*. each from Lord Iveagh and Mr. W. F. D. Smith, 250*l*. from Mr. Otto Beit, 100 guineas each from Lord Northcliffe and Sir James Whitehead, Bart., and 100*l*. each from the Duke of Bedford, K.G., Sir Ernest Cassell, G.C.B., Sir W. Watson Cheyne, Bart., F.R.S., and Lord Rothschild, G.C.V.O. It is proposed to form committees in the provinces, in the dependencies of the Empire, and in

foreign countries, to take such steps as are necessary in order to coordinate the collection of subscriptions. Donations may be sent to the "Treasurers of the Lister Memorial Fund, Royal Society, Burlington House, W." Cheques should be made payable to "The Lister Memorial Fund," and crossed "Bank of England, Western Branch."

REPORTS of an earth-shock at Sunninghill, Ascot, and other places at about 9 a.m. on November 19 were published in several London daily papers last week. In reply to an inquiry as to whether the alleged shock had been recorded at Kew, Dr. C. Chree, F.R.S., superintendent of the Kew Observatory, writes:—"The Kew seismic and magnetic records have been examined with the view of seeing whether there were any indications of seismic movements which could be associated with tremors and sounds recently reported from other parts of the London basin. There were, especially on November 19—though not at 9 a.m.—several tiny movements of the type which Prof. Milne now accepts as seismic provided they occur simultaneously at two or more stations. But the only movement that would naturally be accepted as seismic without such confirmation is one on the afternoon of November 19. Its beginning and end are open to considerable uncertainty owing to the presence of movements which may or may not be seismic. The movements shown extend from 1h. 57m. to 3h. 46m. p.m., with short interludes. The undoubtedly seismic movements extend from about 2h. 40m. to 3h. 0m. p.m. There are two maxima of movement, the larger 1·0 mm. (0·55″) about 2h. 44m., the smaller 0·5 mm. about 2h. 56m. Owing to the long natural period of oscillation of the seismograph boom, the instrument is scarcely designed to show local short-period tremors of very small amplitude."

CABLEGRAMS received last week from Kingston, Jamaica, tell of a hurricane that had been experienced in that island which caused serious damage in the western part of it. The storm began on November 15 and continued with increasing fury for several days. The following telegram, received from the Governor of Jamaica, was read in the House of Commons on November 25:—"Parishes of St. James's, Hanover, and Westmoreland suffered from two periods hurricane intensity Sunday, 17, and Monday, 18; all bananas in these parishes totally destroyed, bread-fruit, coconuts, and ground provisions seriously damaged, and native food supply crippled. Conditions of a similar kind to that of eastern parishes after 1903. Hurricane flooded gullies, destroyed houses recklessly placed in them; loss of life 'Montego Bay about 40; about 15 reported elsewhere; other casualties not extensive; canefields Westmoreland harried by wind, but will recover to a large extent for crop; some in St. James's damaged by flood débris; some sugar works destroyed, new factories stood well; as usual, destruction of flimsy and decayed tenements Savanna-la-Mar, Lucea, and country." The storm, doubless, was of the revolving type, and the centre probably passed considerably to the south and west of Jamaica. West India hurricanes are very rare in November, authentic records of such occurrences numbering fewer than a score in this month during the last 300 years. October and November storms keep, as a rule, well over to the western side of the ocean throughout their track, from their first appearance between the sixtieth and eightieth meridians of west longitude, until they disappear, while proceeding north-eastward between Newfoundland and the eightieth meridians.

IT is announced that Mr. Austen Chamberlain has received 48,000*l.* towards the 100,000*l.* which he is raising for the London School of Tropical Medicine.

THE RIGHT HON. EARL FORTESCUE has consented to accept the office of president of the twenty-eighth congress of the Royal Sanitary Institute, to be held at Exeter on July 7–12, 1913.

A LECTURE, entitled "Birdland through the Bioscope, in Colour," will be delivered by Mr. Oliver G. Pike in the new building of the Young Men's Christian Association, Tottenham Court Road, W.C., on Wednesday, December 4, at 8 p.m.

WE learn from *The Chemist and Druggist* that Prof. P. Sabatier, professor of chemistry at the Toulouse faculty of sciences, has decided to give his portion of the Nobel prize to the Toulouse Institute of Chemistry for the purpose of defraying the cost of new buildings for the institute.

WE are requested to state that a biography of the late Victoria Lady Welby is in course of preparation. It is hoped that her friends and correspondents may be willing to assist by placing such letters as they may possess at the disposal of her family The greatest care will be taken of the letters, and they will be returned to their respective owners intact at the earliest possible date. The letters should be sent to Sir Charles Welby, Bart., C.B., Denton Manor, Grantham.

THE death is announced by Reuter's Paris correspondent of M. Charles Bourseul, one of the earliest workers in telephony, at eighty-three years of age. M. Bourseul's suggestions for the electrical transmission of speech were acknowledged by Dr. Graham Bell and Mr. Edison more than thirty years ago, and the following extract from Prof. Cajori's "History of Physics" describes them:—"The earliest record of a theoretical telephone was contained in Du Moncel's 'Exposé des Applications,' Paris, 1854, when Charles Bourseul, a French telegraphist, conceived a plan of transmitting speech by electricity. The author says, 'Suppose a man speaks near a movable disc sufficiently flexible to lose none of the vibrations of the voice; that this disc alternately makes and breaks the current from a battery, you may have at a distance another disc which will simultaneously execute the same vibrations.' Bourseul did not work out his ideas to a practical end."

ACCORDING to an announcement in a recent number of the *Zeitschrift für Beleuchtungswesen*, an illuminating engineering society has now been formed in Germany. There are therefore now three such societies in existence, the society in the United States (formed in 1906), the society in London (formed in

1909), and the German society, formed this year, the constitution of which will doubtless be modelled on those of the other existing bodies. For some time there has been a need for a body capable of dealing authoritatively with illumination, photometry, standards of light, &c., in Germany, and the Reichsanstalt has been entrusted with the formation of the new society. A provisional committee has been formed, Prof. Warburg and Dr. E. Liebenthal being respectively chairman and secretary, and Herr Dettmar, representing the Verband deutscher Elektrotechniker, and Dr. Bunte, representing the Verein von Gas- und Wasserfachmänner, are also giving their assistance. The first ordinary meeting is to be held next February, when it is expected that Prof. Otto Lummer will deliver an address.

ENGLISH students of megalithic monuments in Cornwall will be interested in an article contributed to the *Bulletins et Mémoires de la Société d'Anthropologie de Paris* (vi. series, Nos. 1–2, 1912) by MM. Édouard and Paul Jeanselme under the title of "Inventaire descriptif et Mensurations des Principaux Monuments Mégalithiques de la Cornouailles," in which we have a series of careful measurements, descriptions, and drawings of rude stone monuments like the Logan Stone, the Cromlech of Zennor, the Lanyon and Mulfra Quoits, the Nine Maidens, and the Nineteen Merry Maidens, with other remains of the same kind in the Cornish peninsula. The writers remark that while these monuments are now carefully protected from destruction, atmospheric erosion is still carrying on the work of disintegration.

THE *Bulletins et Mémoires de la Société d'Anthropologie de Paris* (vi. series, Nos. 1–2) for 1912 are largely devoted to the question of steatopygy among the races of the Mediterranean area in ancient and modern times. As is well known, broad-hipped figures of this type have been discovered in France dating from the Magdalenian, Solutrian, and possibly from the Mousterian periods. A description of prehistoric images of the obese class is here given by Dr. Félix Regnault; and Dr. Atgier describes similar examples in modern times from south and south-east Africa and among existing Parisian women. Dr. Regnault discusses the differences between this type and the well-known Bushman or "Hottentot Venus." The question is of considerable importance to anthropologists, as it may imply a connection between the races of South Africa and those of the Ægean.

IN *The American Museum Journal* for October Mr. V. Stefánsson makes a powerful appeal for the protection of the new Eskimo tribes from pauperisation by a system of quarantine which will limit the entrance of conditions of civilisation into the territory occupied by them. He gives a melancholy account of the ravages of measles and other diseases introduced by sailors visiting their coast. The introduction of permanent houses in lieu of snow huts and tents has led to the growth of tuberculosis among them. Foreign dress has exercised a similar effect, and begging has increased under a system of ill-regulated doles. In the same issue of the journal Mr. Clark Wissler attempts to give a tentative summary of Mr. Stefánsson's recent discoveries, and of the possibilities of the introduction of European blood among the Eskimo.

THE sixth annual report, by Dr. Houston, on the results of the chemical and bacteriological examination of the London waters for the twelve months ended March 31, 1912, has recently been issued. It contains full details of the analyses made, and Dr. Houston expresses the reassuring opinion that seven years' work on the London water question has convinced him that to a progressively increasing extent the Water Board is securing the reasonable "safety" of the metropolitan water supply.

THE Education Committee of the Agricultural Department of the County Council for the County Palatine of Lancaster has issued a report on milk tests and records carried out during 1911 (Farmers' Bulletin No. 23). It strongly urges all owners of milking herds to weigh and test the milk and keep accurate records, so that unsatisfactory animals may be weeded out and the general standard of the herds raised. All that is necessary is a balance with bucket, which need not cost more than 30*s*., and the weighing need not be done more than one day per fortnight.

IN the twenty-first report of the Board of Health on leprosy in New South Wales for the year 1911, Dr. Ashburton Thompson summarises the cases of the year, and also gives a return of the number of persons who have been found suffering from the disease in this colony since 1883. Details of recent cases are given, and in emphasising the remarkable improvement which may take place in cases of leprosy without any special treatment whatever, he remarks: "I have so often seen similar improvement in similar circumstances that I am tempted to say that it is often enough to look steadily at a person who is suffering from leprosy to bring about some improvement, and often a marked improvement, in his general state, and even in some of the stigmata of his disease." A review of recent research into the causal organism of the disease is included in the report.

IN *The American Naturalist* for November Mr. A. L. Hagedoorn points out the essential difference in the nature of the colouring of tricoloured dogs and tricoloured guinea-pigs and cats. The former are never irregularly blotched with black and yellow after the fashion obtaining in the two latter, but are essentially either black and tan, or sable blotched with white. Some tricoloured dogs, such as fox-terriers, are black and tan blotched with white; others, like most hounds, sable; while yet others, such as collies, may be either black and tan or sable blotched with white. A dog with a yellow blotch on the back and a yellow foot appears unknown. It is not easy to understand in what sense the author employs the term "sable."

THE Seismological Society of America is doing useful work in encouraging the detailed study of the

principal earthquake regions of the continent. The last number of the Bulletin (vol. ii., No. 3) contains the first of a series of papers on the earthquakes of Haiti. In this, Mr. J. Scherer examines the distribution of the great shocks which have occurred since the discovery of the island. He finds that their central areas oscillate along three great depressed zones, the more important being the northern depression from the Bay of Samana past Cap Haitien, and the southern depression passing in a parallel direction close to Port au Prince and connecting the deep ocean basin to the south of San Domingo with the well-known Bartlett Deep. Though these two zones are separated by not more than eighty miles, it is remarkable that an earthquake of the northern zone, which ruins towns so completely that they have to be rebuilt on other sites, may pass almost unfelt along the southern band.

THE important problem of seasonal forecasts is being attacked from various points of view. Dr. Walker has applied the method of correlation in dealing with the Indian monsoon; Hildebrandsson has discussed the influence of the "centres of action"; Dr. Lockyer has considered the barometric see-saw in the southern hemisphere. In a paper published in 1909 Dr. Arctowski discussed the sequence of the variations of mean temperature and the changes from year to year in the positions of relatively warm and cold areas, and reached several interesting conclusions. He now discusses in the *Prac Matematyczno-Fizycznych*, tome xxi., the corresponding changes in atmospheric pressure in the United States. The results which he obtains do not appear to be definite enough to be suitable for practical application, although he states that the variations of pressure from the normal can be calculated several months in advance. The charts, on which his conclusions are based, are given for the years 1888, 1889, 1890, 1907, and 1908 only, and do not appear to furnish sufficient evidence either for or against his contention. He gives also a table showing that the departures from normal of pressure in North America are opposite to those in Iceland, but as the values are given for only thirteen selected years during the period 1876–1900, the table can scarcely be taken as proof of his statement that the see-saw is "incontestablement plus caractéristique" than that found by Lockyer for Cordoba and Bombay.

IN order to determine the quantity of manganese, phosphorus, silicon, or sulphur in iron or steel, a certain precipitate is formed, and the weight of this multiplied by a certain factor in each case will give the percentage, if 1 gramme of metal is used for the analysis. A simple table then, in which the weight of precipitate is the argument, is all that is needed to enable the analyst to read the result, and this, it would be thought, any analyst would prepare for himself if he had much work of the kind to do. In order to help him, however, Messrs. E. B. Atkinson and Co., of Hull, have provided an instrument like a large wall aneroid, with a radial index which can be turned round, and behind this are arranged the figures of the table. The range is limited to precipitates ranging in weight from 10 to 49 milligrammes by units. Taking, for instance, a precipitate of Mn_3O_4 weighing 0·039 (gramme?), he will find that the manganese is present in the proportion of 2·809 per cent. It is true these figures are printed very small and upside down, but they are there, and they are embellished with a bevelled edge plate glass front and a 9-inch back of wood stained red, and a spun brass rim. The instrument is called the Ebur calculator.

A PAPER on experimental investigations of the maintenance of vibrations, by C. V. Raman, has just been published as Bulletin No. 6 of the Indian Association for the Cultivation of Science. This account of original work is divided into six sections. Of these the first deals with a new form of Melde's experiment, in which, by placing the prongs of the fork inclined to the string, the vibrations characteristic of the transverse and longitudinal forms of the experiment are simultaneously maintained. The two vibrations were also produced at right angles to each other, and so yielded the Lissajou's figures for the octave. The second section is on small motions at the nodes of a vibrating string observed stroboscopically. The third section treats the amplitude and phase of oscillations maintained by forces of double frequency. Records of the motions are obtained by a beam of light falling on the string and then reflected in turn by (1) a fixed mirror, and (2) a mirror fixed on the prong of the tuning-fork. The fourth section deals with vibration curves maintained by a variable spring. This is shown to occur for the longitudinal form of Melde's experiment, when the period of the force is $\frac{1}{2}n$ times that of the string, where n is any integer. The fifth section is on the maintenance of compound vibrations by a simple harmonic force. The possibility of this follows from the previous section, and its experimental realisation is here described. The sixth section deals with transitional modes of vibration under variable spring. The bulletin contains twelve illustrative plates, representing in all thirty-seven photographic reproductions of the curves obtained and of the disposition of the apparatus employed. The whole forms a welcome addition to our knowledge of such vibrations and their special maintenance.

SOME remarks on the subject of photography by artificial light were contributed by Mr. J. S. Dow at the meeting of the Illuminating Engineering Society on November 19. A number of photographs of lighting installations, some including figures of people, were exhibited, and it was explained that a photometric judgment of the "surface-brightness" of objects in the field of view proved a useful method of estimating the exposure. A good photograph should show both the objects in the room and the sources of light without halation, and this demands very careful exposure and development. Allusion was made to the difficulties of taking "snap-shots" by artificial light. This seems just possible by the light of such illuminants as the Moore tube, but is at present scarcely feasible in the case of most installations using incandescent electric lamps. The introduction of a very much faster plate may, however, enable even this to be done.

THE November issue of *The Journal of Physical Chemistry* contains papers by Mr. F. F. Fitzgerald on the electrical conductance of solutions in methylamine and ethylamine and on the fluidity of ammonia, methylamine, and sulphur dioxide, and the fluidity of certain solutions in these solvents. The former paper is remarkable for a series of curves of molecular conductance of potassium iodide and silver nitrate in methylamine, in which a maximum is reached in concentrated solutions, in addition to the usual maximum at infinite dilution; in the cases now recorded the two maxima are separated by a very strongly developed minimum, which is most pronounced at the higher temperatures. In ethylamine, a weaker ionising solvent, the maxima in concentrated solutions are equally pronounced, but the dilutions studied were not sufficient to reach the minimum, and the final maximum representing complete ionisation was quite inaccessible. These phenomena, which have been noted in several instances by Franklin and others, and probably depend on the autolytic conductivity of the salt in the more concentrated solutions, are of considerable importance in studying the theory of electrolytic conductivity.

A COPY has reached us of the current number of Merck's "Annual Report" upon recent advances in pharmaceutical chemistry and therapeutics. As former readers of the report will know, it emanates from the well-known Darmstadt chemical works, and aims at giving in an impartial manner new information likely to be of use to medical men and pharmacists. Only those drugs are discussed which have been introduced into therapeutics as a result of scientific research; "secret remedies" and scientifically questionable preparations are excluded so far as possible. The special articles upon groups of drugs, which are a feature of the work, are this year devoted to the glycerophosphates and to the digitalis glucosides and allied drugs. The first article is a good summary of our present knowledge of the salts of glycerophosphoric acid and their medical applications. In the second, the history, chemistry, and pharmacology of the complicated digitalin group are treated at considerable length, the article running to a hundred pages, and including what appears to be an exhaustive bibliography of the subject. Of the general sections, those on the cacodylates, salvarsan, sera and antigens, the hypnotic action of adalin, bromural, and veronal, and on the use of sterilised kaolin in the treatment of dysentery and cholera, are specially worthy of note. The report is quite up to the standard of former issues, and as a record of new therapeutic preparations and of new uses for drugs already known, will be found very useful.

IN *Engineering* for November 22 Prof. A. H. Gibson, of University College, Dundee, gives a brief summary of the results of experimental work on the resistance to the flow of air through pipes. From experiments made by Dr. J. H. Grindley and himself, it appears that any formula of the usual form—

$$dp = \frac{flv^2}{2gm}$$

only applies if the coefficient f is varied, not only with the physical condition of the interior surface of the pipe, but with its diameter, with the mean velocity of flow, with the mean pressure, and with the temperature of the air. Prof. Gibson proposes a new formula which he has tested against a large number of results by different experimenters. The practical form of the formula for cast- or wrought-iron pipes laid under normal conditions as regards jointing, &c., and for air at a temperature of about 65° F., is—

$$dp = 0{\cdot}00000125\frac{p^{n-1}v^n l}{6{\cdot}6^n d^{5-n}} \text{ lb. per sq. in.}$$

Here d and l are the pipe diameter and length respectively in feet, p is the mean absolute pressure of the air in the pipe in lb. per sq. in., and v is the velocity in feet per second; n has values as follows:—

Diameter, inches	3	5	7	9	12
n	1·83	1·81	1·79	1·78	1·77

The formula gives the drop in pressure with a high degree of accuracy. It may be rendered applicable to other temperatures by introduction of a coefficient K, the value of which depends on the values of n and of the temperature; a table of values of K is given from which it appears that at 32° F. K is 0·980 when n is 1·28, and is 1·052 when n is 1·85. At 180° F. K is 1·061 when n is 1·28, and is 0·865 when n is 1·85. K is unity for all values of n at 65° F.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR DECEMBER:—

Dec. 2. 18h. 55m. Mercury in conjunction with Jupiter (Mercury 0° 35′ S.).
7. 10h. 12m. Mars in conjunction with the Moon (Mars 4° 2′ N.).
8. 7h. 7m. Mercury in conjunction with the Moon (Mercury 6° 11′ N.).
,, 11h. 0m. Mercury in inferior conjunction with the Sun.
,, 20h. 55m. Jupiter in conjunction with the Moon (Jupiter 5° 7′ N.).
11. 14h. 46m. Venus in conjunction with the Moon (Venus 2° 42′ N.).
,, 18h. 17m. Uranus in conjunction with the Moon (Uranus 4° 15′ N.).
13. 3h. 38m. Venus in conjunction with Uranus (Venus 1° 36′ S.).
18. 8h. 0m. Jupiter in conjunction with the Sun.
,, 9h. 0m. Mercury stationary.
21. 10h. 29m. Saturn in conjunction with the Moon (Saturn 6° 12′ S.).
,, 16h. 45m. Sun enters Sign of Capricornus. Winter commences.
25. 4h. 24m. Neptune in conjunction with the Moon (Neptune 5° 25′ S.).
27. 21h. 0m. Mercury at greatest elongation W. of the Sun.
31. 14h. 0m. Earth nearest the Sun.

THE SOLAR MOTION RELATIVELY TO THE INTERSTELLAR ABSORBING MEDIUM.—In *Monthly Notices*, No. 9, vol. lxxii., Prof. W. H. Pickering has a note suggesting that the interstellar light-absorbing medium may consist of material, gaseous molecules, rather than being simply the æther, and should demonstrate

any existing drift of the æther relatively to the sun. The existence of such molecules in space may be accounted for by their continual expulsion from the sun and stars, and it is obvious that, if the æther is at all capable of offering any resistance to the passage of such materials, the molecules would eventually take up the motion of the æther relative to the sun. Then to determine the motion of the resisting medium would be, in any case, to determine the relative motion of the æther. Owing to their very small density comets would be the most likely celestial bodies to indicate the existence of the resisting medium.

Assuming that the majority of comets really have elliptic orbits, and are therefore following the sun through space, the effect of a resisting medium would be to drag their aphelia to the rear of the sun, *i.e.* towards the anti-apex of the sun's path.

As bright comets probably owe their conspicuousness to the fact that they are surrounded by enormous, very tenuous envelopes of gaseous material, the resisting action should be more evident on them, and on plotting the aphelia of a number of comets Prof. Pickering finds that this is the case. The aphelia of the brighter elliptical comets do appear to concentrate in a particular region of the sky, and this anti-apex in regard to the resisting medium coincides pretty closely with the solar anti-apex. There are some inconsistencies still to be accounted for, but on the whole it would appear that these cometary aphelia are dragged to the rearward of the sun, thus indicating a drift of the resisting medium, and therefore of the æther, in regard to the sun.

OBSERVATIONS OF COMETS.—The *Comptes rendus* for November 11 (No. 20) contain reports, from many observatories, of observations of comets 1912*b* (Tuttle's) and 1912*c* (Borrelly's). M. Borrelly states that on November 3 the nucleus of his comet appeared to be asymmetrically placed in the coma, while M. Coggia on November 4 and 8 could detect no definite nucleus but only a gradual brightening towards the centre; in this he is confirmed by M. Esmiol, of the Marseilles Observatory. Generally the comet is reported as a round nebulosity, with a very indistinct or no nucleus, and no tail; during the early part of the month the magnitude was about 9 or 10, and according to the ephemeris it is now about two-thirds as bright, and will continue to decrease.

METEOROLOGY AT THE BRITISH ASSOCIATION.

THE leading feature of meteorological interest in the proceedings at Dundee was the joint discussion with Section M, Agriculture, on the application of meteorological information to agricultural practice.

Dr. Shaw said that the annual loss to this country through unfavourable weather might be put at 20,000,000*l.*, and as forecasts must ultimately be forecasts for the whole globe, the amount of the loss some portion of which meteorologists aimed at saving for the British Empire far exceeded the estimate mentioned. But apart from forecasts, which aimed at saving by preventive precautions, there was probably much to be done in increasing efficiency by the application of our present knowledge of climate. In this connection the meteorologist wished to learn from the agriculturist if he could make use of meteorological statistics, and in what form he wished the statistics to be presented to him. There were, moreover, certain questions the answers to which would render possible considerable economies, and perhaps save the aspiring farmer many disastrous experiences. Such questions were: "What is the effect of climate on crops?" "What deviations from the normal values of the meteorological elements constitute a good or bad farmer's year?" Mr. R. H. Hooker had made some progress towards providing an answer to the first question in his paper on correlation between weather and crops, and he himself had investigated the relation between autumn rainfall and yield of wheat. Recently also Unstead had reached interesting conclusions in connection with the world's wheat crop, the polar limit of which depended upon the accumulated temperature and the duration of daylight in the summer months.

Mr. Watt communicated some results which he had obtained for the connection between rainfall and temperature, and the yield of crops in Forfarshire. He found that a dry June and July were favourable to the potato crop, and warmth during that period was also desirable. For oats, however, a cool June was decidedly favourable.

Dr. E. J. Russell spoke of the effect of climate on plant life by direct action on the plant itself, and indirectly through its action on the quality and texture of the soil. Heavy rain washed out the nitrates in the soil, while hot dry weather and frost conserved them. At the end of the summer of 1911 the soil contained 3½ times the usual amount of nitrates, but the heavy rains of the succeeding autumn and winter washed out nine-tenths of them.

Mr. R. M. Barrington, speaking as a practical farmer, testified to the great utility of local observations in conjunction with the reports of the Meteorological Office, and expressed the opinion that meteorology ought to be taught to every budding farmer.

On the Tuesday morning Prof. Turner gave an account of his investigation of periodicities in earthquake phenomena. He found evidence of a real period of about 15 months and indications of a period of 11·76 months, which was also found in the rainfall at Greenwich. He communicated also a paper by Mr. J. I. Craig, in which the author showed that Schuster's method of the periodogram and the method of correlation were practically identical.

Mr. E. M. Wedderburn gave an account of his investigations of the temperature conditions in the Madüsee in Pomerania and in Loch Earn. In both cases the temperature changes were found to be oscillatory and capable of explanation on the assumption that the motion of the water in the lake was in opposite directions above and below the level of maximum rate of change of density.

Miss White read two papers on the results for wind and temperature obtained at the upper air station at Glossop Moor during 1908, 1909.

She found that the average velocity of the wind changed from 5·0 m.p.s. (metres per second) at ground level (335 m.), to 11·8 m.p.s. at 1000 m., and to 13·6 m.p.s. at 2000 m. above mean sea-level. The velocities at all heights were greater in winter than in summer, and greater also for occasions when the surface pressure was below the average than for occasions when it was above. The rate of increase of velocity was greater for westerly than for easterly winds. At the surface it was approximately the same, 5 m.p.s. in both cases, but at 2000 m. altitude the velocity was 16 m.p.s. for westerly winds compared with 12 m.p.s. for easterly. On the average, the theoretical value of the gradient wind calculated from the pressure distribution was reached by the actual wind at an altitude of 650 m., or 300 m. above ground level.

In the second paper on temperature, the rate of fall with height was found to diminish from 8·5° C. per km. near the surface to 4·3° C. per km. at

2000 m. altitude. The height at which the mean annual temperature is 0° C. was found to be about 2100 m. The temperatures in the upper air were higher, both in winter and in summer, over regions of high pressure than over regions of low pressure.

Both papers contained much valuable and interesting information, and Prof. Petavel expressed the hope that they would be utilised by aviators. The probable conditions in the upper air could be forecasted from the surface conditions by using the average values given by Miss White.

The report of the joint committee on the investigation of the upper air contains the results obtained at Mungret College, Limerick, during the past year, from which it appears that the height of the stratosphere over Ireland is very nearly the same as it is over England and the Continent. In speaking on the report, Rev. W. O'Leary, S.J., who has conducted the work at Mungret College, expressed the desire felt by those engaged in this work for definite instructions as to the type of weather in which ascents might be made with a fair chance of the balloon and instruments being recovered.

A grant of 50*l.* was made to the committee for the extension of the work during 1912–13, when it is hoped that ascents will be made over the North Atlantic.

EDUCATION AT THE BRITISH ASSOCIATION.

THE presidential address was devoted to the consideration of the progress made in the development of an objective standard in education. It was therefore a departure from the type of address with which this section has been opened, and as such it marks a distinct stage in the evolution of the science of education. Prof. Adams's statement was distinguished by its moderation. He realises the difficulties, but is not unhopeful of their being overcome. Whether the psychologists will be quite happy about his statement that education has captured their subject is not quite certain, but, much as education owes to psychology, there can be little doubt that psychology is vastly in the debt of education. But we are only at the beginning of the scientific study of the problem of education, which, by reason of its special aims and restricted field, must ultimately acquire that definiteness which we recognise as belonging to the older sciences represented in the British Association.

Most closely connected with the subject of the presidential address was the meeting devoted to the psychological processes underlying reading and writing. A sectional committee had reported upon the subject and arranged for papers to be read. Mr. F. Smith dealt with the process as it takes place in the practised reader, and Mr. Dumville with the learner. Mr. Dumville's paper was in the main a defence of the so-called "Look and say" method of teaching to read—the method, that is to say, which deals with whole words first, leaving their analysis to the time when the learner has realised the meaningful character of the printed page and is anxious to get at it. The natural tendency to analysis comes out in the effort to deal with new word-forms, and the teacher may profitably act as guide. Miss Foxley's experiments had led her to the same conclusions as those reached by Mr. Dumville. Dr. Brown and Dr. Rusk followed with accounts of movement in writing. The pedagogical consequences of these analyses were not, however, discussed.

Friday's meeting was devoted to the burning question of the relation of the school to future vocation. Mr. J. W. Peck, until recently clerk to the Edinburgh School Board, gave a lucid account of the way in which his authority attempted to meet the vocational call in the evening continuation schools of the city. Out of the 17,000 folk between fourteen and eighteen years of age, 12,000 were actually reached by their scheme—a purely voluntary one, as they have not put into operation the compulsory powers vested in them by the Act of 1908. The freedom of choice left to the pupils produced a want of balance in their work; the subjects having a directly utilitarian value were unduly favoured. Thus only 2½ per cent. took courses in civics, and only 10 per cent. pursued English studies. Mr. Peck favoured some form of compulsion, as only in that way would they reach the outstanding 5000, and a reasonable curriculum be ensured. Mr. Holland showed us some of the difficulties of relating education to vocation, at any rate in the day school. The division of labour was so minute in his own district that a man might spend his working life on making the ninety-fifth part of a shoe. How exactly the difficulty was to be overcome Mr. Holland was not quite clear, although he was convinced that school work should, and could, be made more meaningful to the pupils.

Miss Faithfull spoke with conviction against allowing education to be determined by vocation. Her plea was for a liberal education in the old-fashioned sense of that word. She would deny that a training could be both liberal and vocational. Her voice was, however, a solitary one. Miss Burstall, of the Manchester High School, was wholeheartedly in favour of giving a vocational turn to the education of girls. She had worked in that direction in her own school with unqualified success. School was no longer a bore to girls who had at one time chafed under the exercises which seemed to lead nowhere. Mr. Reid spoke of the question from the point of view of the engineer, and Mr. Ferguson told the section of the successful effort to "liberalise" the vocation of cardboard-box makers in the Bourneville works.

An interesting review of the present position of mathematical teaching was opened by Dr. T. P. Nunn, followed by Drs. Pinkerton and Milne, and Mr. Eggar. The first three speakers were at one in their defence of the attempt to humanise school mathematics, even at the expense of dexterity in dealing with complex mathematical expressions—at any rate, in the initial stages. Mr. Eggar voiced a doubt as to the position in geometry, and Prof. Silvanus Thompson supported him in saying that reformers had often gone too far—further than Prof. Perry himself ever intended. Both Prof. Thompson and Principal Griffiths felt that a definite mathematical quality had been weakened or lost in the abandonment of Euclid, and that this loss would continue until some adequate substitute had been found.

Scotch experience in the matter of leaving certificates was described by Mr. Strong and Mr. Donne, and the Scotch Education Department was attacked by Principal Sir J. Donaldson, who in a previous discussion had advocated individual liberty in the matter of spelling.

The section received various reports from committees on (1) school books and eyesight, (2) the curriculum and organisation of industrial and Poor Law schools, and (3) the overlapping between school and university. It is hoped that the "books and eyesight" report will be circulated very widely amongst education authorities. It is clear, too, that there is much that needs amending in our industrial schools, especially perhaps in those which are run on the subscriptions of the charitable, and are therefore less directly under public control.

MINUTE LIFE ON OUR SEA-BEACHES.[1]

IN thinking of a suitable subject on which to address you this evening, it naturally occurred to me that the fellows of the Linnean Society and their friends include both botanists and zoologists, and are all of them, I hope, good field naturalists, who delight in work in the open. So I have decided to talk about

FIG. 1.—A Lancashire mussel skear.

what I am coming to regard as a somewhat neglected field of investigation, namely the minute life of our ordinary sea-beaches and the changes which that life undergoes throughout the year. Many biologists are inclined to regard an ordinary sandy beach as a very uninteresting collecting ground, where, they would say, there are but few living things to be found—perhaps some burrowing worms, such as Arenicola, some heart-shaped urchins, like Echinocardium, some lamellibranch molluscs, Solen, Mya and the cockles, and that is about all that most collectors would bring back from such a beach; and we have all heard fishery experts exclaiming at the poverty of such coasts in eloquent words. "Oh, the barren, barren shores which might be cultivated so richly!" is the burden of their cry. There is some truth in it. But if I am able to show that they are not so barren as is supposed, that only makes it the more likely that the beaches might be cultivated with advantage for the benefit of man.

The amount of living things, both plants and animals, that can grow or may be reared in suitable localities between tide marks is astonishing. Let me show you a few photographs exhibiting life in profusion, both in its natural wild state and also under artificial cultivation, as examples of characteristic views on our coasts. Some show patches of the littoral zone near low tide mark, with in some cases huge colonies of the fleshy coral Alcyonium, and numbers of sea-anemones, of worm-tubes, and of zoophytes; in other cases masses of the larger algæ, Fucus and Laminaria; and then again some have the molluscs, Patella, Purpura, and Littorina, covering almost every available inch of the ground. Other more rocky shores, such as Bradda Head at the south end of the Isle of Man, have the stone so closely infested with Balanus, the acorn-shell, that for hundreds of yards it looks at low tide, from a distance, as if a broad, uninterrupted horizontal band of white had been painted on the rock, and on going close up to such a cliff one sees that for many yards in succession it is difficult to find a spot of exposed stone on which to put a finger.

Then, as an example of what could be done by cultivation, even of the rudest kind, we may look at these photographs of the mussel skears on some parts of the coast of Lancashire (see Fig. 1), where the shellfish soon become so closely crowded that, unless thinned out, they prevent each other's growth by their mutual pressure.

These organisms, however, are all large, common, and well known, while what I desire to bring before you as a neglected field is the presence of minute and little-known organisms which appear in profusion in some localities, at any rate on certain occasions, and are probably of enormous importance in their influence on the life of larger forms, both on the shore and at sea. Probably many, if not all, seashores would show the phenomena I wish to refer to, but the beach which I take as my example is that at Port Erin, in the Isle of Man, where between two rocky sides there is a flat expanse of sand with the usual barren appearance, and the usual burrowing annelids and molluscs.

The sandy beach has a steeper slope in its upper part, and at the base of this, not very far below high-water mark, and just where the damper, flatter, and less stony part of the sand commences, there are found from time to time throughout the greater part of the year larger or smaller greenish-brown patches, sometimes yards in extent, such as most naturalists would declare at a glance to be caused by accumulations of diatoms—and diatoms we at Port Erin at first supposed them to be. But one day last year on collecting a sample and putting it under the microscope I was astonished to find that the deposit was composed of an enormous quantity of minute, active, flagellate, yellow organisms, evidently belonging to the Dinoflagellata, and related to Peridinium (see Figs. 2 and 3).

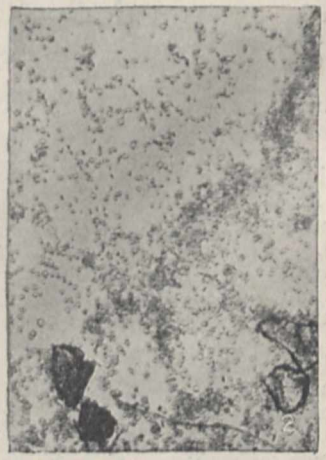


FIG. 2.—Sand-grains and Amphidinium from the beach. Low-power.

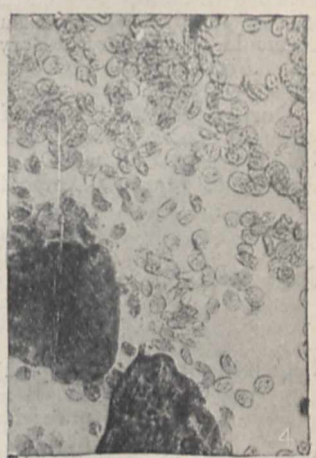


FIG. 3.—Part of Fig. 2 under high-power magnification.

[1] An address given at the Linnean Society's Reception on October 31 by Prof. W. A. Herdman, F.R.S.

This organism proved on further investigation to be *Amphidinium operculatum*, Clap. and Lachm., which had never before been found in British seas, and very rarely anywhere else. And yet here it was in vast amount for weeks at a time[2]; and I am inclined to think it may be abundant on other beaches also. Several naturalists have told me since I mentioned this matter to the Linnean Society last year that they are convinced that they have previously seen Amphidinium patches on the shore, and had taken them for diatoms. But one of the most extraordinary points about the occurrence of this little Dinoflagellate is that it seems to alternate in time on the beach with almost pure cultures of certain common diatoms, such as *Navicula amphisbaena*, Bory, and *N. digito-radiata*, Greg. (see Figs. 4 and 5).

FIG. 4.—*Navicula digito-radiata.*

FIG. 5.—*Navicula amphisbaena* (?).

During 1911 the history of these coloured patches on Port Erin beach was as follows:—

April 7 to May 1.—Amphidinium and a few diatoms (Navicula).

June 3 to July 22.—Diatoms (some Navicula, others Pleurosigma).

September 9 and 10.—Amphidinium in abundance; diatoms absent.

September 16 to 18.—Diatoms (Navicula).

October 2 to 26.—Amphidinium in abundance; diatoms absent.

October 28 to November 1.—No Amphidinium present.

November 2.—Amphidinium (three small patches).

During the remainder of the winter no patches were found, but by the beginning of April Amphidinium had reappeared in force and monopolised the beach for a couple of weeks. It was then replaced by diatoms for a few days, and in the latter part of April, 1912, the alternation took place no fewer than four times, ending with a couple of weeks in May, when neither organism was present. Amphidinium reappeared on May 15, and was present more or less during the greater part of the summer, except in the drier intervals of July and August, when it was absent. From September 14 onwards it has again been present in larger or smaller patches, and I have examined living samples sent from Port Erin, up to the last day of October; but, curiously enough, the individuals in these recent gatherings differ considerably in shape, size, and some other minor points from the *Amphidinium operculatum* we had been examining in such quantity at Port Erin during the previous year.

I am not of opinion as yet that this difference indicates more than a form of the same species—possibly seasonal or due to age or nutrition, or some other environmental influence; and the variation does not affect the broad phenomenon of the striking alternation of the two very different kinds of organisms, diatoms and Dinoflagellates, in vast quantity. Although it may not be possible yet to give any detailed explanation, the facts seem to point to the probability that the cause of the phenomenon is a physiological one, and that the explanation may consist in showing that each organism in turn in its metabolism exhausts or alters some essential constituent of the environment, so as to prevent its own continued existence, in quantity, at that spot, but leaves the ground suitable, or even favourable, to the physiological needs of the other set of competing organisms.

FIG. 6.—Copepod zoo-plankton from summer gatherings.

FIG. 7.—Diatom phyto-plankton from spring gatherings.

I owe all the photomicrographs to the skill of my friend Mr. Edwin Thompson.

Possibly we have a similar phenomenon on a more extended scale in the well-known seasonal variations of the plankton of the open sea, where during spring and summer the main constituent groups of organisms are Diatoms, Dinoflagellates, and Copepoda, succeeding one another in that order. (Figs. 6 and 7 show

[2] See Journ. Linn. Soc., vol. xxxii., No. 212, October, 1911.

a spring phytoplankton and a summer zooplankton gathering.) Prof. Benjamin Moore has recently found[3] a noteworthy change in the chemical reaction of the sea water round our coasts at different seasons of the year, no doubt in co-relation with the development of the plankton organisms. In spring (April) the water, not only on the shore, but out at sea, is acid to phenolphthalein, while in summer (August) it is distinctly alkaline to the same indicator. This change signifies an enormous conversion of carbon in the inorganic into carbon in organic form, a turn-over of colossal extent amounting to between 20,000 and 30,000 tons of carbon per cubic mile of sea water, or, if we think of the carbon as being in the bodies of living organisms, then the weight of these organisms will amount to about ten times that quantity of carbon in the cubic mile—or, if we imagine it occupying the deepest part of the Irish Channel, say, 300,000 tons of organisms per strip of water ten miles long by one mile broad and eighty-eight fathoms deep, all supplied with their necessary carbon from the carbon dioxide present in the sea water in spring.

Thus we can be led on from the simple observation of minute organisms on the beach to some of the greatest problems in the metabolism of the ocean; but the naturalist investigator need not necessarily venture out to sea in his quest. There is plenty of useful work to be done on the beach in carefully examining with the microscope the various deposits, such as sand and mud, found between tide marks, not once for all, but periodically, so as to determine the nature of the minute animals and plants, their relative abundance, and their variations, seasonal or otherwise, in quantity and character throughout the year. We know that some of these organisms, although individually insignificant, may exist in such quantities as to discolour the sands or the sea water, and even give rise to plagues amongst shellfish and other more directly valuable animals. Invasions of this kind, due to Dinoflagellata closely allied to our Amphidinium, are known to have appeared in America and in Australia, and possibly elsewhere. It is work worthy of the best endeavours of some of the younger botanists and zoologists of the Linnean Society, who have ready access to the coast, to try to extend our knowledge of the range and life conditions of some of those remarkable organisms—organisms which not only present scientific problems to the field naturalist, the cytologist, the experimental biologist, and biochemist, but, moreover, may well, from their vast numbers and sudden changes, have a profound effect upon the metabolism of the ocean, and so upon the prosperity of sea-fisheries.

[3] In the course of a Percy-Sladen Trust research upon the nutrition of marine animals, the detailed results of which will be published at an early date.

THE UNIVERSITY OF BRISTOL IN RELATION TO AGRICULTURE.

THE University of Bristol, the youngest of our universities, has made it evident that it intends to play an active part in the development of agricultural education and research. Some two years ago the University associated with itself the Royal Agricultural College, Cirencester, for purposes of higher education in agriculture, and arrangements for the granting of degrees in that subject are now being completed.

The Board of Agriculture and Fisheries has recently notified its intention of making an annual grant of 500*l*. to the college to enable it to provide for research on questions relating to forestry for the west of England area.

The University has also recently associated with itself the National Fruit and Cider Institute, which was established at Long Ashton, near Bristol, in 1903, to carry on investigations on fruit culture and cider-making. This institution has been supported since its establishment by annual grants from the Board of Agriculture and Fisheries, the county councils of Devon, Gloucester, Hereford, Monmouth, Somerset, and Worcester, and the Bath and West of England Agricultural Society. Its association with the University is the result of an offer on the part of the Board of Agriculture and Fisheries to the latter of an annual grant approximating to 2500*l*. to provide for the establishment of one of the agricultural research institutions contemplated by the Board in connection with the grant from the Development Fund available for the promotion of agricultural research.

The special subject of research allotted to Bristol is that of fruit-growing, including the practical treatment of plant diseases. The offer of the Board was conditional on the National Fruit and Cider Institute being made the centre at which the work was to be carried on. In connection with the scheme a capital expenditure of 10,000*l*. has been estimated to be necessary. Of this sum the Development Commissioners intimated their willingness to provide 50 per cent., provided that the remaining half was raised locally. Largely owing to the efforts of the Rt. Hon. Henry Hobhouse, chairman of the Somerset County Council, the necessary money has been subscribed. The expenditure is required for the purchase of land and the erection and equipment of laboratories and other buildings at Long Ashton. A department of agricultural and horticultural research has thus been created, Mr. B. T. P. Barker, director of the National Fruit and Cider Institute, being appointed head of the department and professor of agricultural biology in the University. Towards the upkeep of the department the University is contributing an annual sum of 300*l*., the income of a gift from the late Lord Winterstoke for the purpose of agricultural research; and the income from other sources, including county council grants, is about 1500*l*.

The department of chemistry in the University is also taking part in the work. In the biochemical laboratory, investigations on the tannins of cider are proceeding in connection with the fruit research work. A special grant from the Development Fund for the continuation of investigations on the chemistry of Cheddar cheese, which have been carried out during the past two years by Dr. Nierenstein, has been promised. This work was begun in the first place at the request of the Somerset County Council, a grant for the purpose being given by that body.

The Board of Agriculture and Fisheries also proposes to make the University the centre for a group of the western counties in connection with its scheme for the provision of technical advice to farmers. The group will probably include Gloucester, Hereford, Somerset, Wiltshire, and Worcester, and possibly one or two other adjoining counties for special purposes. An annual sum of 1000*l*. is provided by the Board for this work. Under this scheme investigations on problems of local agricultural importance will be undertaken. In this connection reference may be made to the work on the "teart" or scouring land of Somerset, which has already been conducted by Mr. C. T. Gimingham for the past two years.

The following appointments to the staff of the Department of Agricultural and Horticultural Research have already been made:—Mr. A. H. Lees as plant pathologist, Mr. C. T. Gimingham as agricultural chemist, and Mr. Otto Grove, for some time assistant to Dr. Alf. Jörgensen, of Copenhagen, as

œnologist. A mycologist will be appointed in due course. In the biochemical laboratory Mr. Arthur Geake has been appointed research assistant to Dr. Nierenstein for the investigations on the chemistry of Cheddar cheese, and Mr. C. W. Spiers research assistant for the cider tannins investigation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The council of St. John's College has offered to the University 500*l.* as a contribution to the equipment of the Solar Physics Observatory on its installation in Cambridge.

The special board for biology and geology has adjudged the Walsingham medal for 1912 to E. D. Adrian, for his essay entitled, "On the Transmission of Subnormal Disturbances in Normal and in Incompletely Recovered Nerve."

The Walsingham medal for 1913 is to be awarded for an essay embodying the results of original research on any botanical, geological, or zoological subject, zoology being understood to include animal morphology and physiology.

K. R. Lewin has, with the approval of the Vice-Chancellor, been appointed assistant to the Quick professor of biology, in succession to Mr. C. Strickland, who has resigned the post.

The General Board of Studies has appointed W. B. Hardy a University lecturer in physiology from January 1, 1913, until September 30, 1917.

N. Cunliffe has been appointed to the studentship in medical entomology lately held by G. Merriman.

It is proposed to confer the degree of Master of Arts, *honoris causa*, upon Sir Arthur Thomas Quiller-Couch, King Edward VII. professor of English literature, and upon Dr. John Read, assistant to the professor of chemistry.

OXFORD.—On November 26 the preamble of the statute abolishing the existing division into orders of the elected members of council was moved in Congregation by Prof. Geldart, and supported by the warden of Keble. It was opposed by Prof. Gotch and Mr. Ball, and rejected by 87 to 105. The statute will probably be reintroduced in another form.

At the same meeting of Congregation the preamble of a statute amending the constitution of Congregation by abolishing the qualification of residence, and providing that in future that body shall consist only of the teaching and administrative elements in the University and colleges, was moved by Prof. Geldart, and, in spite of the opposition offered by the master of Balliol and Mr. Ball (by the latter on the ground that it provided for the safeguarding of vested interests), was carried by 100 to 79. An objection felt in many quarters to this enactment is based on the fact that it will disfranchise such persons as those graduates engaged in scientific or other research who do not happen to be employed in teaching or administration within the University. It is understood that no amendment to admit such persons will be possible under the preamble as now carried.

THE office of Vice-Chancellor of the University of Sheffield, vacant through the retirement of Sir Charles Eliot, has been accepted by Mr. H. A. L. Fisher, fellow and tutor of New College, Oxford.

AMONG the bequests of Mrs. A. M. Jones (widow of Prof. Tom Jones, of Manchester, surgeon), who died on October 30, are 1000*l.* to the Victoria University, Manchester, in augmentation of the endowment of the Prof. Tom Jones memorial scholarship, and 500*l.* to the University College of Wales, Aberystwith, as an endowment for promoting the study of surgery.

AT the annual meeting of the court of governors of the University of Wales on November 22 a resolution, moved by Sir Isambard Owen, that steps be taken to secure representation in Parliament for the Welsh University was carried by seventeen votes to twelve. In moving his resolution, Sir Isambard said that if university representation is to be continued there is no doubt that the younger universities will all be agitating for privileges with the older universities, and there is a danger that Parliament will pool these younger universities with only one representative for each group. He held that it is necessary that the Welsh University should not be pooled with, say, Birmingham or Bristol, because the Welsh University is national and possesses distinct interests.

THE governing body of the Imperial College of Science and Technology has decided to combine all the mathematical work of the Imperial College, and of its integral parts, viz. the Royal College of Science, the Royal School of Mines, and the City and Guilds (Engineering) College, into one department, and to place the supervision of this department under a chief professor of mathematics. A special joint committee of the governing body and of the delegacy of the City and Guilds College has now been constituted in connection with the selection of a suitable individual for appointment to the chair. It is the intention of the governing body to make the appointment from a date during the current session, so as to enable the new organisation to be perfected before October next, when the work of session 1913–14 begins.

THE proceedings at the congress of the fifty-three universities of the Empire, which took place in London last July, were described in articles published in the issues of NATURE for June 13 and July 11 last (vol. lxxxix., pp. 385 and 477). The official record of the proceedings has now been published for the congress by the University of London Press, Messrs. Hodder and Stoughton, London, as a volume of 464 pages, the price of which is 10*s.* net. If the congress meets, as proposed, at recurring intervals of five years, reports such as that now available will serve excellently to record the steps in the future development of university ideals. Not only are the papers read at the congress by experts on university education included, but the speeches made at the various meetings are also reported.

THE calendar for the session 1912–13 of University College, London, which is now available, is full of interesting particulars of the manifold activities of this important constituent college of the University of London. The list of original papers and other publications from the various departments of the college, since the dean's report in the preceding calendar, runs to sixteen pages, and an examination of it shows that each faculty recognises fully the vital importance of research work. It is worthy of note that the new chemical laboratories have been begun, and will be ready in about a year's time. The equipment of the faculty of medical sciences has been improved by the provision of the new pharmacology laboratories by Mr. Carnegie. These laboratories will shortly be opened. The total number of students in the college during the session 1911–12 was 1679—1031 men and 648 women. Engaged in post-graduate and research work there were 286 men and 117 women. The faculty of science was chosen by 175 men and 135 women, and engineering was taken up by 104 men.

THE Department of Agriculture and Technical Instruction for Ireland has arranged that a limited number of scholarships and of teacherships-in-training,

tenable at the Royal College of Science, Dublin, shall be offered for competition among Irish students of science and technology in 1913. The scholarships are of the value of 50*l.* per annum, and, in addition, entitle the holder to free instruction during the associate course. A teachership-in-training has similar advantages except that the maintenance allowance is 21s. per week for the session of about forty weeks. Candidates must be not less than sixteen nor more than thirty years of age on June 1, 1913, and will have to satisfy the Department as to their knowledge of English and of one other of the languages—Greek, Latin, Irish, French, or German. The competition will be confined to mathematics, experimental science, and drawing. Applications for admission to the examination must be made not later than April 30, 1913, on forms copies of which may be obtained upon application to the Secretary, Department of Agriculture and Technical Instruction for Ireland, Upper Merrion Street, Dublin, or to the Registrar, Royal College of Science, Upper Merrion Street, Dublin.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 8.—Prof. A. Schuster, F.R.S., president, in the chair.—H. R. **Nettleton**: A method of measuring the Thomson effect. The distribution of temperature down a conductor conveying an electric current and at the same time moving uniformly through two fixed temperature sources is investigated. The effect of the Thomson heat on the distribution is exactly similar to the effect of a small impressed velocity. This result was applied to mercury to measure the Thomson effect by comparing the alteration of temperature $\Delta\theta_1$ at a point near the middle of the gradient caused by reversing a current of C amperes with the alteration of temperature $\Delta\theta_2$ at the same point due to a flow of mercury of m grams per second. Without any approximation as to emissivity loss or magnitude of Joulian heat, $2C\sigma/ms = \Delta\theta_1/\Delta\theta_2$, where s is the specific heat of mercury and σ the specific heat of electricity. Working with currents of from 4 to 9 amperes and with flows of different magnitudes—but never exceeding 1 cm. per hour—consistent values of σ were obtained, the value at 61° C. being $-1{\cdot}52 \times 10^{-6}$ calories per degree Centigrade per coulomb. The thermo-junctions, which were of iron and constantan, were fused through the glass tubes with inappreciable distortion.—F. W. **Jordan**: An improved Joule radiometer and its applications. The first part relates to improvements made in order to convert the original Joule convection apparatus into an instrument for the exact measurement of small steady rates of evolution or absorption of heat. These improvements consisted in (1) replacing the badly conducting glass enclosure and cardboard partition by others made of brass and copper; (2) replacing the uncertain and variable magnetic control of the movement of the vane in Joule's apparatus by the elastic control of a quartz fibre; (3) shaping the channels, in which the vanes moved, so that the angular deflection of the vanes was proportional to the rate of evolution of heat; (4) reducing the size, so that uniform temperatures of its various parts could be maintained by (5) placing the radiometer within a concentric brass tube to exclude all extraneous heat excepting that which might be directed through apertures in its side towards the radiometer. The sensibility of the instrument was measured and found to be equal to 0·52 mm. per microwatt, as measured on a scale at a distance of one metre from the mirror. Thus the instrument may be used for the measurement of feeble oscillating currents. To convert the apparatus into an instrument for the measurement of radiant heat it is suggested that the radiant heat be directed through a small rock salt or fluorite window in the side of a compartment on to a thin blackened metal disc supported centrally. Its use for the quick measurement of the heat given out by radium is also suggested. The second part relates to a suggested method of measuring the Thomson effect with this radiometer. The method hinges on an experiment described by the author in NATURE, May 18, 1911.—Miss A. **Somers**: Note on the attainment of a steady state when heat diffuses along a moving cylinder. The paper dealt with the case of a column of mercury moving with uniform speed between two fixed temperature sources. The differential equation for the temperature within the column was stated and its solution given, and it was shown how the time of attainment of a steady state could be obtained from the latter. Dr. S. W. J. **Smith**: Thermomagnetic study of steel. Thermomagnetic measurements make it increasingly evident that the magnetic properties of steels are frequently those of mixtures of magnetic substances, each possessing characteristic properties, which contribute in a comparatively definite way to the properties of the material as a whole. In the case of a simple ferromagnetic substance, magnetising fields can be found in which the permeability variation with temperature is small except in the neighbourhood of the critical temperature. In such fields there is a marked peak in the permeability temperature curve for the substance. The explanation of this peak suggests that the phenomenon should be found common to all ferromagnetic substances. The paper shows that it is exhibited by the carbide of iron (cementite) in annealed carbon steels.

Mineralogical Society, November 12.—Anniversary meeting.—Dr. A. E. H. Tutton, F.R.S., president, in the chair.—Prof. W. J. **Lewis**: Ilmenite from the Lengenbach Quarry. Imbedded in the dolomite was found a minute crystal, irregular in habit, showing the forms 110, 10$\bar{1}$, 100, 112, 111, 275. The best readings were obtained from pairs of faces of 101 and between them and faces of a prism, the corresponding angles being found to be 64° 47′ and 57° 33′ respectively.—Prof. W. J. **Lewis**: Multiple twin of cassiterite. Threefold twinning is well and regularly developed on opposite sides of the crystal, which consists of two main portions with twin axes all in one plane, and the triplets so formed are connected together in a somewhat irregular way. Further, some of the individuals are twinned along pyramid faces inclined to the general plane, so that the back of the crystal is unlike the front.—Arthur **Russell**: An account of the minerals found in the Virtuous Lady Mine, near Tavistock. The following species were met with:—Chalybite, in pseudomorphs after fluor and barytes, termed respectively "boxes" and "slippers" by the miners; marcasite in sheaf-like aggregates; mispickel in two modifications; anatase, on one crystal of which was found a small crystal of brookite, the only one seen by the author from this locality.—Dr. A. **Hutchinson**: Some graphical methods in crystallography and crystal optics. Diagrams of expressions involving sines, such as $\sin E = \beta \sin V$, are much simplified by taking log sines for coordinates, the result being a series of parallel straight lines.—Dr. A. **Hutchinson** and W. Campbell **Smith**: Labradorite from St. John Point, co. Down. The large fresh crystals of felspar, which occur in a basaltic dyke, have physical characters—specific gravity 2·706, extinction on 010 and 001 −23° and −11° respectively, refractive

indices α 1·5598, β 1·5648, γ 1·5694—which agree closely with the position of the felspar in the plagioclase series given by its chemical composition, which is approximately represented by the formula 33Ab5Or62An.—Dr. G. F. H. **Smith**: Apparatus for preparing thin sections of rocks. A description was given of the apparatus recently made for the Mineral Department of the British Museum.—Russell F. **Gwinnell**: Calcite crystals from a water tank. The crystals, which were deposited during the dry summer of 1911 from water derived from a spring in the marlstone of Belton Park, near Grantham, Lincs., averaged 0·1 mm. in greatest diameter, and showed the unusual unit rhombohedron form 10$\bar{1}$1.

Zoological Society, November 12.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—H. R. **Hogg**: Some Falkland Island spiders. The paper was based on a small collection of spiders formed by Mr. Rupert Vallentin during a two years' stay in the Falkland Islands. Of some of the species there were a fair number of specimens, but they comprised only six species of spiders and one of the allied suborder Opilio. The species were all apparently new, but the genera were all to be found either in Patagonia, Tierra del Fuego, or the islands about Cape Horn. The ancestors of the spiders might all have been transported aërially at an early period, and therefore afforded no evidence for or against a former land-connection, but in the event of the latter there should be many more species. The Opilio might have been conveyed under the bark of floating trees.—G. A. **Boulenger**: Descriptions of three new fishes discovered by Dr. Spurrell in the vicinity of Bibianaha, near Dunkwa, Gold Coast, and presented by him to the British Museum.—Dr. H. Lyster **Jameson** and Dr. William **Nicoll**: Some parasites of the scoter duck (*Oedemia nigra*), and their relation to the pearl-inducing trematode in the edible mussel (*Mytilus edulis*).—F. F. **Laidlaw**: Dragon-flies from Borneo belonging to the subfamily Corduliinæ, and to the genera Disparoneura and Amphicnemis of the subfamily Agrioninæ, with an account of a number of new species.

Royal Meteorological Society, November 20.—Dr. H. N. Dickson, president, in the chair.—Dr. H. R. **Mill**: The unprecedented rainfall in East Anglia on August 26 last. The rain commenced in London between 1 and 2 a.m. on August 26, but the hour of commencement grew later towards the northward, rain not beginning to fall in Lincolnshire until after 7 a.m. The intensity of the fall increased rapidly over the whole area, the maximum being reached in a fall of 4 in. in four hours from 11 a.m. in the neighbourhood of Norwich. In the central area the rain fell without intermission for more than twenty hours, and at some points probably for twenty-four. The distribution of the rain was somewhat remarkable. There were two foci of maximum fall, both in Norfolk: the northern central south of Cromer with more than 7·50 in.; the larger central east of Norfolk culminating in about twenty square miles with more than 8 in. of rain in the twenty-four hours. About 1940 square miles in Norfolk and Suffolk had more than 4 in. of rain; the area with more than 2 in. of rain was at least 5800 square miles. The general rainfall of each of the counties was calculated for this day, and also for the various river-basins, and it appeared that during the twenty-four hours as much water was deposited on the land as would fall in normal circumstances in two or three months. Several very heavy falls of rain in one or two days which had been recorded in different parts of the country were considered, and it was shown that although more than 8 in. had fallen at Seathwaite, in the Lake district, on more than one occasion as the result of one or two days' rain, there was no instance of so large an area having more than 6 in. of rain in two days as occurred in East Anglia on August 26.—A. P. **Jenkin** A three-year period in rainfall.

CAMBRIDGE.

Philosophical Society, October 28.—Dr. Duckworth in the chair.—Dr. **Duckworth**: Anthropometric data collected by Prof. Stanley Gardiner in the Maldive Islands. The anthropometric data collected by Prof. J. Stanley Gardiner during his expedition to the Maldive Islands and Minikoi relate to sixty-nine individuals. Analysis of the data shows that the islanders are very variable as regards their physical development. The men of Minikoi are on the whole more variable than the rest. They are shorter and their heads are rounder than is the case elsewhere. Addu Atoll, the most southern islet, is in contrast with Minikoi in this respect. The highest caste in Male has the greatest stature and the largest head-dimensions. High caste seems to be associated with a broader nose, though this relation is contrary to expectation. No trace of a genuine pygmy element can be detected in any of the groups measured. Three main sources of immigration into the Maldives and Minikoi are considered briefly.—R. H. **Compton**: Preliminary note on the inheritance of self-sterility in *Reseda odorata*. As discovered by Charles Darwin, certain individuals of mignonette are self-fertile, others self-sterile. Breeding experiments, though as yet incomplete, indicate that self-fertility is a Mendelian character, behaving as a simple dominant to self-sterility.—J. **Gray**: The effects of hypertonic solutions upon the eggs of Echinus. It was shown that the abnormalities which are invariably found in the first segmentation division of the hybrid *Echinus acutus* ♀ × *E. esculentus* ♂ can be induced in the normally fertilised eggs of *E. acutus* by treatment with hypertonic sea-water after fertilisation; similar solutions, however, do not affect the normally fertilised eggs of *E. esculentus* to anything like the same extent, such eggs being practically normal. On these results was based an explanation of the fact that whereas the eggs of *E. acutus* ♀ × *E. esculentus* ♂ show irregular mitoses, those of the reverse cross are normal.—G. R. **Mines**: *Pulsus alternans*.

PARIS.

Academy of Sciences, November 18.—M. Lippmann in the chair.—E.-L. **Bouvier**: *Dugastella marocana*, a new primitive shrimp of the family of the Atyideæ. A representative of a new fresh-water genus found in Morocco; it corresponds most closely to the Californian Syncaris.—M. **Imbeaux** was elected a correspondant for the section of rural economy, in the place of the late M. Arloing.—Paul **Montel**: Some generalisations of the theorems of M. Picard.—Th. de **Donder**: The invariants of the calculus of variations.—M. **Lémeray**: The principle of relativity and the law of variation of central forces. The law of variation with the square of the distance for the action between heavy points at rest may be deduced as a necessary consequence of the principle of relativity.—Ch. **Féry**: A dead-heat galvanometer with a moving needle. Each pole of the magnet is suspended between two pairs of flat bobbins so close together as to constitute practically one solenoid. The sensibility of a galvanometer mounted in this way was 1 mm. deflection at one metre for a current of 8×10^{-10} ampere; the resistance of the four bobbins in series being 2 ohms, and the time of oscillation fifteen seconds.—G. **Denigès** and L. **Chelle**: A new reagent for free and combined

chlorine and bromine. Details are given of the application of a method described in a previous note, based on the use of fuchsine decolorised with sulphuric acid. Dealing with such small quantities of bromine as are found in certain natural waters, the method can be applied quantitatively; it is more delicate and rapid than the methods in current use.—J. B. **Senderens** and Jean **Aboulenc**: The ethereal salts derived from the cyclanols and the acids of the fatty series. Starting with the six lower members of the fatty acids and the alcohols *cyclo*hexanol and the three isomeric methyl*cyclo*hexanols, twenty-four esters have been prepared by the catalytic method described in an earlier paper. The physical properties of these esters are tabulated.—Jacques **Duclaux**: The specific heat of bodies at low temperatures. It is known that the specific heat of most substances diminishes rapidly at low temperatures; the author discusses the hypothesis that this reduction of specific heat is due to increasing polymerisation.—Daniel **Berthelot** and Henri **Gaudechon**: The photolysis of saccharose by the ultra-violet rays. A study of the effect of the wave-length of the ultra-violet light on the chemical changes produced.—R. **Fosse**: The transformation of an alcohol into the sulphide of peroxide by the action of sulphuretted hydrogen and of hydrogen peroxide.—J. **Tchougaeff** and B. **Orelkine**: Some complex compounds of platinous chloride with aminoacetal.—R. de **Litardière**: The formation of heterotypical chromosomes in *Polypodium vulgare*.—Maurice **Durandard**: The combined influence of temperature and of the medium on the development of *Mucor Rouxii*.—Marc **Bridel**: The presence of gentiopicrin in *Swertia perennis*. The biochemical examination has shown that this plant contains a glucoside hydrolysable by emulsin; this glucoside has been isolated in a pure state and identified with gentiopicrin.—J. **Wolff**: The biochemical function of the peroxydases in the transformation of orcin into orcein.—Pierre **Bonnier**: The late awakening of the bulbar centres. The bulbar nervous centres in newly born children often require stimulation to start their action. This defect can be remedied by a very slight cauterisation of the nasal mucous membrane. Several successful cases of the application of this treatment are cited.—Jules **Amar**: the laws of work; experiments on filing. A study of the work expended by a man during the operation of filing brass, with a statement of the best conditions for the maximum yield for given expenditure of muscular effort.—Charles **Nicolle**, A **Conor**, and E. **Conseil**: Intravenous inoculation of dead typhoid bacilli in man. The treatment is marked by the absence of any reaction or local pain, and by the production in the system of a notable amount of the typhoid antibody.—Auguste **Lumière** and Jean **Chevrotier**: The polyvalence of the anti-typhoid sera.—A. **Marie** and Léon **MacAuliffe**: The study and measurement of 100 French tramps.—De Montessus de **Ballore**: An earthquake of epirogenic origin probable in the neighbourhood of Michigan and Wisconsin.—M. **Bourée**: The vertical migration of bathypelagic animals.

BOOKS RECEIVED.

The Note-books of Samuel Butler. Selections, arranged and edited by H. F. Jones. Pp. xii+438. (London: A. C. Fifield.) 6*s*. net.

Annuaire pour l'An 1913. Publié par le Bureau des Longitudes. Pp. vi+707, &c. (Paris: Gauthier-Villars.) 2.50 francs net.

Memoirs of the Geological Survey. England and Wales. Explanation of Sheet 359. The Geology of the Lizard and Meneage. By Dr. J. S. Flett and J. B. Hill. Pp. viii+280. (London: H.M. Stationery Office; E. Stanford, Ltd., and others.) 5*s*.

Nutritional Physiology. By Prof. P. G. Stiles. Pp. 271. (Philadelphia and London: W. B. Saunders Co.) 6*s*. net.

Plant Geography. By Prof. G. S. Boulger. Pp. viii+136. (London: J. M. Dent and Sons, Ltd.) 1*s*. net.

University of London. University College. Calendar Session 1912–13. Pp. clxxiii+574. (London: Taylor and Francis.)

Report on the Enquiry to bring Technical Institutions into Closer Touch and more Practical Relations with the Employers of Labour in India. By Lieut.-Col. E. H. de V. Atkinson and T. S. Dawson. Pp. v+100. (Calcutta: Superintendent Government Printing, India.) 1*s*.

Les Actualités Médicales. Le Radium: son Emploi dans le Traitement du Cancer des Angiomes, Chéloïdes, Tuberculoses Locales et d'Autres Affections. By L. Wickham and P. Degrais. Pp. 96. (Paris: J. B. Baillière et Fils.) 1.50 francs.

How to Attract and Protect Wild Birds. By M. Hiesemann. Translated by E. S. Buchheim. Third edition. Pp. 100. (London: Witherby and Co.) 1*s*. 6*d*. net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 23, 24, 25. (Jena: G. Fischer.) 2.50 marks each.

Catalogue of the Serial Publications possessed by the Geological Commission of Cape Colony, the Royal Observatory, the Royal Society of South Africa, the South African Association for the Advancement of Science, the South African Museum, and the South African Public Library. With an Appendix containing a List of the Serials in the Bolus Herbarium of the South African College. Pp. 54. (Cape Town: South African Public Library.)

La Théorie de l'Aviation. Son application à l'Aéroplane. By P. Gastou. Pp. 31. (Paris: F. L. Vivien.) 1.50 francs.

Les Aéronefs sans Chutes. By A. Remacle. Pp. 89. (Paris: F. L. Vivien.) 1 franc.

Science from an Easy Chair. By Sir Ray Lankester. A second series. Pp. xiii+412. (London: Adlard and Son.) 6*s*. 6*d*. net.

The Star Calendar for 1913, with Revolving Chart. By Mrs. H. P. Hawkins. (London: Simpkin and Co., Ltd.) 1*s*. net.

The Star Sheet Almanac for 1913. By Mrs. H. P. Hawkins. (London: Simpkin and Co., Ltd.) 6*d*. net.

Practical Physics. By A. McLean. Pp. xi+402. (London: A. and C. Black.) 7*s*. 6*d*. net.

Metalwork and Enamelling. By H. Maryon. Pp. xiii+327. (London: Chapman and Hall, Ltd.) 7*s*. 6*d*. net.

A New Algebra. By S. Barnard and J. M. Child. Part i. Pp. viii+182. Parts ii. and iii. Pp. viii+149–340. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*. each.

A Dictionary of Applied Chemistry. By Sir E. Thorpe and others. Vol. iii. Revised and enlarged edition. Pp. viii+789. (London: Longmans and Co.) 45*s*. net.

Questions on Newth's Inorganic Chemistry. By Prof. G. D. Timmons. Pp. 64. (London: Longmans and Co.) 1*s*. net.

Practical Measurements in Radio-activity. By Drs. W. Makower and H. Geiger. Pp. ix+151. (London: Longmans and Co.) 5*s*. net.

An Introduction to Mathematical Physics. By Dr.

R. A. Houstoun. Pp. ix+199. (London: Longmans and Co.) 6s. net.

Yorkshire Type Ammonities. Edited by S. S. Buckman. Part viii. (London: W. Wesley and Son.)

The People's Books:—Hypnotism and Self-Education. By Dr. A. M. Hutchinson. Pp. 92. The Structure of the Earth. By Dr. T. G. Bonney. Pp. 94. Weather Science. By R. G. K. Lempfert. Pp. 94. Navigation. By W. Hall. Pp. 96. The Baby. By A University Woman. Pp. 94. Marriage and Motherhood. By H. S. Davidson. Pp. 94. (London and Edinburgh: T. C. and E. C. Jack.) 6d. net each.

Congress of the Universities of the Empire, 1912. Report of Proceedings. Edited by Dr. A. Hill. Pp. xlii+464. (London: Hodder and Stoughton.) 10s. net.

Primeval Man. By A. H. Quiggin. Pp. 140. (London: Macdonald and Evans.) 1s. 6d. net.

Sentinel Hours. By Prof. E. E. Speight. Pp. viii+261+plates. (London: A. and C. Black.) 2s.

The South Pole. By R. Amundsen. Translated by A. G. Chater. Vol. i., pp. xxxv+392+map. Vol. ii., pp. x+449+maps. (London: J. Murray.) Two vols., 2 guineas net.

A History of Geographical Discovery in the Seventeenth and Eighteenth Centuries. By E. Heawood. Pp. xii+475. (Cambridge University Press.) 12s. 6d. net.

Karakoram and Western Himalaya, 1909. An Account of the Expedition of H.R.H. Prince Luigi Amedeo of Savoy, Duke of the Abruzzi. By F. de Filippi. Pp. xvii+469+plates, and volume of Plates and Maps. (London: Constable and Co., Ltd.) Two vols., 63s. net.

The Beginner's Guide to the Microscope. By C. E. Heath. Pp. 119. (London: P. Marshall and Co.) 1s. net.

Herbals: their Origin and Evolution. By A. Arber (Mrs. E. A. Newell Arber). Pp. xviii+253. (Cambridge University Press.) 10s. 6d. net.

An Elementary Treatise on Coordinate Geometry of Three Dimensions. By Dr. R. J. T. Bell. Pp. xviii+381. (London: Macmillan and Co., Ltd.) 10s. net.

Mixed Metals or Metallic Alloys. By A. H. Hiorns. Third edition. Pp. xx+469. (London: Macmillan and Co., Ltd.) 6s.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 28.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Farthed *v.* Unearthed Neutrals on Alternating Current Systems: J. S. Peck.

CONCRETE INSTITUTE, at 7.30.—Bills of Quantities for Reinforced Concrete Work: John M. Theobald.

SATURDAY, NOVEMBER 30.

ESSEX FIELD CLUB (at the Essex Museum, Stratford), at 6.—Some Letters from the Rev. Wm. Derham, Rector of Upminster, Essex, to Dacre Barrett, of Belhus, Essex (1704–1710) Communicated, with Remarks, by T. Barrett-Lennard.—The Mycetozoa: Miss Gulielma Lister.

MONDAY, DECEMBER 2.

RÖNTGEN SOCIETY, at 8.15.

ROYAL SOCIETY OF ARTS, at 8.—Methods of Economising Heat: C. R. Darling.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—New Apparatus for the Examination of Mine Air: L. A. Levy.—Slate Bed Treatment of Sewage: W. J. Dibdin.

ARISTOTELIAN SOCIETY, at 8.—Purpose and Evolution: A. Lynch.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Geographical Results of the Abor Expedition: A. Bentinck and Capt. Beauchamp Duff.

SOCIETY OF ENGINEERS, at 8.—The Deflection of Reinforced Concrete Beams: P. J. Waldram.

TUESDAY, DECEMBER 3.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion:* Mechanical Handling of Coal for British Locomotives: C. J. B. Cooke.—*Paper:* The Vibration of Rifle Barrels: F. Carnegie.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Modern Methods of Indirect Lighting: Their Advantages and Merits: F. W. Willcox and H. C. Wheat.

WEDNESDAY, DECEMBER 4.

ROYAL SOCIETY OF ARTS, at 8.—The Manufacture of Sugar from Wood, and its Economic Importance: A. Zimmermann.

GEOLOGICAL SOCIETY, at 8.—The Lower Palæozoic Rocks of the Cautley District: Dr. J. E. Marr.—(1) The Trilobite Fauna of the Comley Breccia Bed (Shropshire); (2) Two Species of Paradoxides from Neves Castle (Shropshire): E. S. Cobbold.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Value of the Guaiacum Test for Bloodstains: H. S. Shrewsbury.—The Detection of Adulteration in Linseed Oil: G. D. Elsdon and H. Hawley. The Determination of Nitrates and Nitrites in Sewage Effluents: A. Higginson.—The Estimation of Citric Acid and its Separation from Tartaric and Succinic Acids: L. Gowing-Scopes.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, DECEMBER 5.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Physiological Observations made on Pike's Peak, Colorado, with Special Reference to Adaptation to Low Barometric Pressures: C. G. Douglas, Dr. J. S. Haldane, Y. Henderson and E. C. Schneider.—Notes on the Life History of *Trypanosoma gambiense*, with a Brief Reference to the Cycles of *Trypanosoma nanum* and *Trypanosoma pecorum* in *Glossina palpalis*: Muriel Robertson.—A Gregarine *Steinina rotundata*, nov. sp., present in the Mid-gut of Bird Fleas of the Genus Ceratophyllus: Dr. J. H. Ashworth and Dr. T. Rettie.—(1) The Size of the Aorta in Warm-blooded Animals and its Relationship to the Body Weight and to the Surface Area expressed in a Formula; (2) The Size of the Trachea in Warm-blooded Animals and its Relationship to the Weight, the Surface Area, the Blood Volume and the Size of the Aorta: Prof. G. Dreyer, W. Ray, and E. W. A. Walker.—Studies of the Processes operative in Solutions. The Conversion of Ammonic Cyanate into Urea, especially as Influenced by Alcohols: E. E. Walker.—(1) The Hydrolysis of Cane Sugar by Dilute Acids; (2) The Hydrolysis of Cane Sugar by Sulphuric Acid, with a Note on Improvements in Polarimetic Apparatus; (3) The Hydrolysis of Methylic Acetate by Acids: F. P. Worley.—The Nature of Hydrolytic Process: Dr. H. E. Armstrong and F. P. Worley.—The Direct Production of Characteristic Röntgen Radiations by Kathode Particles: Dr. R. T. Beatty.—The Penetrating Power of the γ Rays from Radium C: A. S. Russell.—The Photo-electric Behaviour of Iron in the Active and Passive State: Dr. H. S. Allen.—A Determination of the Radiation Constant: H. B. Keene.

LINNEAN SOCIETY, at 8.—Notes on Two Orchids New to East Sussex, and on several Rarer Species of Orchidaceæ: E. J. Bedford.—The Hebridean Diagona described as "Syntethys," and other Exhibits from the Cruise of the S.Y. *Runa* in 1912: Prof. W. A. Herdman.—Nature Camera Work, an Attempt to Combine Photography with Drawing in Body-colour: Miss Maud Umfreville Clarke.—Coloured Drawings of South African Plants: Miss Mary W. Johnstone.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.