THURSDAY, MAY 23, 1907.

MENDELISM.

Mendelism. By R. C. Punnett. Pp. vii + 84. (Cambridge: Macmillan and Bowes; London: Macmillan and Co., Ltd., 1907.) Price 2s. net.

A SECOND edition of Mr. Punnett's "Mendelism" has followed the first after an interval of two years. The book gives a very good account of Mendelian work. Issuing as it does from Cambridge, the source of by far the greater part of the Mendelian discoveries of the last six years, it is the most authoritative account of this subject, and as it is eminently readable it is the very book for anyone who wants to know what Mendelism is. It is cheap and of a very convenient size, and we cannot suppress an expression of our admiration for the beautiful purple colour of the cover of the second edition.

At the same time, no good can be done by refusing to face the fact that the truth of the Mendelian doctrine is not universally admitted. No one denies the extraordinary interest of these discoveries. He must be a very callous man who is not fascinated by the way in which the proportions 9 : 3 : 4 and 9 : 7 and the phenomenon of reversion in certain cases have all been brought into line. But we hold that he must be a very rash man who accepts without further question the doctrine of gametic purity. Yet it is just in the sphere of interpretation that Mendelians are so certain. Once in this sphere, we can no longer be guided by facts—if we were dealing with facts we should be in the sphere of discovery—but by "such things as our mind conceives." And one's attitude should be one of continual, unceasing, and active distrust of oneself. The attitude of the Mendelian is different from this. He may reply that he is only triumphant about his discoveries; but we must remember that there is no fixed criterion by which we can say where discovery ends and interpretation begins; and we must be careful not to beg the question by defining discovery as that about which there can be no doubt.

There are those who deny the theory that the germ cells of an extracted recessive are pure in respect of the character of the organism which contains them, and who assert that the characters of the hybrid which produced it are not absent from, but latent in, those germ cells. If this were discovered to be the case, it would be regarded as a demonstration of the falsity of the doctrine of gametic purity by everyone who was not a Mendelian. But we should strongly condemn the proclamation of such a conclusion, because we think it is high time that the spirit which derives satisfaction from the victory of one opinion over another should be swept from science. There is no place for the party system in science; because it tends to make the triumph of truth the main object and truth itself a secondary one. We are not arguing that Mendelian theory is untrue, but that the attitude of anyone daring to say of anything "this is true" should be apologetic rather than victorious.

There is another and a larger point of view from which we may examine the Mendelian position: it is that which refers to the relation between the Mendelian and the material with which he deals. The differences between biometrician and Mendelian have been due partly to the fact that these two sets of workers have dealt with different sets of facts. But we are concerned with the difference between their attitudes to the same classes of facts, and with the paradox that in spite of this difference they both claim to have introduced exact methods into biology. How is it that the two schools which claim to have introduced the exact method into the study of biology are not at peace? What is the relation between the methods of the two schools? One author attempts to express the difference in the statement that the Mendelian deals with units and the biometrician with masses, and illustrates this view by saying that the difference between the relation of the biometrician and that of the Mendelian to the units with which they deal is the same as the difference between the relation of the physicist and that of the Maxwellian demon to the units (the atoms) with which they deal. The physicist and the biometrician deal with them in masses. The demon and the Mendelian deal with them separately. It is striking testimony to the callousness of biologists to general discussion that it has never been pointed out that this comparison, though plausible, is based on a fallacy. To anyone who tries to take a broad view of the matter, the truth or falsity of the statement (repeatedly made by Mendelians) that the biometrician deals with masses while the Mendelian deals with units is the most interesting question presented by this whole subject. For if the Mendelian really does deal with units while the biometrician deals with masses composed of these units, and if the Mendelian sets out with the object of enabling himself to predict what will be the result of a given union, and succeeds, while the biometrician starts on the assumption that a knowledge of the ancestry of a given pair does not enable him to predict the character of its offspring, there is little to be said for the "application of exact statistical methods to the problems of biology."

But is it really true that the Mendelian deals with the units of which the biometrician's masses are composed? We believe not. In order to see what the real state of affairs is we must try to begin at the beginning. The difference between the two schools lies in the difference between their respective attitudes to natural phenomena. The biometrician says, "We look at them as close as we can and we see nothing uniform." The Mendelian, "We look as close as we choose and we see everything uniform." The latter does not pretend that "dwarf" peas are not variable, but treats them as if they were all the same. The former does not pretend they are not all "dwarf," but treats them as if they were all different.

The exactness of the biometrician makes him count the number of hairs per square centimetre on the lower leaf surface of *Lychnis vespertina*; the exactness of the Mendelian enables him to tell at a glance in a row of hybrid stocks which are hoary and which are glabrous. The two forms of exactness correspond to the two ways in which we may try to make certain of hitting the bull's-eye of a target when we shoot at it. We may either improve our marksmanship or enlarge the bull's-eye. The latter is the only method of ensuring uniformity, of enabling oneself to predict the result with certainty. To this the biometrician justly replies, "This is no real uniformity. It is an ideal uniformity substituted for a real variability. Your shots are scattered round the centre of your bull's-eye just as mine are scattered outside mine. I never hit. My bull's-eye is a point. I keep a record of the deviation of every single shot from it. I am faithful." To which the Mendelian replies, "I always hit. I keep no such records. I am successful." We do not hold a brief for either party. A bull's-eye so large that it cannot be missed is as unfair as one so small that it cannot be seen is unpractical. All we wish to insist on is that because Mendelians can predict and biometricians cannot, it does not follow that the units with which the Mendelian deals are the units of which the biometrician's masses are composed. The Mendelian's units *are* the biometrician's masses, except when the latter exceeds his limits and includes within his masses more than one such unit. The Mendelian can no more predict about the units of which the biometrician's masses are composed than the biometrician can, except when the biometrician includes more than one Mendelian unit in his mass.

CERTAIN ASPECTS OF SCIENTIFIC WORK.

Progress of Science in the Century. By Prof. J. Arthur Thomson. Pp. x+536. (London: W. and R. Chambers, Ltd., 1906.) Price 5*s*. net.

IN a book bearing the present title it is surely unfortunate to find that progress in one branch of science, and that certainly not the least important, is wholly ignored. Yet while chemistry, physics, astronomy, geology, physiology, psychology, and even sociology each has a separate chapter devoted to it, not a word is said about the remarkable developments that have taken place in mathematical science during the century. The changes which recent times have witnessed in regard to our conceptions of the notion of space are certainly no less remarkable, and are quite as capable of being outlined in a popular work as the kinetic theory of gases or developments of theories of the ether.

The study of matter and energy is so closely connected with the study of space that a discussion of the former without some reference to the latter must give a reader an incorrect impression of the present state of physical science. But the omission of frequent and explicit mention of the work of the mathematician in certain other directions is also likely to be misleading. Why, the reader may ask, is Lord Kelvin's vortex atom theory recognised—we will not say accepted—by the scientific world while Mr. Horatio Gubbins (to use a fancy name) has been pestering secretaries of societies and editors in vain with his theories of gravitation or the ether, and no scientific man will have anything to say to him? It may be that the reader in question is Mr. Gubbins himself. If he studies the chapters on "The Scientific Mood" and "The Unity of Science," he will find in them every justification for believing that his grand discovery marks a new era in the advancement of science. If, again, he turns to p. 178 and reads the paragraph "Value of these Hypotheses" at the end of the chapter on physics, he will find the sentence:—

"These molecular and ethereal hypotheses are human imaginings—and nothing more; they are constructed in terms of one sense; that of sight; they are attempts to see that which is invisible, to invent a machinery of Nature, since the real mechanism is beyond our ken; but it must be observed that these hypotheses are not *vain* imaginings, for they prove themselves yearly most effective tools of research, and that they are not *random* guesses, for they are constructed in harmony with known facts."

This statement may be true enough, but the *suppressio veri* in the omission of all reference to the rigid framework of mathematical equations and formulæ supporting the hypotheses conveys a dangerous *suggestio falsi* to the unmathematical reader. Mr. Gubbins is perfectly convinced that his own theory, at any rate, is constructed in harmony with known facts, whatever may be said about Lord Kelvin's theories, which he not unfrequently has "*proved convincingly*" are wrong, and he may even take unto himself to say that he has at last discovered a theory which is something more than a mere human imagining. No book of the present kind should be issued which does not strongly emphasise the fact that the true test of every scientific theory is in all cases a quantitative test based on a comparison of the formulæ of the mathematician with the measurements of the experimenter. Otherwise the English reader will be led to believe that the needs of science, which are now being pressed forward, can be adequately met by the erection of laboratories and the endowment of scholarships for passing elementary examinations, while the brain workers who interest themselves in researches carried out in their own studies with ink and paper will find themselves, as time goes on, more and more unable to cope with the accumulation of unsolved problems that is being pressed on them from every quarter.

Descending to matters of detail, we find many important theories conspicuous by their absence. We need only specify the phase rule and the second law of thermodynamics as instances in point. Yet the very possibility of a world existing which is inhabited by living beings, including man, depends essentially on this neglected second law. It seems almost unnecessary, in view of this omission, that the author should apologise in his preface for the absence of any reference to radium on the ground that the book was printed before the discovery had been made.

It cannot be denied that in attempting to trace the scientific progress of a century, even in its barest outlines, in a volume of this size the author undertook an impossible task. It is probable that he would have done better if he had confined his attention to discoveries made in the earlier part of the century, merely sketching their later developments. We do not blame the author for omitting many discoveries of importance, but it is a great pity that he did not realise that the present selection gives a somewhat one-sided view of scientific aims and methods.

Having said so much about a weak point in the book, it would be unfair not to dwell on several useful features. The specialist working in one branch of science is very apt to forget what he ever learnt about other directions of scientific progress. In these days, over-specialisation and over-elaboration are being carried to greater excess every year. Even the subdivision of the Royal Society's Proceedings into two series has completely destroyed their former all-round character. A book like the present, taken up and read in a leisure hour, will recall to the specialist many interesting points in the history of different branches of science of which he would otherwise never think. If there is one class of specialist who is more likely than others to benefit by reading the book, that is the mathematician himself, and next to him, possibly, the physicist. These in particular will be brought into contact with ideas quite different from those with which they are commonly associated, and it may be hoped that the mathematician will learn a lesson, and be less prone to hide his light under a bushel, when he finds how his genius is unappreciated by the writers of popular treatises.

G. H. BRYAN.

ANCIENT AND MODERN LEICESTER.

Glimpses of Ancient Leicester in Six Periods. By Mrs. T. Fielding Johnson. Second edition, with supplementary notes. Pp. xv+439. (Leicester: Clarke and Satchell; London: Simpkin, Marshall and Co., Ltd., 1906.)

THIS book was first published in 1892 as a "History of Leicester from the Earliest Times to the End of the Eighteenth Century." The present edition has been enlarged considerably by a supplement, in which more recent developments have been dealt with. The author belongs to a Leicester family which has taken a leading part in the public life of the town for several generations. Local histories are wont to be rather dull, but in this case, thanks to a lucid and lively style, the writer has succeeded in producing a volume of more than usual attraction for the general reader.

Leicester appears to have been an important Roman settlement, of which the chief remains are a part of the old rampart, now called the "Jewry Wall"; some fine examples of tesselated pavements; and a milestone with an inscription to the Emperor Hadrian, said to be the oldest stone inscription in Britain. During Saxon times the Church of St. Nicholas was built on the site of a Roman temple. This church "still includes in the north wall of its nave portions of the identical walls of the original Saxon church, showing a quantity of material taken from the Jewry Wall and other ruined Roman buildings near the spot." "Under the Norman and Plantagenet kings, Leicester reached its highest point of importance as a mediæval borough," under its greatest earl, Simon de Montfort. Several buildings of this period are in existence; amongst them may be mentioned the Newark Gateway and the Old Town Hall. Memorials of the sixteenth century may still be seen in the Abbey and the Queen Elizabeth Grammar School.

The supplement gives an interesting account of the development of the place from a market town with a population of 17,000 at the end of the eighteenth century into an industrial centre of nearly a quarter of a million people.

In this connection reference should be made to the excellent description of the rise and progress of the present important knitting and hosiery trade. A great impulse was given to the prosperity of the town by the opening of the Leicester and Swannington Railway. This was the second railway in the country, and was built by George Stephenson in 1832. Some of the original rails and other specimens of early railway work are preserved in the town museum.

This useful institution owes its origin to the Literary and Philosophical Society, through which it gained the nucleus of its present valuable collection. The scientific activity of the town has always centred round this society, which was founded in 1835.

The attention of the reader of Mrs. Fielding Johnson's book will be attracted to the names of several of her townsmen who have attained distinction in scientific pursuits, amongst whom may be mentioned Russel Wallace, the naturalist Bates, and another, not so well known, Mr. Ludlam, who assisted Dollond in the production of achromatic lenses for his telescopes.

The history of the educational institutions of the town receives adequate treatment. Secondary education is mainly in the hands of the Wyggeston and Queen Elizabeth Grammar Schools, and Alderman Newton's School, the latter an eighteenth-century foundation. During last century a working men's college and a mechanics' institute were started. The former does useful work still, whilst the latter has developed into a fine technical school.

A special interest attaches to the new edition of this attractive work in view of the forthcoming visit of the British Association to Leicester, and intending visitors would find in it a pleasanter account of their place of meeting than the pages of an ordinary guide-book can afford. The book is admirably illustrated, and is provided with an index.

R. E. T.

A NEW LIFE OF HUXLEY.

Thomas H. Huxley. By J. R. Ainsworth Davis. (English Men of Science Series.) Pp. xi+288. (London: J. M. Dent and Co., 1907.) Price 2s. 6d. net.

MR. DAVIS has produced in small compass an account of the life and work of Huxley that is at once readable and stimulating. It was inevitable that he should draw largely upon Mr. Leonard Huxley's biography of his illustrious father, but the materials have been skilfully employed, and the book is far from being a mere abstract of the larger work. Huxley's energy, industry and fixity of purpose are brought into due prominence; while his intellectual keenness and honesty, his intolerance of pretentious ignorance, his appreciation of everything good in art and literature, his jealousy for the right use of the mother tongue, his admirable social and domestic qualities, all have ample justice done to them in the pages of this modest volume.

The attentive reader will easily discern how it is that among the great names of the Victorian epoch few take a higher place than that of Huxley. Eminent as an original worker in science, whose investigations covered an unusually wide field, he was scarcely less distinguished as a philosopher and as a practical man of affairs. By dint of unwearied industry, of a single-minded love of truth and of a nature at once candid and fearless, he made for himself a reputation in the intellectual life of the last century which will outlive many of those that, for the time being, bulked more largely in the public view.

In controversy, as Mr. Davis often reminds us, Huxley was a strenuous but never ungenerous adversary, though it sometimes seemed hard for him to realise that his opponents might hold their convictions as sincerely as he did his own. The popular notion of Huxley as an intellectual pugilist who found his chief delight in propounding dogmas, the more startling the better, in science and philosophy, is scarcely borne out by the facts of his career. It is true that in his own judgment he was "rather prone to jump at conclusions," and when he felt sure of his ground no man could speak with greater confidence. But questions, even of the first magnitude, as to which the data were not in his opinion sufficient for a solution, were by him left open to the end.

Perhaps the most conspicuous instance of this truly "agnostic" attitude was the position he took up in reference to Darwin's theory of natural selection. Curiously enough, while his acceptance of the fact of evolution was hastened, if not caused, by the publication of the views of Darwin and Wallace, he never committed himself to an unqualified approval of those views. He was converted *by*, but not *to*, the doctrine of natural selection. This, however, did not prevent him from acting as Darwin's champion against attacks dictated by ignorance and prejudice, nor from treating the Darwinian hypothesis as "the most powerful instrument of investigation which has been presented to naturalists since the invention of the natural system of classification, and the commencement of the systematic study of embryology."

It is probable that we here touch upon one of Huxley's limitations. Unrivalled as he was in many departments of biology, it is clear that field natural history did not come to a great extent within his sphere of mental activity. Had this been otherwise, and had his attention been more directed to the study which now goes by the name of bionomics, it seems fair to conjecture that his views as to the validity of Darwin's theory might have undergone some modification.

There are certain slips in Mr. Davis's book which should be remedied in a future edition. We note a few, as follows:—*Ephestia elatella* (*recte* elutella) is not a "small beetle," but a Phycid moth. In the letter given on pp. 204–5, Huxley wrote "inconceivable," where Mr. Davis has "conceivable" with much detriment to the sense of the passage. Finally, Duns Scotus we know, and Scotus Erigena we know, but who is Scotus Erigenus?

F. A. D.

PHYSICAL AND INORGANIC CHEMISTRY.

(1) *Practical Physical Chemistry.* By Dr. Alex. Findlay. Pp. xii+282; illustrated. (London: Longmans, Green and Co., 1906.) Price 4*s.* 6*d.* net.

(2) *Physical Chemistry in the Service of Medicine.* Seven addresses by Dr. Wolfgang Pauli. Translated by Dr. Martin H. Fischer. Pp. ix+156. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1907.) Price 5*s.* 6*d.* net.

(3) *Vorlesungen über anorganische Chemie für Studierende der Medizin.* By Dr. Ernst Cohen and Dr. P. van Romburgh. Pp. viii+431; illustrated. (Leipzig: Wilhelm Engelmann, 1906.) Price 15 marks.

(1) SLOWLY but surely the necessity of systematic laboratory instruction in the methods of physical chemistry is being recognised. One of the causes which may have contributed to the absence of such instruction in many university courses of chemical study has been the lack of a suitable practical text-book. With the appearance of Dr. Findlay's work this regrettable deficiency in laboratory literature can, however, be no longer said to exist. The apparatus required for the measurement of density, viscosity, surface-tension, refractive index, molecular weight, conductivity, transport numbers, electromotive force, velocity of chemical change, solubility, transition temperatures, and thermal changes is described, and instructions for the carrying out of the measurements are given in an easily intelligible form.

The course is modelled on that of the Leipzig school, which for many years occupied a unique position as the Mecca of students of practical physical chemistry. This is doubtless partly due to the author's personal association with this particular school. It may perhaps account for the omission of several important types of experimental exercises. In particular, electrochemical experiments involving the estimation and separation of the metals and the preparation of different classes of compounds afford many valuable applications of physicochemical principles, and the omission of chapters dealing with these phases of the subject is regrettable. Some difficulty may be experienced in interpreting what is meant by the term "maximum apparent error" in the first chapter. With a vocabulary of errors in which relative, absolute, possible, probable, and apparent errors may be spoken of, a careful definition of terms is essential. In the dilatometric determination of transition temperatures (p. 274), Glauber's salt is not nearly so suitable as some other substances for the purposes of a laboratory exercise.

Of the usefulness of the book as a laboratory guide there can, however, be no doubt; it should be in the hands of every serious student of the science.

(2) Dr. Pauli's volume is a collection of seven addresses delivered at various times by the author, and deals with the application of physical chemistry to various branches of medicine—physiology, pharmacology, and pathology—an application rendered possible more particularly by the recent advances made in the study of organic colloids. The problems discussed are of fundamental importance, and even though it be true that "life can perhaps be completely understood only through life itself," yet the volume before us indicates that many great advances may be expected by the proper utilisation of the instruments afforded by physical chemistry. In the separate chapters an account is given of the physical chemistry of cells and tissues, the colloidal state and the reactions in living matter, the relations between ions and their medicinal and therapeutic effects, the changes effected in pathology by recent chemical work, and the significance of the electrical charge of protein. The entire omission of literature references to the large number of investigations by authors whose names are quoted is most unfortunate. The translation is good, although it is not difficult to recognise in it the work of a medical man rather than that of a physical chemist. In medical circles the book should be of general interest.

(3) A distinctive feature of the lectures on inorganic chemistry is the authors' attempt to minimise the number of chemical compounds described, and to illustrate by carefully selected examples the most important general phenomena and the laws which regulate them. In the opinion of one who has had some little experience in the chemical training of medical students this is a distinctly gratifying feature. Whether it is not possible greatly to improve the training of the medical student by demanding a smaller knowledge of isolated facts and a more extended acquaintance with general principles is a question which demands serious consideration. In the twenty-eight lectures, into which the subject-matter is divided, the attention of the reader is continually directed to general relationships in discussing particular facts, and this cannot but have a satisfactory effect on the chemical aspect of the future medical man. For 430 pages of elementary inorganic chemistry fifteen marks is a singularly high price to have to pay, and may be prohibitive to many would-be purchasers.

H. M. D.

OUR BOOK SHELF.

Practical Coal Mining. By Leading Experts in Mining and Engineering. Edited by Prof. W. S. Boulton. Divisional, vol. i. Pp. vii + 160. (London: The Gresham Publishing Company, 1907.) Price 6*s.* net.

THIS is the first instalment of a work which, when completed in six volumes, is intended to cover the whole ground of modern coal-mining practice. Each of the sections into which the work is divided will be written by a different author, fourteen leading authorities cooperating with the editor in his task. This division of responsibility among many contributors, and the fact that orders are accepted for complete sets only, render it difficult to judge from the first volume what the value of the work as a whole will be.

In the first volume there is undoubtedly a certain want of harmony in treatment of the subject-matter. There are three sections and part of the fourth, dealing respectively with the geology of the Coal-measures, the composition and analysis of coal, trial borings, and shaft sinking. The section on geology, written by the editor, covers sixty-six pages, and contains much useful information. It is questionable, however, whether, in a treatise on practical mining, it is possible to deal usefully with so comprehensive a subject or to give sufficient detail to render the geological manuals superfluous. As an illustration, the information regarding foreign coalfields, which has had to be compressed into a single page, is not nearly so full as that contained in Geikie's "Text-book of Geology."

The editor's literary style, too, is far from faultless. His opening sentence, for example, cannot be regarded as elegant in composition. It reads as follows:—"While some knowledge of geology is necessary for all mining engineers and others connected with coal mining, and especially the ability to construct and interpret geological plans and sections, there are certain branches of the science which bear upon coal mining only very indirectly, and which at present are of theoretical rather than practical importance, and which, therefore, it has been thought advisable to omit in the following pages."

The second section, on the composition of coal, has been written by Mr. C. A. Seyler. It describes the author's new system of classification, or rather of new chemical terms, and does not seem likely to commend itself to practical men, who would probably find such expressions as "sub-para-bituminous-pseudo-anthracitic species" somewhat cumbersome. The third section, on trial borings, which has been written by Mr. H. F. Bulman, is admirable. It contains as much practical information as could possibly have been compressed into thirty pages. The fourth section, on shaft sinking, as far as published, is equally good. Written by Prof. H. Louis in excellent literary style, the information is clearly given, and its value is increased by the introduction of hitherto unpublished details of cost, and by the fact that the illustrations, unlike others in the volume, have in every case an indication of the scale to which they are drawn.

Morale de la Nature. By M. Deshumbert. Pp. 74. (London: D. Nutt, 1907.) Price 1*s.* net.

THE first part of this essay is devoted chiefly to the thesis that the object of all creation is to produce those forms of life which are the most active, intelligent, and moral possible, that is, life in its most complete form. Good is that which contributes to the increase of life in its high development, and evil is that which has a contrary effect. The latter half of the essay consists of ethical aphorisms which we commend to the notice of the Moral Instruction League.

Spring Harbingers and their Associations. By M. G. B. Pp. 62. (London: Elliot Stock, 1907.)

THE writer of these six short essays on the snow-drop, violet, daffodil, cowslip, daisy, and rose, not only loves flowers, but evidently has made a practice of recording references to her favourites made by the poets she has read—and these are a goodly company.

LETTERS TO THE EDITOR.

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

The Structure of the Ether.

THE recent interesting communication of Sir Oliver Lodge to NATURE (March 28) and the *Philosophical Magazine* on the density of the ether recalls an objection to theories of the ether which identify magnetic intensity with resultant ethereal velocity that does not seem to have received the attention it deserves. The objection arises when the distribution of momentum in the system is taken into consideration.

It will be remembered that Sir Oliver Lodge commences by pointing out that the volume occupied by the electrons which constitute a mass of platinum is small compared with the volume of the platinum itself, whence it follows, if the mass of the electrons is that of the ether they carry with them, that the density of the ether must be enormous compared with that of platinum. This conclusion appears to be inevitable if we are to have a hydrodynamical theory of the ether. I do not wish to contest the contention that the density of the ether is enormous.

The second method used by Lodge to evaluate the density of the ether assumes that the magnetic intensity at any point is always proportional to the speed of the ethereal flow. By equating the mechanical and magnetic expressions for the energy of the field, and assuming that the ethereal circulation at the equator of an electron is equal to the velocity of its forward motion, Lodge arrives at the relation

$$e=4\pi a^2\sqrt{\frac{\rho}{4\pi\mu}},$$

where e is the charge and a the radius of an electron, and ρ is the density and μ the magnetic permeability of the ether. This may be combined with the known values $e^2\mu=10^{-40}$ gm. cms. and $a=1.2\times10^{-13}$ cms. to give $\rho=3.83\times10^{10}$ gms. per c.c. This gives for the velocity of ether drift in a magnetic field of intensity equal to 1 electromagnetic unit the value $w=1.44\times10^{-6}$ cms. per sec. These figures enable us to calculate the momentum due to any given magnetic distribution.

A moment's consideration of the simplest possible case, that of a moving charged sphere or an electron, will serve to show that this distribution of ethereal velocity leads to impossible results. We have seen that $\rho=e^2\mu/4\pi a^4$, and by making use of the expression for the magnetic field due to a moving charged sphere of radius a we find that the velocity of ethereal flow w, at a point the coordinates of which are r, θ with respect to the electron and its line of motion, is given by

$$\tfrac{1}{2}\rho w^2=\frac{\mu e^2u^2\sin^2\theta}{8\pi r^4}$$

or

$$w=\frac{a^2}{r^2}u\sin\theta.$$

Hence the momentum per unit volume at a point r, θ from the centre of a sphere of radius a and charge e moving with velocity u is given by

$$\rho w=\frac{e^2\mu u}{4\pi a^2}\,\frac{\sin\theta}{r^2}.$$

Since the momentum is distributed in circles round the line of motion there is no resultant momentum, but if the above expression be integrated it will be seen that there is an infinite quantity of momentum in the field for any finite value of u, and, moreover, there is an infinite moment of momentum about the line of motion. The existence of this momentum would make it impossible to set a charged sphere in motion; the same result would be arrived at by any theory which makes the velocity of the ether proportional to the magnetic force.

Electrodynamic theory has led to an expression for the momentum per unit volume of the ether by ways which are less speculative. This expression is $1/4\pi$ times the product of the electric and magnetic displacements, and it has the merit of making the momentum in the ether equal to the product of the (electric) mass and velocity of the moving charge. If we are to have a hydrodynamical theory of the ether it seems reasonable to make this agree with the fluid momentum. We thus get for the case of the charged sphere

$$\rho w=\frac{\mu e^2u\sin\theta}{4\pi r^4},$$

and from the energy expressions

$$\rho w^2=\frac{\mu e^2u^2\sin^2\theta}{4\pi r^4},$$

whence $w=u\sin\theta$ and $\rho=\mu e^2/4\pi r^4$. This result makes the velocity of flow of the ether independent of the radial distance from the electron, but the amount moved varies inversely as the fourth power of the distance. It has been pointed out by J. J. Thomson that this result can be interpreted hydrodynamically by supposing that the ether is carried along by the tubes of electric force, and that the extent to which the ether is "gripped" by the tubes of force is proportional to the square of their concentration. If we suppose the whole of the ether to be carried along at the equator of the electron, this method would give the same estimate for the density of the ether as that found by Lodge. If only part of the ether were carried along by the tubes of force even at the equator of an electron, the density of the ether would have to be correspondingly increased, so that this method can be regarded as giving the value $\rho=\mu e^2/4\pi a^4=3.85\times10^{10}$ gms. per c.c. as an inferior limit to the density of the ether. The actual value may be much greater than this.

The hypothesis of no ether slip at the equator of the electron leads to what seems to be a difficulty, at present at least. From what has been said it will be seen that it definitely establishes the relation $e=4\pi a^2\sqrt{\rho/4\pi\mu}$, so that the charge on an electron is equal to its superficial area multiplied by a quantity which depends only on the properties of the ether. Thus the size and mass of any electron are determined as soon as its charge is known, and any one of these quantities is determined by any non-identical combination of the others. The experiments of Bragg on the stopping power of different substances for α rays lend support to the suggestion, first put forward by H. A. Wilson, that these are positive electrons. Now the experiments of Rutherford have shown that the value of e/m for the α rays emitted by a large number of radioactive elements is very nearly 5×10^3 e.m.u. per gm. This value of e/m leads, on the hypothesis of no equatorial slip, to the value $e_2=10^{-13}$ e.m.u., or 10^7 times the charge on the negative electron. It would be difficult to make an electron with a charge of this magnitude the foundation of atomic structure. This difficulty occurs with at least equal force on the assumption of magnetic ether flow.

The argument of the last paragraph, so far as it is deserving of weight, tends to show that the ethereal density is greater than the limiting value. The considerations brought forward earlier would appear to show that the ethereal flow, if it exists, is at right angles to, and not along, the lines of magnetic force, and that the effect sought for experimentally by Sir Oliver Lodge is not to be expected.

O. W. RICHARDSON.

Princeton, N.J., May 12.

Radium and Geology.

WITH apologies to Prof. Joly (p. 55), I think my estimate of a gradient of 1° F. for 98 feet in the Simplon Tunnel will bear examination. From a contemporary notice in the *Daily Mail* of October 3, 1904, it is clear that the heat in the tunnel was endurable until the hot spring was tapped. The water is stated to have been at 131° F., which agrees *exactly* with 55° C., "the highest temperature" of Prof. Joly. Surely, then, this was the temperature of the spring, and not of the rocks.

I would also remark that Mr. Strutt considered that the amount of radium in the igneous rocks examined by him would, on his theory, account for a gradient as high as 1° in 42·2 feet, a very different thing from the 1° in 70 mentioned by Mr. Fox.

O. FISHER.

Graveley, Huntingdon, May 17.

Eye Migration in Flat-fishes and Lamarckianism.

MR. R. H. LOCK, in his recent book on "Variation, Heredity, and Evolution" (reviewed in NATURE of April 27), has, in common with many other writers, adduced the phenomenon of eye transposition in flat-fishes as a cogent argument in favour of the transmission of acquired characters, remarking that "an alternative hypothesis is lacking." I venture to dispute this position, believing it to be decided evidence in support of the potency of natural selection to accumulate small mutations. I quote a part of the passage (p. 35) that my argument may be the better understood :—

"In the adult condition these fishes lie flat on one side; and during their development from the young condition that eye which, if it remained in its original position, would look directly downwards travels round the head until it comes to lie quite upon the upper surface. . . . The very young fish whilst still symmetrical, are known sometimes to fall upon one side, and when in this position to twist the lower eye forcibly upwards. Darwin himself therefore supposed that the origin of the adult structure is to be attributed to the inherited effect of efforts of this kind."

This misinterpretation of the phenomenon seems to me to arise from an inadequate appreciation of the nature of the actual variation, *i.e.* the *capacity to twist the eye*, which is exhibited by the young fish. The young of some other fish are known to exhibit the same muscular control over the orbit ("Origin of Species," p. 292), and we need only to suppose that the forerunner of the modern race of flat-fishes possessed it as a fortuitous variation to the extent of making vision just possible whilst in the recumbent position; and this would seem to be the case, for it is recorded in the "Origin of Species" that a young fish has been observed to "raise and depress the eye through an angular distance of about seventy degrees." In the transmission of the original variation to the offspring it is not the *effect* of the movement which is passed on, but the *structural arrangements which enabled it to initiate the movement*, the amplitude being increased in successive generations by the aid of natural selection.

This contention may be supported by citing a peculiar muscular capacity possessed by myself. I am able to raise and depress the right eyebrow independently of the left, but I have no such control over the other. To test whether this power may not be induced by practice, I have striven to raise the left whilst holding down the right, but find myself quite unable to accomplish it. Herein we see that the capacity to make the movement is of itself a distinct mutation; and assuming that in the case of the flat-fish mobility of the optic aperture was so far possible as to be of advantage to it, natural selection would operate in preserving those of the progeny which were able to retain the eye in the advantageous position with the least possible effort.

I have ventured to tender this explanation to the readers of NATURE because the phenomenon is very generally used as a good illustration of Lamarck's doctrine, and as being "inexplicable on the theory of natural selection."

Bournemouth, May 10. ARTHUR J. HAWKES.

TWO WORKS ON INDIAN ETHNOGRAPHY.[1]

MR. CROOKE'S book appears in a series edited by Mr. N. W. Thomas which, to quote the general preface, "is intended to supply in handy and readable form the needs of those who wish to learn something of the life of the uncivilised races of our Empire." To Mr. Crooke has been entrusted the task of describing the races of northern India, and we may at once state that he has achieved very considerable success. The area covered, extending from Afghanistan to the Chinese frontier, is so great, and its aspects are so complicated, that not even such an authority as this distinguished scholar could venture into details within the limits of the two hundred and fifty odd pages at his disposal; but he has given a broad general view, sketching in with a few accurate and telling strokes the more prominent features of the landscape, so that the whole presents a satisfactory and attractive summary of the racial characteristics of an important section of the British Empire.

After a brief account of the country and of the influence of its environment upon the people, Mr. Crooke describes its three main physical race-types—the Mongoloid, the Dravidian, and the Indo-Aryan. The last-named leads him to the consideration of the castes of the great plains, to the Indian village and its industries, and to the home life, including the occupations of women, together with the games and amusements of the children. Turning to the religion of the people, we have first an account of the birth, marriage, and death rites, and then a general description of the popular religion, magic, and witchcraft. There are more than thirty admirable full-page illustrations, the value of which is somewhat impaired by the binder having placed them at approximately equal distances from each other throughout the book, without consideration of the context to which they refer, and which, in spite of a good index, it is not always easy to find. In other respects, too, the mechanical execution of the work leaves room for improvement. Proper names are not always spelt correctly. The well-known Norwegian philologist appears as Dr. "Steinkonow," and the proof-reader's ideas of the spelling of the name of a writer on Chota Nagpur oscillate between "Bartley-Birt" and "Bradley-Birt," the latter, of course, being the correct form. Worst of all, the numbering of the plates was evidently altered after the text had been printed off, so that not a single reference in the text to the plates is correct.

These are, however, but minor matters, which can easily be set right in the next edition, and for the work as a whole, although we may differ on a few controversial points, we have nothing but praise. Mr. Crooke, while following Mr. Risley in his conclusions as to the race-origins of the Indian people, shows a wise caution in accepting his opinion with regard to details, and, like other scholars, enters a protest against his undue extension of the name "Dravidian" (properly a linguistic term) to the entire mass of the population of northern India which is not Aryan or Mongolian. He himself, on the other hand, seems to have misunderstood the results of the latest philological researches when he states that it has been recently proved that the two great non-Aryan linguistic families of India, the Munda and the Dravidian, are mutually connected. He quotes Dr. Grierson's authority for this; but we are under the impression that, in his latest writings, that scholar has strongly maintained the distinct origin of these two groups of speeches, and the researches of Pater Schmidt, of Vienna, have shown that the Mundas are related, both ethnically and linguistically, to the Mon-Khmer tribes of Further India, and perhaps even to the inhabitants of Polynesia. As for the Dravidian languages, it seems not improbable, although positive proof is yet wanting, that they are connected with those of the aborigines of Australia. The fact that the speakers of Dravidian languages and the speakers of Munda languages have the same physical type has not yet been satisfactorily explained, but Dr. Sten Konow's theory that the common type is really Munda, and has been acquired by the Dravidian-speakers through intermarriage (just as the Indo-Aryan type of the Lower Ganges

[1] "The Native Races of the British Empire. Natives of Northern India." By W. Crooke. Pp. xiv+270. (London: A. Constable and Co., Ltd., 1907.) Price 6s. net.
"The Khasis." By Major P. R. T. Gurdon, I.A. With an Introduction by Sir Charles Lyall, K.C.S.I. Pp. xxvii+227. (Published under the Orders of the Government of Eastern Bengal and Assam. London: D. Nutt, 1907.) Price 7s. 6d. net.

Valley has been similarly altered) is at least worthy of attentive consideration.

In dealing with the general race question, Mr. Crooke adopts the only scientific method (too often neglected) of commencing at the bottom with the so-called aborigines and working upwards through the mixed tribes to the pure Indo-Aryan. His account of the wild hill-tribes, whether Mongoloid or Dravidian, is excellent, and brings together a mass of information that has hitherto been scattered through a number of not always accessible memoirs. When he comes to the Gangetic plains he is on his own ground, and writes at first hand. His unrivalled acquaintance with the people of the United Provinces, their customs, and their religion, makes this the most valuable section of the book. The

FIG. 1.—Raja of Rampur, with attendants, Punjab Hills. From "Natives of Northern India."

thorny question of the origin of caste could not be adequately discussed without trenching on space which might more legitimately be devoted to other purposes, and he contents himself with stating his own opinion, which is a modification of that put forward by Mr. Risley. He considers that castes owe their inception partly to crystallisation of occupation and partly to the persistence of the idea of tribe. He gives the reader a vivid picture of the home-life of the plains villages. It is one with which most Indian officials and missionaries are familiar, but which has seldom been put in print. The existence of an Indian agriculturist is a laborious one, with little to relieve its monotony except a rare pilgrimage or the occasional chance of the greatest luxury of all, a lawsuit. Perhaps Mr. Crooke lays too much stress on his alleged ignorance of any literature. While books are almost unknown to him, he has not only ballad poetry, much of it of real excellence, but is more or less familiar with the works of the great religious writers of his country, such as Kabīr or Tulsi Dās, and has had their best verses ready on his lips since childhood. Here, too, we may point out that while Mr. Crooke's account of Indian village religion is, so far as it goes, masterly, it only illustrates one side of the subject, the worship of local deities. He has failed to take into consideration the results of the great reformation of Hinduism which swept over northern India in the

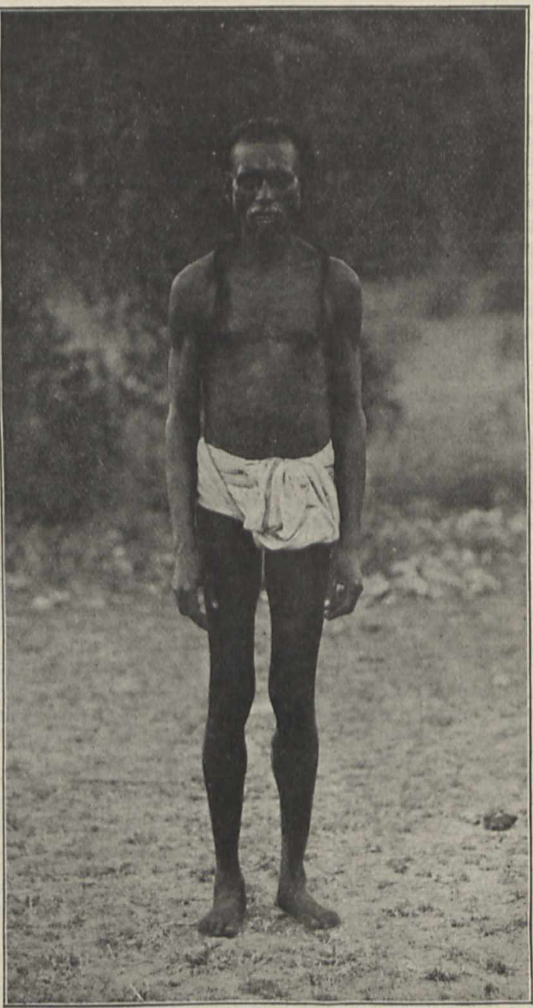

FIG. 2.—A Panka, Dravidian Weaver, Southern Hills. From "Natives of Northern India.

sixteenth century, and which has, in Rāma, given the village people a personal supreme deity, whom they can and do worship, and who is above all the local gods and godlings. The essence of the reformation was the discovery of the Fatherhood of God, and that fact alone has had immense influence in moulding the general character of the population of the Gangetic Valley.

If we have criticised a few of Mr. Crooke's statements, we freely admit that they deal with points of detail, some of which are objects of controversy. We can strongly recommend his book to the general reader who desires information regarding the native races of northern India. His style is always interesting, and there is not a dull page from beginning to end of the volume.

Major Gurdon's work is the first of a series of monographs on the more important tribes and castes of Assam now being issued by the Government of that province. While Mr. Crooke deals with the broad outlines of the ethnology of the whole of northern India, this work is confined to a single tribe numbering less than two hundred thousand souls. Although they are so few, the Khasis are a race deserving special study. Half a century ago Logan showed their relationship to the distant Mons of Pegu and Khmers of Cambodia, but his researches lay hidden in a local magazine, so that, until Kuhn revived the question in 1883, it was the general impression that the tribe was an isolated survival from prehistoric times, whose language formed a distinct family by itself, and which had no connection with any other known race. The researches of Kuhn, and, later on, of Schmidt, have placed the whole subject on a new and sure footing. We now know that Khasi is a member of an important group of languages including forms of speech, such as Palaung and Wa, closely allied to Mon and Khmer, and also Nicobarese and the Munda tongues of India proper. Moreover, not only are the languages connected, but the speakers all possess the same racial characteristics. This language-group Schmidt has named the "Austro-Asiatic" subfamily, and he maintains that it is related to the "Austro-Nesic" subfamily spoken in Indonesia, Polynesia, and Melanesia—the two together forming, under the name of the "Austric" family, the most widely spread collection of allied speeches upon the face of the earth. A special and minute study, therefore, of the speakers of one of the members of this great family is just now well-timed and of considerable interest, and Major Gurdon, the superintendent of ethnography in Assam, is exceptionally fitted to undertake the task.

For the benefit of those who are not familiar with Indian ethnography, it may be stated that the Khasis are a tribe inhabiting the Khasi and Jaintia Hills in the Indian province of (as it is now called) Eastern Bengal and Assam. They are surrounded on all sides by alien peoples, Tibeto-Burman and Aryan, and are believed to be a survival of a primitive Austro-Asiatic race that once occupied the whole of eastern India until they were conquered and dispossessed in prehistoric times by an invasion of Tibeto-Burmans. The tribal constitution is strongly matriarchal. Inheritance is through the female line, the youngest daughter being the chief heir of her mother; ancestral property can only be owned by women, and the only property which a man can possess is that which is self-acquired. The chief deities are all female. So is the sun, while the moon is represented as a man, and in the grammar and vocabulary the feminine element is much more prominent than the masculine.

Besides chapters discussing introductory and miscellaneous topics, Major Gurdon's work is divided into five sections, dealing respectively with domestic life, laws and customs, religion, folklore, and language. Each subject is treated in great detail, and the book contains much new and valuable matter not hitherto recorded. We may direct special attention to the account of the remarkable memorial stones, menhirs, dolmens, and cromlechs scattered over the country, and also to that of the curious custom of egg-divining (ᾠοσκοπία). The chapter on folklore is also most interesting. It contains a number of stories, both in the original text and in translation. These form part of a larger collection placed at the author's disposal by the Rev. Dr. Roberts, and we are glad to learn that there is a prospect of the entire series being published at some future date. The full-page illustrations of the book are numerous and in their right places, and it is further enriched by an introduction from the accomplished pen of Sir Charles Lyall.

There have been Welsh missionaries among the Khasis for more than sixty years, and to them we owe the fact that the language has been reduced to writing. Under their fostering care the tongue of a once rude and barbarous people has been given an alphabet, a fixed system of spelling (based on Welsh), and a literature. It is now recognised by the Calcutta University as sufficiently cultivated to be offered as a subject for examination by candidates from Khasi-land.

We congratulate the Eastern Bengal and Assam Government on the successful inception of what promises to be a most interesting and useful series of monographs.

ASTRONOMICAL OBSERVATIONS IN PRAGUE, 1900–1904.

THE Astronomical Observatory of Prague, like many other similar institutions which might be mentioned, has its work considerably restricted by the fact that the city in which it is situated has grown. The restricted horizon, the smoke, and the glare of the illuminated air all have tended, year by year, to cut down the amount of useful work such an observatory is capable of doing, and it is quite possible that the time will soon come when it will

Tycho Brahe's Observatories. A, On the island Hveen (Uranienberg); B, in Wandsbeck; C, in Benatek; D, in Prague (Ferdinandeum); E, in Prague (Curtius's House).

be transferred to a site where its sphere of activity can be extended.

The volume[1] before us contains, therefore, some of the results of observations which can be carried out under such restricted conditions. Of these may be mentioned an excellent series of observations of the culmination of the moon and the crater Mösting A. The determination of the latitude of the observatory was also undertaken. The result obtained, namely, 50° 5′ 16″·02, was in complete agreement with the value obtained by Prof. E. von Oppolzer from observations made in the period 1889 to 1899. Other work here described refers to the observations of Jupiter's satellites, Nova Persei, shooting stars, &c.

The appendix contains, further, a series of useful papers by Prof. Weinek. These, for the most part, deal with some graphical explanations of the theory of the sextant, precession, planet-transits across the sun's disc, cometary orbit determinations, &c.

October 24, 1901, being the 300th anniversary of the death of Tycho Brahe, some very interesting historical notes are given relating to his two years' activity (1599–1601) in Prague. The reader may be reminded that this celebrated Danish astronomer died in Prague, and in the Teynkirche there a handsome gravestone marks his resting-place.

During his lifetime Tycho Brahe had five different observatories, and these were situated (*a*) on the island of Hveen (Uranienberg), (*b*) in Wandsbeck, (*c*) in Benatek, (*d*) in Prague (Ferdinandeum), and (*e*) in Prague (Curtius's House). These are shown in the accompanying illustration, which is taken from one of several of the fine reproductions inserted in this volume.

Others to which reference may be made are a fine coloured reproduction, in colours, of Tycho Brahe from an oil painting in the Prague Observatory; the Belvedere of Ferdinand I. (Ferdinandeum), where he observed; the Teynkirche, where he was buried; his two sextants, and other interesting reproductions of the Prague of to-day.

The volume concludes with a useful summary of the chief lunar maps and photographic moon atlases, commencing with Lohrmann (1824) and finishing with W. Pickering's atlas which was published in 1903.

THE DISCOVERY OF STONE IMPLEMENTS OF PALÆOLITHIC TYPE IN VEDDAH CAVES.

Drs. F. and P. Sarasin recently made an expedition to Ceylon for the express purpose of investigating the caves now and in past times inhabited by the Veddahs, to see whether any stone implements could be discovered. Their earlier researches proved the Veddahs to belong to a lower and older type than the other inhabitants of Ceylon, and it is conceded that they must represent the few remnants of the aborigines who were met with by the Sinhalese on their first arrival, and by whom they were called Yakas, according to the tradition preserved in the Mahawansa. Presumably, these autochthones were at that time living in their Stone age; but no record of Veddah stone implements occurs in anthropological literature. From an article in the *Ceylon Observer* of April 22, written by these indefatigable travellers, we find that on this, their fourth, expedition into the Veddah country they were lucky enough to find a cave near the village of Nilgala, which until very recently was inhabited by Veddahs, the soil of which contained in great abundance stone implements of a very rough kind. Further investigations of some other caves, one near Kattragam, the other near Kalodai, led to an identical result. They also succeeded in discovering upon the hilltops of the country of Upper Uva the same rough stone implements in great quantities and still well preserved. Not only the autochthony of the Veddahs can be regarded as a proved fact, but also their former distribution over probably the whole island, including the low country as well as the mountainous districts.

The shape of the chips, knives, lance points, scrapers, and fragments of bone awls enables this stone-industry to be described as analogous to that of the Madelaine period of the Palæolithic age. "Yet," as the cousins Sarasin remark, "this industry is to be denoted as a special *Facies Veddaica,* inasmuch as white quartz (mainly of an ice-like transparency) furnished the principal part of the material." Besides this, they also found a red, yellow, and black variety of quartz (jasper) employed in great profusion, which contrasted strangely with the monotonous grey gneiss of the caves themselves. On the whole, these implements are of small size, suited to small hands, and therefore employed by a small race of men. The stone hammers which were used to strike chips off the cores are of a remarkably small size. The Sarasins conclude their article with these words:—"We, furthermore, may already venture to say that the second main-period of the Stone age, the Neolithic one—viz. that characterised by the polished stone axe—is entirely wanting in the island of Ceylon, the Veddahs having made the step directly from the Older Stone Age into the Modern Age of Iron, which was brought them by the Sinhalese, or perhaps by another people of the Indian continent."

It is believed by some in Ceylon that there are only some hundred Veddahs existing, and Dr. Sarasin informed a *Ceylon Observer* representative that there are but a small number of Veddahs of pure blood to be found, perhaps only about fifty or sixty. These chiefly occur in Nilgala, Bibile, and the Putipola hill in Moligala, where there are only three small communities of the purest blood. Most of them build small, primitive huts, while some live in the open, sometimes in caves, but not always; those who have families build huts. Their own language is lost; being a small tribe surrounded by thousands of Sinhalese they have learnt a simple dialect of Sinhalese. They have no knowledge of their history. There is no chief, but the oldest man is called the speaker; he has, however, no privileges, and is not empowered to issue orders. They no longer know how to make stone implements, and now buy iron from the Sinhalese. Dried flesh and forest fruit are eaten. They have no religious ceremonies, but some believe in ghosts, whom they call *yakas,* though others disbelieve in their existence. Idolatry is not practised, nor do they worship stones or trees, or pray to them; indeed, the majority deny that they know anything about them. The Veddahs are strictly moral, there are no thieves among them, they never take alcohol, and they never tell lies.

A. C. H.

AN ITALIAN MONUMENT TO LINNÆUS AT THE END OF THE EIGHTEENTH CENTURY.

In these days, when all the world of science unites in celebrating the memory and glory of the great Swedish naturalist, it is interesting to recall from the utter oblivion in which it has remained until now the monument and inscription dedicated to Linné in Naples at the end of the eighteenth century, presumably in 1778, the year of Linné's death.

The monument, which probably consisted only of the marble inscription, was not a public monument,

[1] "Astronomische Beobachtungen an der k.k. Sternwarte zu Prag, in den Jahren 1900–1904." Auf öffentliche Kosten herausgegeben von Prof. Dr. L. Weinek. (Prag: K.U.K. Hofbuchdruckerei A. Haase, 1907.)

but was raised by the fervour and admiration of Domenico Cirillo, the Neapolitan friend and correspondent of Linné, to whom the latter had dedicated the heathers of the genus Cyrilla, now included in the family of the Cyrillæ.

The Cirillo had been for long a family of doctors, naturalists, and artists. It is said that Domenico Cirillo, who was born in 1739, and graduated in 1759, was the twentieth doctor of medicine belonging to the Cirillo family. At the beginning of the eighteenth century, Nicola Cirillo, who in 1718 became a Fellow of the Royal Society of London, formed in his own private grounds in Naples a botanical garden which continued to be the scientific centre of Neapolitan naturalists until its destruction and the dispersion of the collections and herbarium in the fatal year 1799. In the sack of Cirillo's house were lost the letters written by Isaac Newton to Nicola Cirillo, and the famous herbarium of Ferrante Imperato, preserved since the sixteenth century, before which Martyn Vahl, Linné's friend and disciple, had knelt in admiration when he visited Naples in 1783.

The garden of Cirillo was the rallying point for the flower of Neapolitan thought and science, soon to be decimated and dispersed by royalist persecution during the storms of the Revolution of 1799. Many of the most distinguished men of Naples must have stood round Cirillo when the following inscription was raised in honour of Linnæus:—

CAROLI LINNAEI

Animam sapientissimam
Terris divinitus impertitam
ut
Naturae universae arcana
Declararet patefaceret
Illustraret
Postea
per dephlogisticatam
Aethereum regionem
Obvolitantem
Ne quid respub. Botanicorum
Detrimenti capiat
Vos
Fragrantissimae, soporiferae
Tetrae, spirantes
Ambrosiacae, Aphrodisiacae
Perennis voluptatis ministrae,
Herbae, Arbores, Plantae
Odoribus, Effluviis, aromate
Sistite, involvite, detinete.

The mob destroyed this inscription, together with Cirillo's house and collections, and Cirillo, with many of the noblest thinkers and benefactors of his country, was hanged in the market-place of Naples on October 29, 1799.

The inscription by Domenico Cirillo is one of the first memorials erected in a botanical garden to the memory of Carl Linné. Perhaps it may be raised again in Naples, a memorial not only of Linné's glory and of Cirillo's devotion, but also of that brotherhood of science to which Linné and the societies that bear his name have so much contributed.

ITALO GIGLIOLI.

DR. ALEXANDER BUCHAN, F.R.S.

WITH the death of Dr. Alexander Buchan on Monday, May 13, after a brief illness, a long industrious life and a distinguished scientific career were brought to a close; a genial and striking personality has become a memory.

Born at Kinnesswood, Kinross-shire, in 1829, educated at the Free Church Normal School and the University of Edinburgh, he became a schoolmaster at Banchory, Blackford, and subsequently at Dunkeld. He had, at the same time, an independent taste for field botany and meteorology.

An affection of the throat proved to be an embarrassment in his scholastic work, and in 1860 he was called to Edinburgh to be secretary of the Scottish Meteorological Society. It was a time of remarkable activity; indeed, it was a notable period in the development of the modern science of meteorology. In Paris, Leverrier had traced the progress across Europe of the celebrated Crimean storm. In London, FitzRoy was busy with the daily comparison of reports by electric telegraph from a number of stations in the British Isles. The British Association was maintaining a physical observatory at Kew, in the superintendence of which Balfour Stewart had just succeeded Welsh, a pioneer in meteorological ballooning. In this enterprise Welsh was soon followed by the intrepid Glaisher, under the auspices of a British Association Committee, with the active support of Lord Wrottesley. The Master of Trinity included the design of an anemograph among his achievements. In Scotland, Thomas Stevenson, Milne Home, and Sir Arthur Mitchell, with the support of the great Scottish physicists, formed the nucleus of the energetic society which, under Buchan's management, became one of the most important centres of meteorological investigation, the focus for the collection of observations from all parts of Scotland, and the controlling body for a network of volunteer stations. The work of examination and tabulation, conducted almost wholly by Buchan and his niece, Miss Jessie Hill Buchan, received official recognition as supplying many of the summaries of observations at stations of the second order in Scotland required by the Meteorological Office in London for international purposes, and as preparing the meteorological reports for the Registrar-General for Scotland on lines somewhat similar to, but not identical with, those prepared for the Registrar-General for England and Wales by James Glaisher, first as a member of the staff of the Royal Observatory, and subsequently on his own account.

A few words as to Buchan's scientific work must suffice. With Baxendell, of Manchester, he was largely instrumental in securing the general acceptance of Buys Ballot's principle of the relation of wind to air pressure. He had the faculty of statistical insight, and realised that by the appropriate combination of many observations it was possible to trace the interdependence of phenomena which might be affected separately by a number of independent causes. This insight is illustrated in a remarkable way by his papers with Sir Arthur Mitchell upon the relations of climate and health in London. Such a method of investigation does not always commend itself to the student of physics, who, fortunate in having the conditions under his own control, is accustomed to trace the direct connection between cause and effect in each separate experiment. But the remarkable results of Buchan's work, which still remain to be followed up, enable one to understand the enthusiasm for collecting observations, and more observations, that seem purposeless to some of those who look on.

His "Handy Book of Meteorology," published in 1867, followed by a second edition in 1868, and now long since out of print, though a new edition has always been looked for, and his "Introductory Textbook of Meteorology" (1871) are ample evidence of his general grasp of meteorological work, but his favourite method of meteorological investigation was the map. Beginning from the time when the reduction of the barometer to sea-level for synchronous charts and the identification of closed isobars as cyclonic and anticyclonic areas were novelties, he was the first to trace the course of a "depression" across the Atlantic; and subsequently, by the collection and discussion of data from all parts of the world, to give in a paper before the Royal Society of Edinburgh "the mean pressure of the atmosphere and the prevailing winds over the globe."

This was followed by the monthly charts and tables representing the atmospheric circulation in the volume contributed to the *Challenger* Reports and published in 1889, and the corresponding results for "oceanic circulation" in 1895.

His monthly maps of forty-year averages for the British Isles developed likewise (with the assistance of Dr. A. J. Herbertson) into the compilation of the wonderful atlas of pictorial meteorology published by Bartholomew in 1899. Therein is, indeed, a worthy representation of Buchan's meteorological method.

It was by the method of the map that he proposed to deal with the outstanding results of the Ben Nevis observations, which were collected largely under his own supervision, and have been already the subject of numerous papers. His capacity for dealing in this way with huge masses of figures was amazing. I have often gone with him over the details of daily maps exhibiting the results for Scottish weather at official stations, lighthouses, and private stations to trace some generalisation which had been suggested by his work. His programme was to correlate these daily maps with the observations at the summit and base of the mountain. The methodical care in ordering the entries, and their arrangement as regards colour or design to bring out any salient features, were thoroughly characteristic of his work.

From 1877 until last year, when it was arranged that he should continue the work upon the Ben Nevis observations instead, he was inspector of Scottish stations for the Meteorological Office. Throughout Scotland he succeeded in eliciting from the observers an enthusiasm for accurate work that is truly remarkable. Last year I followed myself the course of his rounds, and was interested to verify the eulogistic phrases about the Scottish stations which used to be characteristic of the reports of the annual visitation.

In 1887, Buchan succeeded Stokes as a member of the Meteorological Council. Sir R. Strachey, Sir W. Wharton, Sir G. H. Darwin, Mr. Galton, Mr. E. J. Stone, and subsequently myself, were his colleagues.

The period of his tenure almost synchronises with that of the final form of the work on Ben Nevis, which was brought into full activity by the endowment by the council of the base observatory at Fort William in 1890. It may also be regarded, not inaptly, as the period during which the interest of meteorological work passed from the geographical extension of observations over the earth's surface to the exploration of the upper air, begun by Welsh, continued by Glaisher, but afterwards allowed to drop. The great enterprise of maintaining a station of the first order at the highest point of the British Isles absorbed practically all the energy of the Scottish society during Buchan's membership of the Meteorological Council. Ultimately it proved to be a greater charge than the society could support, and appeal was made first to the council, who were themselves experiencing the pinch of straitened circumstances, and then to the Government, who after a lengthy inquiry by means of a committee arrived at a misunderstanding; and the closing of the observatories was the result.

Indeed, the course of the negotiations began, as it ended, in a misunderstanding. The financial position of the office was well known; but at the time the National Physical Laboratory was in course of formation, and it was supposed that, being itself in receipt of Parliamentary aid, it would maintain its physical observatory at Kew out of its own resources. The annual sum of 400*l*. voted by the Meteorological Council would thus become free for meteorological enterprise elsewhere. But it was ordered otherwise; the payment to Kew still goes on.

In the course of the appeal some hard things were said of the council in its corporate capacity, but they were not followed by any diminution of mutual respect between its members. The only real difference of opinion was as to the ways and means of enlisting the practical support of Parliament for meteorological work. The motives which actuate the decisions upon such matters are not even now sufficiently clear to obviate legitimate difference of opinion upon the subject.

However one may regret the termination of a great enterprise, it is fair to say that the only possible conditions for its continuance were a sufficient supply of funds. All are agreed that a precarious existence under financial conditions involving semi-starvation of the work of research could not be regarded as an alternative.

Buchan was an honorary LL.D. of Glasgow, and a Fellow of the Royal Societies of London and Edinburgh. He was curator of the library and museum of the latter, and received the Makdougall-Brisbane prize from the society in 1876, and the Gunning prize in 1893. He was the first recipient of the Symons medal of the Royal Meteorological Society of London in 1902. He served for some time on the committee of the Government grant for scientific research. He was president of the Botanical Society of Edinburgh in 1870–1. He was also an honorary member of the Royal Society of Sciences of Upsala, of the Philosophical societies of Manchester, Glasgow, and Emden, and of the meteorological societies of Austria, Germany, Mauritius, Algiers, &c.

In Edinburgh society, and indeed throughout Scotland, he was a well-known figure. His striking appearance, his geniality, his familiar acquaintance with Scottish literature and literary men, and his enthusiastic devotion to his work, easily account for the high degree of respect and affection with which he was regarded in the Scottish capital. He was at his best at the hospitable gatherings of the Royal Society Club, with the management of which he was associated for many years.

He married in 1864 Sarah, daughter of David Ritchie, of Musselburgh, who died also on May 13 seven years ago. He leaves a son, Dr. A. Hill Buchan, with whom he lived, and who was his companion on many journeys.

In thus taking leave of a kindly master and a valued friend, it is not too much to say that the work of Buchan's life has contributed largely to justify the claim of meteorology to be regarded as a separate scientific subject, entitled to separate academic recognition. The physics of the atmosphere has its geographical aspect, but it is not a branch of geography; it has its mathematical aspect, but it is not a branch of mathematics; it has its experimental aspect, but it is not a branch of experimental physics. The constitutional affection of the throat prevented Buchan from using his natural powers of exposition to their full extent, but may we not hope that the University of Edinburgh will see her way to recognise the devotion of her distinguished alumnus by providing the subject of his devotion with a voice among the sciences which she fosters? W. N. SHAW.

NOTES.

WE regret to see the announcement that Sir Benjamin Baker, K.C.B., F.R.S., died suddenly on Sunday, May 19, in his sixty-seventh year. We have also to deplore the death of Sir Joseph Fayrer, K.C.S.I., F.R.S., on Tuesday, May 21, at eighty-two years of age.

M. DE LAPPARENT has been elected permanent secretary of the Paris Academy of Sciences in succession to the late M. Berthelot.

THE second annual meeting of the American Association of Museums will be held at the Carnegie Institute in Pittsburg on June 4–6.

THE *Observer* states that the honorary freedom of the City of London is to be conferred on Lord Lister. The proposal will come formally before the Corporation probably at its first meeting after the Whitsun recess.

THE section of geology and geography of the American Association for the Advancement of Science will hold a summer field meeting from July 3 to July 10 in New York State in the region between Lake Champlain and the Adirondacks.

AN exhibition of reflex cameras at present on the market, and of photographs illustrating the use of reflex cameras, is to be opened at the house of the *British Journal of Photography* on June 13, and will remain open until July 6.

THE will of Mr. C. T. Yerkes, who died at New York on December 29, 1905, has just been made known. The testator bequeathed 20,000*l*. for the upkeep of the observatory at Lake Geneva, Wisconsin, to the University of Chicago, with the condition that the observatory shall always be known as the Yerkes Observatory.

DR. W. S. BRUCE is organising an Arctic expedition, with the special object of completing the exploration of Prince Charles Foreland, Spitsbergen, which he began last summer, in company with the Prince of Monaco, in the *Princess Alice*. The expedition will proceed in the first instance to Tromsoe, in Norway, and from there to Spitsbergen, in a specially chartered steamer.

THE German steamship companies Norddeutscher Lloyd and the Hamburg-Amerika Linie will allow a reduction for passage tickets on different lines to members attending the fourteenth International Congress for Hygiene and Demography to be held at Berlin next September. The office of the Hamburg-Amerika Linie in Berlin has undertaken to procure rooms in different hotels for members of the congress. Detailed information concerning the reduction in price for tickets, and means of communication with Berlin, will shortly be published, and is obtainable at the bureau of the congress, Berlin 9 W., Eichhornstr. 9.

ON Tuesday next, May 28, Prof. G. H. F. Nuttall will deliver the first of two lectures at the Royal Institution on "Malaria, Sleeping Sickness, Tick Fever, and Allied Diseases," and on Saturday, June 1, Sir William White will begin a course of two lectures on "The Contest between Guns and Armour." The Friday evening discourse on May 31 will be delivered by Mr. A. Henry Savage Landor, on "Recent Journey Across Africa," and on June 7 by Sir James Dewar, on "Studies in High Vacua and Helium at Low Temperatures."

ON Friday afternoon, May 17, an earth tremor—possibly due to some shift of strata not wholly unconnected with extensive mining operations—took place in the Rhondda Valley, Glamorgan, and is described by those who felt it as more severe than last year's earthquake. The vibration was very distinctly felt by the miners underground, who estimated its duration at half a minute. Householders also felt the shock, and noticed crockery rattle. The vibration was not noticed anywhere else in South Wales. Similar local shocks have been felt before, notably one in the same spot on October 16, 1896.

IN a letter published in the *Times* of May 18, Sir James Blyth suggests the formation of an Imperial Council to continue and elaborate the work which has, with the end of the Colonial Conference, been suspended for a time. Among the subjects calling for investigation by such an Imperial Council, Sir James Blyth includes, with many others, State-aided organisation, where needed, of agricultural activities, such as the improvement of the breeds of cattle and horses, dairy, forestry, seed selection and supply, and the promotion of technical and scientific education, with the endowment of research, in both of which we are greatly behind other nations. This permanent Imperial Council would "act as eyes and ears to the Empire as a whole," and would greatly assist scientific procedure in government.

THE Pasteur Institute of South India at Coonoor was opened, the *Pioneer Mail* states, by Sir Arthur Lawley, Governor of Madras, on April 25. The Governor, in the course of a short address, sketched the history of the institute, and said that Lord Ampthill was the originator of the scheme. The consummation of the work was due to the generosity of an American millionaire, Mr. Henry Phipps, who placed one lakh of rupees at the disposal of the Madras Government. The institute will involve annually considerable expense; and the Indian Government has undertaken to bear the chief part of this, but the committee of the institute and the Government look for support to the public and the neighbouring States. His Highness the Nizam of Hyderabad has set an example of generosity by promising, for at least ten years, to give a substantial contribution to the annual expense.

THE cold days of May have this year been more than usually pronounced, and for five consecutive days, from May 17 to May 21, the shade temperature in London did not exceed 55°, while on May 19 and 20—Whit Sunday and Monday—the maximum temperature was 51°, or about 15° below the average. The observations of past years commonly show low day temperatures after the middle of the month, although the occurrence is not sufficiently frequent to be exhibited in any marked manner in the mean readings for any considerable number of years. In London and in many parts of England night frosts were frequently registered by the exposed thermometer during the past week, and a very keen north and north-east wind was blowing. The cold snap was more severely felt, following so closely on brighter and warmer weather; the shade temperature in London on May 12 was 28° higher than on May 19 and 20.

WITH the object of bringing the Smithsonian Institution at Washington into closer touch with the representative national scientific organisations of the United States and to create a new channel for the diffusion of knowledge, the secretary of the institution, Mr. Charles D. Walcott, recently sent an invitation to the National Academy of Sciences and to the American Association for the Advancement of Science to make the Smithsonian Institution their headquarters. The authorities of both the National Academy and the American Association have accepted the offer with thanks, and the step taken will assist greatly to make the Smithsonian Institution a clearing-house of national scientific learning for the United States.

In connection with the second centenary celebration of the birth of Linnæus, the opening article of the April number of *Naturen* is devoted to a sketch of the life and work of the great naturalist, by Mr. J. Holmboe. It is illustrated by reproductions of Hoffman's portrait and C. F. Inlander's medallion.

The practical work of the members of the Australian Ornithologists' Union during the sixth congress, held last November and December in exploiting the bird-life of Mount Wellington, Tasmania, forms the subject of the chief article in the April number of the *Emu*. Among the illustrations to this article is one of a group of Eucalyptus trees showing the manner in which the great black cockatoo strips off the bark in long streamers in order to feed upon the grubs of certain bark-burrowing insects. It is stated that only dead timber is attacked by the cockatoos, which are thus exceedingly useful in keeping in check insects injurious to the forests.

Insects injurious to barley and other grain when in store form the subject of a paper by Mr. W. E. Collinge published in the Journal of the Institute of Brewing, vol. xiii., No. 3. The statement, on the authority of Miss Ormerod, that in the winter of 1884–5 a sum of between 1000*l.* and 2000*l.* was lost on a single cargo of Russian barley by the ravages of *Calandra granaria* gives an idea of the magnitude of the evil, and the list of five-and-twenty injurious species given by the author serves to emphasise the seriousness of the situation. Worse still is the statement that the number of species and of individuals of such pests has notably increased in this country during the last few years. Gauze-covered windows, cleanliness, and fumigation with carbon disulphide are the chief remedies suggested by the author.

In a paper on the so-called renal portal system, published in the April issue of the Proceedings of the Zoological Society of London, Mr. W. Woodland concludes that the structures thus called are misnamed, and that there is really no "portal system" connected with the kidneys. He accordingly proposes to replace the terms "renal portal system" and "renal portal vein" by "renal cardinal meshwork" and "post-renal vein." As the renal cardinal meshwork appears to have no excretory function, the association of kidney and vein is probably functionless, and thus, in a sense, accidental. The meshwork seems, in fact, to be merely "an instance of the extension of a growing organ in the direction of least resistance; in other words, a mechanical product having no direct relation to the physiological needs of the animal."

The *Popular Science Review* for May contains the first connected account of the Jamaica earthquake which has reached us. From this description, by Prof. C. W. Brown, we learn that the earthquake was not remarkable for its violence, as this is not put at higher than 9·5 degrees; of what scale is not stated, but whichever was used, this is far short of that attained by really great earthquakes. The shock, as distinguished from the damage, was not so localised as appeared from telegraphic accounts; there seem to have been independent centres, of lesser violence, on land, and the submarine cable was broken at two places, about four and about twenty miles from Bull Bay, a couple of miles or so of cable being so thickly covered with débris that they had to be abandoned. At several places along the edge of the harbour the bottom has sunk from its old level, the maximum difference being more than six fathoms, but this subsidence was confined to a belt of from a hundred to three hundred yards in breadth, surrounding the harbour and located on the shore or slightly off shore; the middle portion of the harbour and the entrance channel were unchanged.

One of the principal functions of the International Association of Botanists is to provide critical notices of papers and books on botany in their journal, the *Botanisches Centralblatt*. An extension of this review work has given rise to the "Progressus Rei Botanicæ" for the publication of summaries prepared by acknowledged authorities in different branches of botany. The first part, issued in November, 1906, contained articles by Prof. E. Strasburger, on cell-ontogeny; by Dr. D. H. Scott, on Palæozoic botany; and by Dr. C. Flahault, on botanical geography. The second part, lately received, also contains three articles. Dr. L. Laurent reviews the progress of palæobotany with reference to angiosperms, Mr. W. Bateson deals with the subject of genetics, and Dr. F. Czapek writes on the physiology of nutrition. With regard to Dr. Laurent's contribution, he explains that it is concerned with the development of the angiosperms in the Cretaceous and Tertiary periods. Besides recording new observations, the author discusses methods employed and the general trend of results. A noticeable feature of Mr. Bateson's review is the general combination of zoological and botanical facts. Dr. Czapek starts from the date of the publication of the first volume of Pfeffer's "Plant Physiology," and follows that author in his arrangement. Among the subjects receiving special notice are the water-current in plants, methods of absorption, assimilation of carbohydrates and enzymes.

A monthly list of the publications of the U.S. Department of Agriculture is sent to all who apply for it, and is received by us. The activity of the department in obtaining information upon every branch of scientific agriculture and making it available in reports, bulletins, circulars, and other publications, issued at the nominal price of a few cents, is really remarkable. The monthly list now before us is a six-page leaflet containing the titles of many publications of importance, and including as new no fewer than nineteen bulletins, twenty-one circulars, and two farmers' bulletins on flax culture and experiment-station work. Our Board of Agriculture and Fisheries issues many useful leaflets, but its work cannot be compared with that of the United States Department of Agriculture, which is continually obtaining new knowledge. It could not be otherwise under the present conditions; for while a few hundred pounds a year represent the contribution our Board is able to make for agricultural research, the expenditure on investigations under the U.S. Department of Agriculture amounts to more than two hundred thousand pounds annually, exclusive of salaries of permanent officials and expenses of publications. Our politicians profess regard for British agriculture, but they do nothing to provide for the development of the knowledge which is even more necessary in the old country than it is in the new.

Dr. V. Conrad made some interesting experiments on the ionisation of the air at the Säntis Observatory, Switzerland (altitude, 8200 feet), in August, 1905, the results of which are published in the Proceedings of the Vienna Academy for July 12, 1906. The author found that the daily variation in the amount of positive ions exhibited quite a different type from that of the negative ions. The daily range of the amount of positive ionisation showed a principal maximum at 11h. a.m., that of the negative at 3h. a.m. The minima agreed fairly well in time, the positive occurring at 3h. p.m. and the negative at 2h. p.m. A secondary maximum of the positive at 4h. a.m. occurred near the time of the principal negative maximum, while a secondary maximum of the negative, at 11h. a.m., occurred at the time of the principal positive maximum.

IN *Meteorologische Zeitschrift* (No. 12, 1906) Dr. A. de Quervain urges several arguments in favour of the real existence of the inversion of temperature at the height of 8–13 kilometres, upon which doubt has been thrown by several persons. M. Teisserenc de Bort instituted a number of ascents at Trappes (near Paris) during the night or early morning, so that the unmanned balloons might reach their greatest heights before sunrise, which seem to show without doubt the real existence of the inversion. Dr. de Quervain points out that in the international ascents made during the daytime at Strassburg, St. Petersburg, and Zürich (as well as other places), every possible care has been taken to eliminate the effect of radiation, and that the results also fully support the reality of the inversion. There is also the fact that a stratum of air is frequently found above the inversion zone, where the temperature again decreases decidedly with increasing altitude.

WE have frequently had occasion to refer to the useful work of the Zi-ka-wei Observatory, near Shanghai, in issuing timely notice of the approach of dangerous storms. At the present time it receives telegraphic reports from several of the Chinese stations, and telegrams twice or thrice daily from thirty-two foreign stations, obligingly forwarded with the consent of their respective Governments. Telegraphic storm warnings are sent from Zi-ka-wei to some fifteen of the principal Chinese ports, nearly all of which have semaphores which exhibit storm signals; notices are also transmitted to Vladivostock, Tokio, Formosa, and Indo-China. The Inspector-General of Chinese Customs has, at the urgent request of the director of the observatory, further sanctioned the erection of semaphores at twenty-five selected lighthouses not yet electrically connected, to which, from May, 1907—about the time of the beginning of the typhoon season—captains of ships leaving port are invited to repeat, during the daytime, the warning notices they have seen in the harbours for the benefit of the fishing and other small craft in the offing.

IN view of the approaching tercentenary of the discovery of logarithms, Dr. F. H. Loud contributes a note to the semi-annual Bulletin of the Colorado College Observatory in which he proposes several rapidly converging series, and shows how they might be used for the re-calculation of logarithms to a large number of decimal places. A table is given of logarithms of primes below 110 to eighteen places.

MR. CHARLES URBAN issues a pamphlet recommending the use of the kinematograph for scientific and educational purposes. He has published a large number of rolls demonstrating living objects, such as pond life as seen through the microscope, and it is suggested, among other uses, that the kinematograph may be applied to take records of important surgical operations for future use in class demonstration, and also to exhibit to medical students the details of experiments on living animals without repeating the actual experiments before every fresh batch of students.

PROF. E. WIEDEMANN is well known for many contributions he has made to the subject of Arabian astronomy. In a recent communication to the Physikalisch-Medizinischen Society of Erlangen he gives the translation of a paper from the Qâsid al Irschad, "Guide to the Aspiring," to which his attention had been directed by Prof. Nallino, of Palermo. The original author, who seems to have been indifferently known as al Ansârî or al Sachâwî, was a competent exponent of the astronomy of his day. Astronomy he describes as the science which teaches the nature of separate bodies, their figures and positions, the distances between them, the motions of the planets, and the magnitude of the heavenly bodies. Four fundamental parts are recognised. In the first is investigated what is common to all spheres or orbits, the words seem to have the same significance, to the relations between them, and the proof that they all move, the earth remaining at rest. In the second is demonstrated the character of the motions of the heavenly bodies, how many there are, the divisions of the zodiac, and the phenomena of the eclipses. The third treats of the earth and of the climate in different places, and of the differing lengths of the day and night according to latitude. The fourth part considers the magnitude and the distances of the stars. References are made to classical works in which these subjects can be studied at greater length. Further subdivisions follow, having reference to the calculation of ephemerides, the calendar, the method of observing, the projection of the sphere, and problems connected with the gnomon. Into these it is scarcely necessary to follow either the learned Arabian or his able translator. The paper is interesting, but its scientific value is mainly confined to the elaborate notes with which the author has enriched his translation. These notes are both philological and historical.

STUDENTS of the early history of science will find an elaborate and interesting discussion of Petrus Peregrinus de Maricourt's "Epistola de Magnete," by Prof. S. P. Thompson, in vol. ii. of the Proceedings of the British Academy. Petrus Peregrinus, we learn, was a native of Picardy, a friend of Roger Bacon, and a man of very varied knowledge for his time. The "Epistola" is believed to have been written in August, 1269, while its author was assisting in the siege of Lucera, in southern Italy. Peregrinus's chief claim to distinction, in Prof. Thompson's opinion, was his invention of improved forms of the compass. One form, like earlier compasses, was floated in water, but it was the first to possess the equivalent of a "lubber" line and a divided circle. A second form was pivoted, and may be regarded as the precursor of the azimuth compass. An even more curious instrument, which, though illustrated, was presumably never materialised, was to consist of a light pivoted circle, having a number of inwardly directed iron teeth, with a fixed lodestone at its centre. Peregrinus's hope was to secure perpetual motion. There seems here almost an anticipation of one idea at least embodied in the dynamo, but Prof. Thompson is too experienced a writer to enter on this theme with an audience where his remarks would be liable to misconstruction. The discovery of the declination of the compass from true north has been ascribed by some to Peregrinus, but this Prof. Thompson says is a mistake, arising from a spurious addition made to a Leyden MS. of the "Epistola" about the end of the fifteenth century. In Appendices A and B Prof. Thompson enumerates the various MSS. and printed versions of the "Epistola." Of the twenty-eight MSS. enumerated, it is surprising to find that no fewer than twelve are in libraries situated in the United Kingdom, seven being in the

Bodleian and two in Prof. Thompson's own possession. Some of the scientific aspects of Peregrinus's work received a somewhat fuller treatment recently at the hands of Dr. L. A. Bauer (U.S. Coast and Geodetic Survey's "Magnetic Declination Tables and Isogonic Charts," 1902, pp. 16–20), but the present discussion is much more complete on the literary side.

THE magazine of photographic art known as the *Practical and Pictorial Photographer*, so ably edited by the Rev. F. C. Lambert, was until quite recently published by Messrs. Hodder and Stoughton. This monthly has now been acquired by Messrs. Robert Atkinson (London), Ltd., and will in future be published at their offices in 10 Essex Street, Strand. From the editorial notes it is gathered that some changes have been contemplated in the new issues, and the March and April numbers point out the direction in which such alterations have been made. The modifications include an attempt to issue the publication on the first of each month; one long or a collection of small articles dealing with one subject in a comprehensive manner in each issue; a change in the inks and paper employed for the illustrations to secure more transparent and luminous shadows in the reproductions; a detachable card which deals with all the constant needs of the dark-room, such as standard developing formulæ for negatives as given in the March number. Another important innovation is the insertion of the text and a page of illustrations in connection with the great National Photographic Record Survey that is being so well taken in hand now all over the country. The reader will therefore gather that the future issues of this excellently illustrated magazine will have an added interest, and the March and April numbers should be seen to fully appreciate the changes made.

THE twelfth of a series of Bulletins published by the Engineering Experiment Station of the University of Illinois embodies a detailed report, by Prof. A. N. Talbot, on tests of reinforced concrete T-beams. The tests were made with the object of determining whether the width of the slab is a controlling element in the strength of the beam, and to ascertain the efficacy of vertical reinforcing stirrups in resisting web stresses.

IN the Journal of the Franklin Institute (vol. clxiii., No. 4) Mr. Persifor Frazer discusses the application of scientific methods to the study of handwriting, and shows that when the province of this study is recognised as within that of experimental psychology, entirely capable of being conducted like other investigations of the human faculties by exact measurement and numerical statement, the shallow pretenders who have from time immemorial infested it will disappear.

AN interesting account of the work of the United States Reclamation Service is given by Mr. C. J. Blanchard in the *National Geographic Magazine*, Washington (vol. xviii., No. 4). The vast expenditure on national irrigation is the outcome of an Act passed in 1902 which provided that the money received from the sales of public lands in fourteen arid States and two Territories should be used as a reclamation fund for the construction of the works necessary to irrigate arid lands in those regions. In the same issue Miss E. R. Scidmore reproduces twenty-five admirable typical illustrations, of great anthropological interest, of women and children of the Far East.

MESSRS. A. GALLENKAMP AND CO., LTD., have added to their "technical" series of physical apparatus ten useful pieces of apparatus which will greatly assist the practical study of heat. The catalogue describing the instruments shows how satisfactory results may be obtained and used to illustrate principles.

MR. EDWARD STANFORD announces for early publication a new edition of his "Geological Atlas," which will deal with Great Britain and Ireland in place of Great Britain alone as formerly. The maps and text have been revised, and among the new features is a full list of the figured fossils, with indications of their zoological position and range in time.

PART V. of Mr. Charles Stoneham's elaborate work on "The Birds of the British Islands" has been published by Mr. E. Grant Richards. The work will be completed in twenty parts, and its general character was described in a review of the first part in NATURE of October 18, 1906 (vol. lxxiv., p. 607). We shall notice the publication again when the whole of the parts have reached us.

MESSRS. W. AND A. K. JOHNSTON, LTD., have placed upon the market a form of their "world-wide sectional pad" which is likely to be of service to surveyors, military men, and others. The side of a small square represents a hundred yards, and intervals of a thousand yards are indicated by slightly darker ruling. The scale of the paper is such that a mile is represented by 1 inch. This form of sectional paper will prove useful to teachers of geography who exercise their pupils in the construction of simple plans. The price of the pad is 1*s*. 6*d*. net.

THE new catalogue of microscopical lenses and apparatus issued by Messrs. Voigtländer and Son, whose manufactory is in Brunswick, Germany, is conveniently arranged and beautifully illustrated. Mr. F. G. Phillips, 12 Charterhouse Street, Holborn Circus, E.C., is the sole agent for Great Britain and the colonies. The tabular arrangement adopted in the catalogue makes it easy at once to discover prices, sizes, and other particulars.

ATTENTION is frequently directed in these columns to the valuable preparatory work in observational science which is being accomplished by natural history and similar societies in the secondary schools of the country. An excellent instance of this useful work is provided by the seventy-third annual report of Bootham School (York) Natural History, Literary, and Polytechnic Society. In addition to the encouragement given to field work in natural science, the boys are afforded every facility to study the science of photography, are offered inducements to practise literary expression, and are provided with lectures on scientific subjects. The authorities are to be congratulated on the good year's work described in the report.

A "GUIDE to the Great Game Animals (Ungulata) in the Department of Zoology, British Museum (Natural History)," has been printed and published by order of the trustees of the museum. The guide has been compiled by Mr. R. Lydekker, F.R.S., and he has devoted the descriptive portion chiefly to the characteristics of the different genera and families. The scientific names employed in the guide are those adopted in the museum, and are, Prof. E. Ray Lankester points out in a preface, "to some extent a compromise between extreme views." The text is illustrated by fifty-three figures, most of which are printed from half-tone blocks. The guide, the price of which is one shilling, will provide the visitor with just the information necessary to enable him to take an intelligent interest in the exhibits.

OUR ASTRONOMICAL COLUMN.

COMET 1907*b*.—From a note published in No. 4175 (p. 366, May 10) of the *Astronomische Nachrichten* we learn that the comet discovered by Mr. Mellish on April 14 had been previously seen by Mr. Grigg, of Thames, New Zealand, on April 9. A set of elements computed by Mr. Merfield from observations made on April 9, 10, and 11 is given.

In the same journal Dr. Ebell continues his ephemeris for this object up to June 19, showing that the comet is now approximately half-way between ι and θ Ursæ Majoris. R.A.=9h. 2·6m., $\delta = +51° \, 18'$.

THE VALUE OF THE SOLAR PARALLAX.—The discussion of the Greenwich photographs of Eros, the results of which were communicated to the Royal Astronomical Society (*Monthly Notices*, vol. lxvii, No. 6, p. 380) at its April meeting, gave $8''{\cdot}800 \pm 0''{\cdot}0044$ as the value of the solar parallax. This result was obtained from the measurement of 151 plates taken with the Astrographic 13-inch refractor and 103 plates taken with the Thompson 26-inch refractor, between October 14, 1900, and January 15, 1901, and agrees very closely with the value, $8''{\cdot}802 \pm 0''{\cdot}005$, published by Sir David Gill in 1897.

EARLY AND LATE PERSEIDS.—In a paper recently communicated to the Royal Astronomical Society Mr. Denning gives a list of the apparent paths of probable and possible Perseids observed by him during the periods July 7 to 22 and August 17 to 25 inclusive, from 1876 to the present time. The observations suggest that true Perseids may be looked for after the first week in July, but not until July 19 does the stream become conspicuous enough to enable a good radiant to be determined. Mr. Denning asks other observers to supply data from which the radiant during the earlier period might be determined with more certainty; at present there is reasonable doubt that the shower commences so early as July 7. Similarly the extension of the date of apparition to August 25 is in question, although Mr. Denning is sure that true Perseids have been observed as late as August 20.

A list of the radiants determined is also given, and the author states that quite possibly the shower extends over a period of fifty nights (*Monthly Notices*, vol. lxvii., April, p. 416).

NEW ELEMENTS OF JUPITER'S SEVENTH SATELLITE.—From twelve observations distributed evenly along the observed arc passed over by Jupiter's seventh satellite during the period January 3, 1905, to September 25, 1906, Dr. F. E. Ross has computed a new set of elements for that satellite. The principal perturbations have been included, and the observations are represented by the elements with an average error of only $0'{\cdot}4$. The inclination of the satellite's orbit, referred to the earth's equator for the epoch January 0·0, 1905 (G.M.T.), is given as $25° \, 18'{\cdot}6$, whilst referred to Jupiter's orbit the inclination is $27° \, 58'{\cdot}3$. The period, according to these elements, is 260·06 days.

Observations secured by Prof. Max Wolf on December 22 and 23, 1906, and by Prof. Perrine on November 23, are not consistent with these elements, the respective residuals in R.A. being $+10'{\cdot}0$ and $-3'{\cdot}3$ (*Astronomische Nachrichten*, No. 4175, p. 359).

THE COMPUTATION OF COMETARY ORBITS.—In Circular 128 of the Harvard College Observatory, Prof. E. C. Pickering points out what needless duplication occurs in the computation of cometary orbits. For comet 1907*a* three almost identical sets of elements were communicated to the Harvard College Observatory, whilst others, giving similar values, were published elsewhere. To obviate this waste of energy Prof. Pickering suggests that these computations should be carried out on some cooperative system, each computer taking them in turn, and further suggests that the labour thus saved might with advantage be expended on the computation of orbits of minor planets, of which objects so many are now being discovered regularly.

ASTROGRAPHIC CATALOGUE WORK AT THE PERTH OBSERVATORY (W.A.).—Although most of the Government Astronomer's report of the work performed at the Perth (W. Australia) Observatory during the year 1905 is devoted to meteorological observation, Mr. Cooke has a few words to say about the regrettable delay in the prosecution of the Astrographic Catalogue work undertaken by the West Australian Government.

The zone apportioned to the observatory was from 32° to 40° south declination, and includes 1375 regions; of these 145 remained to be taken at the date of the report. But the operations of measuring and reducing the plates were not then commenced, and there is a grave possibility that the plates may deteriorate sufficiently to render them useless. The taking of long-exposure plates for photo-mechanical reproduction was commenced, but was afterwards stopped on account of the expense. Some 10,000 standard stars have to be observed by means of the transit circle, and Mr. Cooke suggests that "this will form the basic work of the Perth Observatory, probably for centuries."

THE TOTAL SOLAR ECLIPSE OF AUGUST 30, 1905.—During the total eclipse of August 30, 1905, Prof. Schwarzschild, of the Göttingen Observatory, together with Prof. Runge, made observations with a prismatic camera and a coronagraph at Guelma, in Algeria. Part xxx. of the *Astronomische Mitteilungen der königl. Sternwarte zu Göttingen* contains a complete discussion of the results obtained. The brightness and spectral photometry of the corona are first dealt with at some length, and then the spectra obtained are discussed, the origin, wave-length, intensity, and extension of each arc being given; the region photographed was from λ 4590 to λ 3330, and the identifications include the elements Yt, Zr, La, Ce, Nd, and Yb.

THE ERUPTION OF KRAKATOA AND THE PULSATION OF THE EARTH.

THE vibration of the earth may be caused by volcanic eruptions and earthquakes, but it is doubtful if any regular pulsation can be called forth by a sudden impulse such as an earthquake or paroxysmal outbursts of volcanoes. If any rhythmic pulsation ever comes into existence, it is most probably due to some exciting cause of long duration, such as volcanoes of continuous activity giving rise to occasional explosions, thus causing frequent blows to the earth. The eruptions of Krakatoa afford an example of such a method of excitation, and we have reason to believe that there were pulsations with a period of about 67m.

The exact time of several minor explosions before the great outburst at 10 a.m., August 27, 1883, is not well known, but if we assume that the air was simultaneously affected, the record of the gasometer at Batavia gives us valuable information as to the sequence of the numerous explosions beginning on August 26. The regular succession of remarkable excursions in the indications of the gasometer, reproduced in the Royal Society report on Krakatoa eruption, is at once evident from the following table:—

	h. m.	h. m.	Time interval h. m.	m.
August 26 ...	5 20 p.m.	6 49 =	3 24·5 × 2 =	68·2 × 6
,, 27 ...	0 9 a.m.			
	1 55 ,,			
	2 38 ,,	3 20 =		66·7 × 3
	3 30 ,,			
	4 41 ,,			
	4 55 ,,	3 27 =		69·0 × 3
	*5 43 ,,			
	*6 57 ,,			
	8 25 ,,	3 22 =		67·3 × 3
	9 42 ,,			
	**10 15 ,,	1 co =		60
	*11 15 ,,			

The great explosions are marked with asterisks, while the sign is doubled for the principal outburst.

The whole interval = 67·2m. × 16. The mean interval of successive explosions on August 27, if those at 1h. 55m. and 2h. 38m. and at 4h. 41m. and 4h. 55m. are counted as a single phenomenon, is also 67m. The recurrence of several explosions at multiple intervals of 67m. shows that they were not always irregular, but had a rhythmic character. Another remarkable fact is the recurrence of explosions at intervals of about 3h. 20m. Recent investigations in surface seismic waves show that the principal phase of world-shaking earthquakes travels once round the earth in about 3h. 19m., which almost coincides with the recurrence intervals in the several explosions of Krakatoa. Thus the outburst of the volcano after the explosion of 5h. 20m. p.m. happened after the surface wave had made two complete revolutions round the earth. In the absence of the seismograph records at that time, we are quite ignorant of the existence of seismic waves during those explosions, but the magnetograph records at Batavia show distinct evidence of the vibrations of the ground. The repetition of explosions at regular intervals of time, which has such significance in the propagation of seismic waves, does not seem to be a mere chance coincidence. The surface seismic wave requires nearly the same time in traversing the different major arcs of the earth, so that they will meet at the antipodal point almost simultaneously, and in returning will again coalesce at the centre of excitation, in the same manner as the Krakatoa air waves. The disturbance at the origin must therefore re-accumulate at the interval of about 3h. 20m., and tend to call forth a new explosion, if the preceding explosion has already excited the seismic waves. This will probably account for the repeated occurrence at such stated intervals. Without laying too much stress on the effect of the seismic waves, which may have been associated with the spasmodic activity of the volcano, we have another reason to believe that the ground vibrated with the period of about 67m.

In spite of the numerous theories which may be advanced as to the cause of the Krakatoa sea waves, a simple hypothesis of the existence of vibrations with a period of about 67m. both before and after the explosion removes most of the difficulties that will be felt in accounting for the definite periods observed in tide-gauges scattered in different parts of the world. The activity of Krakatoa continuing from May to August 27, 1883, the exciting causes would naturally have been numerous during that interval of time to start sympathetic vibration of the earth. Whether the movement of the ground was confined to the region in the immediate neighbourhood of the volcano or extended round the whole earth could not be easily answered, and whether the period coincided accidentally with the natural mode of vibration of the earth or not is a matter of doubt, but the various data hitherto accumulated as to the rigidity of the earth from various phenomena connected with it tend to show that such supposition is efficacious as a working hypothesis.

The examination of mareograms in different parts of the world shows that the times of arrival of the Krakatoa waves are by no means definite, and the diagrams are sometimes markedly different from each other. In some the waves are blended together with the proper oscillations of the bay in which the instrument was placed, while in others they appear as regular secondary oscillations. In all cases they present long-continued disturbances; the more conspicuous waves are, with the exception of that at Batavia, preceded by minor oscillations, which sometimes merge insensibly into the higher waves, so that it is difficult to decide where the disturbance begins. According to the recent investigations by Messrs. Honda, Terada, and Yoshida, the secondary oscillations in numerous bays on the Pacific coast of Japan can be looked upon as forced oscillations by the waves of the same periods, which already exist in the surrounding ocean. During the Krakatoa eruptions the waves made their way into the surrounding seas and ocean, and the regular succession of waves in bays is to be attributed to the effect of forced vibrations.

The periods of Krakatoa waves recorded on mareograms are:—in Batavia, 122m.; Port Blair, 63m.; Negapatam, 68m.; Madras, 81·2m.; Dublat, 65m.; Beypore, 58m.; Karachi, 69m.; Aden, 67m.; Port Alfred, 64m.; Port Elizabeth, 70m.; Table Bay, 62m.; Port Moltke, 61m.; Colon, 70m. The average period of this wave series, with the exception of Batavia and Madras, is about 66m., which almost coincides with the mean period of explosions from 0h. 9m. to 11h. 15m. on gasometer records. This remarkable coincidence can be corroborated with simple physical experiments in the following manner.

When a pendulum with a magnet attached to it is set in vibration by intermittent current acting underneath, the period is double that of the exciting current, or when the pendulum support vibrates in a vertical path, the frequency is half that of the vertical motion. The well-known experiment of Melde, by which a string is set in sympathetic vibration by a tuning-fork of double frequency, and the crispation produced by the vertical vibration of the support, as observed by Faraday, are examples of forced vibrations with period double that of the exciting force. In the application to the Krakatoa eruption, we notice that the motion of the sea-bed near the place of eruption was nearly vertical; consequently, if the sea vibrates in an analogous manner as a pendulum, the period of the excited wave would be double that of the exciting body. The tide gauge at Batavia shows a big wave of 132m. ($=2\times66$m.) after the great eruption, and the mean period of the successive fourteen waves is 122m., which is nearly double the mean period of previous explosions. It is quite remarkable that if the rigidity of the earth lies between that of steel and that of glass, the mean fundamental period of spheroidal oscillation is about 67m.

According to Lord Kelvin, the tidal effective rigidity of the earth is about the same as that of steel. I have also lately shown that the prolongation of the Eulerian period to the Chandler period of about 430 days is closely connected with the velocity of seismic waves, and tends to point to the same conclusion as regards the rigidity of the earth. According to Bromwich (Proc. London Math. Soc., xxx., 1899), the periods of fundamental spheroidal vibration of an incompressible elastic solid sphere of the size of the earth are 55m. and 78m., when the rigidity is equal to that of steel and of glass respectively. In the above calculation the effect of gravity is also taken into account, which is to reduce the period by a considerable amount; with the rigidity of steel, the period is 66m. without gravity. The period of 67m. is the mean value when the rigidity lies between that of steel and of glass.

The prevalence of waves of the said period in the tide gauges scattered over the different parts of the earth's surface is a striking coincidence, and may be explained by assuming that the source of the waves was excited by vibrations corresponding to the fundamental mode of oscillation of the elastic gravity waves propagating round the earth. That most of the mareograms show continued disturbance before the appearance of big undulations suggests the probable existence of previous vibrations. Since such vibrations are radial and tangential, the waves appearing in bays at some distance from the exciting source would have mostly the same period as the source, while those observed in the neighbourhood of the eruption, as Batavia, would be double. Some doubts may be expressed as to whether the observed period is not peculiar to these bays, so that whatever may be the period of the exciting source, such undulations should invariably appear. With the exception of Aden and Colon, the proper period of the above-mentioned bays generally differs from that of the Krakatoa wave.

The above considerations favour the view that the vibration of the ground near Krakatoa was extremely slow, and had a period of about 67m. Whether this vibration extended all over the earth, or was confined to the vicinities of the volcano, is a question still to be solved. If the said period is really due to the spheroidal vibration of our planet, we shall have opportunities of determining more exactly the period of vibration when volcanic eruptions of the same character as those of Krakatoa take place, or sometimes even with world-shaking earthquakes. It will be worth examining seismograms, if great earthquakes do not give signs of the existence of vibrations of very long period by enhanced disturbances at regular intervals corresponding to the period of vibration of the earth. Another means of detecting the presence of such vibrations would be to examine the mareograms in bays with the proper period of about 67m. Long-continued observation in such bays will probably reveal the nature of the spheroidal pulsation of the earth, if such really exists.

H. NAGAOKA.

REPORT ON ARCTIC MAGNETIC OBSERVATIONS.

THIS report,[1] which was printed under the auspices of the Videnskabs-Selskabet of Christiania, at the expense of the Nansen Fund for the Advancement of Science, deals with magnetic observations made in the Polar expedition of 1898–1902 under the command of Captain Otto Sverdrup. The observations were taken by Messrs. V. Baumann and G. Isachsen, and reduced by Mr. Steen. A large part of the report is occupied by the reduction of the observations, which were not in reality very extensive. The following abstract of the mean results at the four stations where observations were made comprises the principal facts summarised on p. 81:—

Station	Rice Strait	Havne Fjord	Gaase Fjord	Gaas Fjord
Latitude N. ...	78° 46′	76° 29′	76° 49′	76° 40′
Longitude W. ...	74 57	84 4	88 40	88 38
Epoch	1899·2	1900·5	1901·6	1902·5
Declination W....	103° 4′	116° 47′	129° 33′	128° 51′
Inclination N. ...	86 0	87 1	87 41	87 53
Horizontal Force	0·04031	0·03315	0·02518	0·02353

The observations, as is evidenced by the smallness of the horizontal force, were taken at no very great distance from the magnetic pole, and the instruments, as Mr. Steen explains with regret, were not well adapted for use under such conditions. Captain Sverdrup's original programme, which had to be largely modified, would have taken him further from the magnetic pole, but, even if circumstances had been propitious, a modification in the outfit would seem to have been desirable. However zealous the observers, as Mr. Steen justly remarks, they can hardly be expected to retain their full interest in the work unless the behaviour of the instruments gives them confidence that the results being accumulated are trustworthy; and, it may be added, however competent those reducing the observations, the outcome of their efforts must be accepted with some reserve unless reliance can be placed both in the instruments and the observers. In the present case, economic grounds seem to have been largely accountable for the instrumental deficiencies. After the experience gained during the last few years, those responsible for expeditions to the neighbourhood of the magnetic poles will have small grounds for excuse if they fail to exercise due foresight in the choice of magnetic instruments and the training of magnetic observers in their use.

C. CHREE.

DEVELOPMENT OF LEMUROIDS.

THE development of the tarsier (*Tarsius spectrum*) and the slow loris (*Nycticebus tardigradus*) forms the subject of the seventh fasciculus of Prof. F. Keibel's "Normentafeln zur Entwicklungsgeschichte der Wirbelthiere," now in course of issue by G. Fischer, of Jena. The part before us is the joint work of Prof. A. A. W. Hubrecht and the editor. Although the text is necessarily of an extremely technical nature, the beautiful illustrations of embryos permit the student to see for himself how essentially different are the early phases in the development of these two strange Malay animals, which are included by most zoologists in the order Primates.

Prof. Hubrecht has for several years past devoted special attention to the developmental history of the tarsier, on which he has published papers from 1895 onwards. He has regarded the genus as the most primitive phase of the Primate type, sundered very widely indeed from all other lemuroids, with which it was formerly so closely associated. His unique material has been generously placed at the disposal of his coadjutor for the purpose of illustrating this fasciculus of the "Normal Plates," in connection with such material for the developmental history of the slow-loris as could be obtained—material, unfortunately, much less rich than that available in the case of the tarsier.

While Prof. Keibel, as already indicated, worked out the history of the tarsier, Prof. Hubrecht undertook that of the loris, and has likewise written the general account and the comparison of the two forms.

In the concluding section support is given to Prof. Hubrecht's original suggestion that, in view of the marked and radical divergence of their development, it is illogical to include the loris and the tarsier in the same mammalian order. Before their relative positions can be definitely determined and a thoroughly satisfactory classification of mammals in general formulated, it is necessary that the series of these normal plates of development should be very greatly extended, and our knowledge of the ontogeny of such forms as Manis, Galeopithecus, Hapale, and Chrysochloris and other insectivores very largely augmented. As an instalment to this most desirable end, the fasciculus before us is all that could be desired.

R. L.

MARINE BIOLOGY ON THE WEST COAST.[1]

YEAR by year the report on the Lancashire Sea Fisheries Laboratory increases in bulk, and the fifteenth of the series is again rather thicker than its predecessor. It contains fourteen scientific papers, as against eleven in the previous volume, and in the present case two or three gentlemen other than members of the staff have contributed.

As usual, the volume opens with a general report and review by Prof. Herdman, the honorary director of the scientific work. This is followed by twenty pages by the same author upon sea-fishery research, in which he reviews the present situation and the nature of the work done in the international investigations of the North Sea, and criticises the value of that work from the point of view of the fisheries. Without either agreeing with or dissenting from Prof. Herdman's views, we can say that he has set forth a very clear statement of his case.

Mr. Andrew Scott's report on the sea-fish hatching at Piel again records the liberation of several millions of fry, and again lacks any word as to the results of thus increasing the fish population of the area. In another paper on sea-fish hatching in Norway, however, Captain Dannevig discusses what appear to him to be the results of liberating artificially hatched cod larvæ, but his conclusions are traversed by Mr. K. Dahl, whose paper on the same subject suggests that the increase of cod in the district shows no relation to the liberation of the fry, but is dependent upon variations in the currents of water which are responsible for the distribution of the eggs. Thus the value of "interfering" with the natural reproduction of the food-fishes still remains to be proved.

Mr. Scott also reports, as usual, upon the tow-nettings for the year, and we cannot but admire the amount of trouble taken; at the same time, we are inclined to be sceptical as to whether the value of such work is equal to the labour expended upon it.

The same author contributes a short paper upon the food of young fishes. In this paper also, Mr. Scott illustrates his capacity for taking pains, and there is no doubt that such work will prove valuable, especially when taken in conjunction with work upon the food of mature fishes, such as Mr. R. A. Todd has contributed to the North Sea investigations.

Mr. James Johnstone's paper upon this subject deals only with the plaice and dab, and is upon the same lines as the one he contributed last year upon the same subject. He has now, however, gone more carefully into detail, and shows that, although the dab is less particular than the plaice in its choice of food, both the species depend mainly upon lamellibranch molluscs, especially Solen, and his observations on this point agree well with those of Mr. R. A. Todd on the same species in the North Sea.

The fish-marking experiments were continued during

[1] Report of the Second Norwegian Arctic Expedition in the *Fram*, 1898–1902. No. 6. "Terrestrial Magnetism." By Aksel S. Steen. Pp. 82. (Christiania, 1907.)

[1] No. xv., Report for 1906 on the Lancashire Sea-fisheries Laboratory at the University of Liverpool and the Sea-fish Hatchery at Piel. Pp. 269; illustrated. (Liverpool, 1907.)

1906, and Mr. Johnstone's results agree with his previous ones in so far as they show an off-shore migration in the summer and an along-shore movement in the winter. A number of other movements were observed, just as in the North Sea, where individual fish moved long distances, *e.g.* to the east and south coasts of Ireland, but such movements appear to be irregular according to present knowledge.

The same author also gives a valuable contribution on sewage pollution of shell-fish, and in this connection we regret that Prof. Herdman has not been able to give us a report upon the action of copper in connection with the purification of infected shell-fish, of which a preliminary statement appeared last year.

As usual, there is no lack of charts, tables, and illustrations, and the volume certainly shows very well Prof. Herdman's idea as to the association of scientific research and fishery problems.

FRANK BALFOUR BROWNE.

INCANDESCENT ILLUMINANTS.[1]

A LITTLE more than twenty years ago Auer von Welsbach, who was engaged on researches on the rare earths, invented the modern incandescent mantle. His first mantles were made of zirconia and yttrite earth in the proportion to make a normal zirconate. Shortly afterwards he found that the best material has a basis of thoria. Pure thoria, which requires care in its preparation, gives very little light, but if a small percentage of a coloured and permanent oxide, such as ceria, is added, it gives good illumination.

There has been much discussion about the theory of the incandescent mantle. It has been generally assumed that the temperature of a Bunsen burner is too low for a mantle to give the light it does by simple radiation unless it is much hotter than the flame. Unfortunately, the temperature of the flame is generally taken with a thermocouple, and this gives far too low a reading, as the thermocouple never reaches the real temperature of the flame; but, admitting that the temperature of the flame is high, it is still urged that the light given by the thoria with a small percentage of ceria is so great that there is something more than mere thermal radiation. It is said that the ceria acts as a catalytic agent, and that it oscillates between two states of oxidation. Ceria does act somewhat in the same way as platinum; for instance, if a ceria mantle is put on a lighted burner, the burner turned out, and the gas turned on again, the ceria mantle will glow and finally light the gas. It is odd that this is not brought forward by the advocates of the catalysis theory; but the opponents might urge that zirconia will do the same thing, and the zirconia mantle gives very little light. This does not prove that ceria does not increase the rate of combustion, however.

According to the simple radiation theory, the light depends only on the emissivity, or blackness of the mantle, and its temperature. Its temperature must be lower than that of the flame, as it must be robbing the flame of the heat it radiates. In order to give the flame every chance of supplying the heat, the threads of the mantle have to be made very fine, so that the flame can rush through the meshes, and the hot gas should be in brisk movement through the interstices of the mantle. By using a special draught arrangement, known as the intensive system, about twice the light per cubic foot of gas can be obtained. In order to get the highest temperature the emissivity should be low, that is to say, the mantle should be very white; but then, though it would get to a high temperature, it would give very little light. On increasing the emissivity the light will first increase, but this means a lower temperature, so that as the emissivity is increased from white to black the total radiation increases, but as that means a greater abstraction of heat from the flame, the mantle is cooler, and therefore radiates a larger proportion of the energy as heat and a smaller proportion as light, so the mantle gets redder and gives less light. This is just what happens in practice, whether ceria or any other coloured oxide is used.

It has been urged that, as pure ceria is white, adding it cannot make the mantle blacker; but ceria is white only when cold. A mantle may look quite white cold, and be darker in colour when hot. Rubens has devised an experiment to show this. The mantle is strongly illuminated by an arc and condenser, and its image is thrown on the screen. It looks quite white, of course. On lighting the gas, the mantle, instead of becoming still brighter, at once becomes dull. Again, alumina, which is white, gives little light. Chromium oxide is so dark that it gives only a dull red glow. But on adding a little chromium oxide to the alumina, a dark red light is first given, because the chromium oxide is too dark, but as soon as it combines with the alumina to make a light pink mantle a good light is obtained.

The incandescent mantle is now applied, not only to the ordinary Bunsen burner, but to an inverted form, which lends itself to decoration, and to the petroleum lamp. It is now also applied to air carrying a little hydrocarbon gas, and this application is said to provide an extraordinarily cheap light, which is especially useful for country houses.

One of the drawbacks to gas, compared with electric lighting, is that merely turning on does not light gas. This difficulty has been largely overcome by the use of the bye-pass, but further advances have been made. Welsbach has discovered that an alloy of cerium and iron gives off sparks on being scraped or filed, and a burner has been designed in which the act of turning on the gas scrapes a little wheel of this alloy, causing a spark which lights the gas. This overcomes the drawback of having a little jet always burning. Another invention allows the gas to be lighted from a main tap. Each burner has an attachment which lets the gas straight through to the burner when the pressure is on, but on turning the main supply off, and allowing a little gas to pass at the controlling tap, the attachment to each burner turns off the burner and lights a little pilot jet, which keeps alight until light is wanted again. On turning on the main tap the pilot jets light the various burners and go out themselves. By this means burners can be fully lighted up by turning one tap at the door of the room.

The electric incandescent light is undergoing a great change. Carbon is being replaced by metal wires. It has been found possible to make wires of high enough resistance of tungsten, osmium, tantalum, and a few other metals and compounds. The osmium lamp was the first of these, but there was difficulty in making it of high enough resistance. The tantalum lamp is now in great demand. It is made for 100 volts to 130 volts, and is much more efficient than the carbon lamp. It will not last long on alternating currents, however. The wires of a lamp that have been run for some time on a direct current show a curious notched or crinkled appearance under the microscope; but a wire that has been run on an alternating circuit looks as if the metal had been melted into short cylinders with round ends, and these cylinders had stuck together end to end without their centres being in a line. Sometimes the little cylinders are nearly separated, merely touching at a corner. This action is very extraordinary, and has never been explained. In addition to this, when a lamp breaks down on an alternating circuit, the wire sometimes goes at one point and sometimes it breaks in several places, and tangles itself up in an extraordinary way; at other times it breaks up into numerous little pieces, which will be found lying on the inside of the globe. Some of the other lamps show a change under the action of the current, but it is not so marked as in the case of tantalum.

One of the most interesting of the new lamps is the zircon. It is said to be made of zirconium and tungsten, and lamps of this material have been made for 200 volts, a matter of the greatest importance from a distribution point of view. It is possible that the conductor is really a zirconide of tungsten, and this opens up a new series of compounds. A zircon lamp for 100 volts has really six separate loops of wire mounted in series inside a bulb. A recent improvement is to provide an extremely

[1] Abstract of a Discourse delivered at the Royal Institution on Friday, April 26, by Mr. J. Swinburne, F.R.S.

light spring for each loop, so as to keep it taut. The lamp can then be used in any position.

Tungsten seems to be the favourite metal, as it gives a very high efficiency. It is probable the lamp of the future will have an efficiency of nearly a candle per watt, and this is promised by the use of tungsten. At the same time, it must be admitted that to make a wire with a resistance of 500 ohms small enough to give twenty candles with 20 watts is a triumph of inventive skill.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The board of anthropological studies recommends in a report to the Senate (1) that a diploma in anthropology be established; (2) that an advanced student who has studied some branch of anthropology under the direction of the board, and has presented a thesis, which thesis has been approved for a certificate of research, shall, on the payment of such fees as the Senate may from time to time determine, be entitled to a diploma testifying to his competent knowledge of anthropology; (3) that any member of the University having graduated before the date of the establishment of the diploma, who has presented a thesis on some branch of anthropology, which thesis has been approved by the board, shall, on the payment of such fees as the Senate may from time to time determine, be entitled to a diploma testifying to his competent knowledge of anthropology.

The John Winbolt prize for engineering for 1907 has been awarded to J. E. Sears, St. John's College, for his essay "On the Longitudinal Impact of Metal Rods with Rounded Ends."

The special board for biology and geology has nominated Mr. A. E. Shipley the representative of the University on the council of the Marine Biological Association from the annual meeting of the association in 1907 to the annual meeting in 1908.

MANCHESTER.—The provision for study and research in metallurgy has been recently very materially increased. The equipment for metallography, as also for the heat treatment and mechanical testing of metals, has been brought up to date. Dr. H. C. H. Carpenter, late of the National Physical Laboratory, was elected professor of metallurgy a short time ago, and Mr. C. A. Edwards (Carnegie scholar of the Iron and Steel Institute) has just been appointed demonstrator and research assistant.

SHEFFIELD.—The University council has appointed Mr. Arthur Holden to the post of assistant lecturer and tutor in mathematics. Mr. Holden, who was a scholar of Queens' College, Cambridge, is at present lecturer in mathematics at St. Mark's College, Chelsea. He will enter upon his new duties next session.

THE plans for the restoration of the main building of the Merchant Venturers' Technical College, Bristol, have now been approved by the Society of Merchant Venturers; they involve very considerable changes in the arrangements of the original building. From the description of the provision to be made in the new building, it appears that the governors are concentrating the work of their college so as to provide a much more extensive equipment for those departments which train civil, mechanical, electrical, and mining engineers, and prepare for the B.Sc. degrees of the University of London in science and engineering. With this end in view, they will discontinue certain portions of the work formerly undertaken by the college.

REPRESENTATIVES of the University of London to the number of nearly a hundred are this week paying a visit to the University of Paris. The party includes Sir Edward Busk (Vice-Chancellor of the University), Sir Philip Magnus (the Parliamentary representative of the University), Sir Arthur Rücker (the Principal), Dr. Pye-Smith (ex-Vice-Chancellor), members of the Senate, Deans of the several faculties, Mr. P. J. Hartog (Academic Registrar), and other guests. On May 21 the visitors assembled in the grand amphitheatre of the Sorbonne under the presidency of M. Briand, Minister of Public Instruction, who with M. Liard, Vice-Rector of the University of Paris, delivered addresses of welcome, and Sir Edward Busk replied. Prof. Alfred Croiset and Prof. Gardner, Dean of the Faculty of Arts of the University of London, also spoke. Afterwards the English visitors were entertained at lunch by the municipality of Paris, and in the afternoon paid a visit to Versailles. A reception in honour of the visitors was given by the British Ambassador in the evening. On May 22 there was an excursion to Chantilly. To-day is to be devoted to an inspection of the various departments and laboratories of the Paris University; in the afternoon a reception will be given in honour of the visitors at the Elysée by the President of the Republic and Mme. Fallières. In the evening the English visitors will be the guests of the University of Paris at dinner at the Sorbonne, when the French Ministers of Public Worship and of Foreign Affairs are expected to be present. The dinner will be followed by a concert in the great hall, and a conversazione in the reception rooms of the Sorbonne. The party will return to London to-morrow.

THE urgent needs of the University of Oxford led to an important meeting being held on May 16 to consider a scheme for raising a fund to meet them. Lord Curzon, Chancellor of the University, presided over a large and distinguished assembly, and in the unavoidable absence of the Lord Chancellor proposed a resolution:—"That a fund be raised, entitled the Oxford University Appeal Fund, to meet the needs of the University as set forth in the letter signed by the Chancellor and Vice-Chancellor, which was published in the newspapers on May 2, 1907." Speaking in support of the resolution, Lord Curzon announced that the fund was being started with promises and gifts amounting to 57,000*l*., which includes 10,000*l*. from Mr. Brassey, 10,000*l*. from Mr. W. W. Astor, 2500*l*. from Mr. W. F. D. Smith, 2000*l*. from Lord Curzon, and five donations of 1000*l*. Following the Chancellor's eloquent appeal, the Chancellor of the Exchequer seconded the resolution (which was eventually carried unanimously), and took the opportunity to point out several directions in which the work of Oxford University needed development to keep the University abreast of modern needs. The Archbishop of Canterbury moved:—"That a body of trustees of not less than nine, nor more than twelve, be appointed for the administration of the fund, composed of one-third resident and two-thirds non-resident members of the University, and that the hebdomadal council be requested by the Chancellor to nominate the University representatives, and that the Chancellor and Vice-Chancellor be authorised to consult with the leading supporters of the movement as to the appointment of non-resident trustees." Lord Milner seconded the resolution, and it was carried. A further resolution was adopted appointing a committee to consider the best means of raising subscriptions to the fund. Though we are of opinion that the provision of adequate funds for our universities is a State duty, we hope that until that duty is recognised by the Government our men of wealth will see to it that the work at Oxford is not hampered by the want of what is really a modest amount when compared with the greatness of the needs of the University.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 14.—"The Purification and Testing of Selenion." By R. **Threlfall**, F.R.S.

The paper deals with the purification and testing of considerable quantities of selenion with the object of investigating the electrical constants of the element in the pure state. It was found that Ekman's and Petterson's method is suitable and satisfactory as a means of purification of selenion from other known elements, with the possible exceptions of mercury, tellurium, and arsenic. The analytical separation of selenion from tellurium was investigated, and it was found that the most satisfactory method is by fractional sublimation of the dioxides. It is shown that a sharp separation can be made by subliming a mixture of the oxides containing one part of tellurium to ninety-nine parts of selenion at a temperature of 360° C. The sublimate contains certainly less than one-tenth per cent. of tellurium, and probably less than one-fortieth per cent., the extreme limit of analytical discrimination.

A thorough investigation showed that tellurium cannot be detected in presence of selenion in quantity by spectroscopic analysis. Details as to the method of carrying out Ekman's and Petterson's purification are given. The purified product was tested for arsenic with constant reference to check and blank trials, and it was found that arsenic was present to the extent of 0·00038 per cent. Mercury was sought for by the method suggested by Marcel, and also by Dr. Sand with a special electrolytic apparatus, but none was found.

The remaining difficulty in regard to a possible solubility of selenion dioxide in selenion was not entirely overcome, though it is shown that by distillation of a mixture of selenion and selenion dioxide in an inert gas nearly, if not all, the dioxide can be separated, but there does not seem to be any perfectly satisfactory criterion as to the complete absence of dioxide. This uncertainty prevented the subject of the conductivity of really elemental selenion from being undertaken, but the highly purified material obtained was examined by Messrs. Vonwiller and Mason with respect to its specific inductive capacity. The material employed by these observers was returned to the author for re-examination, and it is shown that no material amount of impurity was introduced during the necessary meltings and treatment which it had undergone.

Royal Microscopical Society, April 17.—Mr. G. C. Karop in the chair.—The Podura scale: E. M. **Nelson.** The author traced the efforts of previous observers to interpret the markings on the scales, giving figures—which were drawn to an enlarged size upon the board—to illustrate the various interpretations, including the result of his own observations.—The root bacteria of pulse: Dr. Antonio **Rodella.**

Zoological Society, April 23.—Dr. J. Rose Bradford, F.R.S., vice-president, in the chair.—The ears of the African elephant as a race character: R. **Lydekker.** To illustrate this paper, a large number of photographs and several specimens were exhibited. The author considered that there must be many more local races than those already named by Dr. Matschie, although, with the present material, he hesitated to give separate designations to several of these. He ventured, however, to propose new names for the elephant of the eastern side of Cape Colony; for that of Mashonaland, as typified by a head in the Imperial Institute; for that of the Lake Rudolf district, as represented by a head presented to the British Museum by Mr. H. S. H. Cavendish; and for the Somali elephant, as typified by a head in the collection of S.A.R. le Duc d'Orléans at Wood Norton, this last race being characterised by the very small ears, which, however, were quite different in shape from those of *E. a. knochenhaueri.* The author also directed special attention to a skull from the Albert Nyanza district, for which he had previously suggested the name *E. a. albertensis.* Differing in many points from those of other African elephants, this skull showed a remarkable resemblance to that of the extinct Indian *E. planifrons,* thus suggesting the descent of the African elephant from that species.—Descriptions of three new species and five new subspecies of Siberian birds: S. A. **Buturlin.**—A list of small mammals obtained in the islands of Saghalien and Hokkaido by Mr. M. P. Anderson for the Duke of Bedford's exploration of eastern Asia: Oldfield **Thomas.** Fourteen species were recorded from Saghalien and thirteen from Hokkaido. The faunas of the two islands proved to be very similar to each other, although in some cases subspecific differences between the representative forms in each were perceptible. In one genus only, Micromys, the relationship of Hokkaido seemed to be with the main island of Japan rather than with Saghalien.—A list of the cold-blooded vertebrates of Saghalien: G. A. **Boulenger.**—Notes on hybrid bears: H. **Scherren.** The author referred to cases that had occurred in the society's gardens, the long series bred by Herr Nill in his zoological garden at Stuttgart (now broken up), and a recent case in the garden at Halle-an-der-Saale. Reference was also made to cases said to have occurred at Cologne and Hanover, but for these the evidence was not conclusive.—Some new species of earthworms of the family Eudrilidæ, belonging to the genera Polytoreutus, Neumaniella, and Eminoscolex from Mt. Ruwenzori: F. E. **Beddard.**—South American pseudoscorpions of the family Cheliferidæ in the collections of the British and Copenhagen Museums: C. J. **With.**

Physical Society, April 26.—Prof. J. Perry, F.R.S., president, in the chair.—Electrical conduction produced by heating salts: A. E. **Garrett.** The experiments described are divided into two series. The first, of a preliminary nature, consisted in testing a large number of inorganic compounds up to a temperature of 360° C. Several compounds, chiefly halogen salts, were found to produce easily detected conductivity when heated. In the case of zinc iodide, conductivity could be detected at the ordinary temperatures of the laboratory. The second series was confined to special cases in order to ascertain the causes of the increased conductivity. It was found that in all the cases tried a formula of the form $I = a\theta^{\frac{1}{2}}e^{-\frac{b}{\theta}}$, where I = saturation current, a and b constants, and θ the absolute temperature, represents with fair accuracy the connection between the saturation-current and the absolute temperature.—Solenoids which will move under the action of the earth's magnetic field: W. B. **Croft.** In showing Ampère's experiments, it is not very easy to complete the theory of magnetism by making a solenoid point to the north. Many years ago Ritchie made a solenoid with an iron core, which acted as a motor with the help of a mercury commutator. A copper solenoid without core was shown which had been made to rotate in this manner. The method is unsatisfactory and uncertain, owing to the rigidity assumed by the skin on the surface of mercury in certain conditions. The ampere mercury contacts cause no difficulty when a wire rotates on its own axis, but there are strong hindering forces when the wire is pushed through the mercury, partly from the skin and partly from amalgamation. The best pattern for a solenoid is suggested by the moving coil of an electrodynamometer. Two of such were shown, which were conveniently worked by four dry cells in series. Each of these was hung with very thin metal strip by bifilar suspension, the threads about 5 inches long and 1/10th inch apart. The bifilar control makes the movements manageable; it is convenient to set the coils N. and S., or the axis of the corresponding magnets E. and W., so as to make these swing up to the meridian when a current is sent through the coils.—The influence of pressure upon convection currents, and a criticism of J. Stark's relation between kathode fall of potential and temperature: W. S. **Tucker.** Stark employed as kathode a wire mounted radially in a globe-shaped vessel. The wire was heated electrically, and its resistance, and hence its temperature, determined. He refers to the weaknesses of the method:—(1) the conduction of heat away from the wire by its leads causes the observed mean temperature to be too low; (2) the error made in assuming the kathode dark space temperature to be that of the heated kathode. The author's apparatus was devised to show how seriously these weaknesses affect Stark's results.—A simple apparatus for mechanically illustrating the tangent and sine laws: J. A. **Tomkins.**

Geological Society, May 1.—Sir Archibald Geikie, Sec.R.S., president, in the chair.—The xerophytic character of coal-plants, and a suggested origin of coal-beds: Rev. Prof. George **Henslow.** It is held that the characteristic feature of the great coal-forests was xerophytic, and the vegetation appears to be of an upland type. Illustrations are given from recent and Carboniferous plants to show the characters of leaf, root, and stem which separate these classes of plants. The position of coal-seams is accounted for by the action of earth movements in late Carboniferous times; these threw the forest-bearing surface into shallow waves and troughs, which became gradually accentuated, the latter being gradually filled with sediment, upon which, during intervals of rest, new forest growth took place.—Petrological notes on the igenous rocks lying to the south-east of Dartmoor: H. J. **Lowe.** The rocks described are contained in the Newton Abbot district, the region east of the Dart and south of the Teign. They are most nearly related, both geologically and petrologically, to those of south-west Devon, or the Plymouth district described by Worth.

Society of Chemical Industry, May 6.—Mr. R. J. Friswell in the chair.—An apparatus for the estimation of carbonic acid: H. W. **Rowell**. The sample of carbonate is decomposed by a suitable acid and boiling, and the carbon dioxide collected and weighed in potash bulbs. The apparatus consists of a 70 c.c. flask with a ground-glass stopper carrying a stoppered funnel, for admitting acid and subsequently air, and a bulb water vapour trap. An air washing tube, drying tubes, potash bulbs, and a supporting stand and aspirator complete the apparatus.—The works chemist as engineer: O. **Guttmann**. All chemical works have a large number of engineering problems to solve, and, as a rule, the chemist will have to look after them. The author explained in detail the selection of a site, the disposition of buildings and plant, the erection of buildings to standard sizes, materials, plant, &c., in view of the products to be worked and any special risks attached to them. The installation of a power-house and the many engineering details which are of advantage in the economy and control of the production of power, smoke preventers, automatic stokers and special grates, as well as water softeners and feed-water heaters, were dealt with. The author emphasised strongly that "works operations were not simply laboratory operations writ large." In his opinion it was useless to teach chemical technology with the help of beakers and test-tubes. To train a chemist properly, he ought to go to college better prepared, and have at least four years of study, with more mechanics and physics in the beginning and a proper course of chemical technology in the end. After that it is only necessary that manufacturers should realise that a works chemist is not solely an analyst, but a highly useful practical technologist, who, given a little confidence, will in a short time repay his salary many times over. The paper concluded with the sentence:—"We have heard too much about the many chemists engaged on research in the large colour works of Germany. Highly valuable as they are and important as their discoveries were, the German chemical industry is infinitely more indebted to that far greater number of works chemists, who patiently and thoroughly investigated the manufacturing processes, who had the ability to devise improvements and economies, and who found generous manufacturers and their college-trained sons to give them their confidence. It is on these lines that we must progress."

PARIS.

Academy of Sciences, May 13.—M. A. Chauveau in the chair.—A functional equation occurring in the theory of certain equations on derived partials: Émile **Picard**.—Theory of the speaking condenser of M. Argyropoulos: Marcel **Deprez**. Explanation of the theory of the condenser in the secondary coil of transformer of microphone described by M. Argyropoulos on May 6.—The glucose coming from the "potential sugar" (*i.e.* the glucosides) of the blood: R. **Lépine** and M. **Boulud**. Experiments on dogs showing the effect of invertin and fibrin on the quantity of glucose which is set free in defibrinated blood from the glucosides present (compare Lépine and Boulud, *Comptes rendus*, October 8, 1906).—The employment of potassium permanganate to remove sodium thiosulphate (so-called "hyposulphate") in photography: Albert **Granger**. The author points out that the preservation of photographic positives and negatives obtained by means of silver salts depends upon the total elimination of the thiosulphate ("hypo") used for fixing them. Many oxidising agents have been introduced to destroy the last traces of thiosulphate, for example, the perborates and persulphates. These salts are, however, very inconvenient. They are expensive, and they tend to spoil either positives or negatives if allowed to act beyond a certain time. It is difficult to tell, too, when they have completed the oxidation of the thiosulphate. Potassium permanganate is free from these disadvantages, and the following method of procedure is suggested for ordinary work. The positive or negative, after rinsing two or three times for about a minute with water, is placed in a porcelain or glass dish, and for half-plate size 250 c.c. of dilute permanganate, made by diluting 10 c.c. of a solution containing 1 gram per litre, is added. If the solution turns brownish add more permanganate until a pink tint remains. Then place the print in a 1 per cent. oxalic acid solution to remove any faint brown deposit. Wash with ordinary water until clear. Oxalic acid gives a precipitate with ordinary water, thus giving an indication when washing is completed.—Observations of the new planet ZB made at the Marseilles Observatory: M. **Coggia**.—The expedition to Turkestan for the observation of the solar eclipse of January 14, 1907: Milan **Štefánik**.—Approximate convergence in mathematical analysis: Ernst **Fischer** (compare M. Riesz, *Comptes rendus*, March 18).—A general method for the solution of Dirichlet's problem: S. **Bernstein**.—The representation of equations of the fourth nomographic order with three and four variables: Maurice **d'Ocagne**.—The resistance of air to the movement of bodies: M. **Canovetti**.—The rapidity of detonation of explosives: M. **Dautriche**. This is a continuation of work already published (*cf. Comptes rendus*, vol. cxliii., p. 641).—The alteration of the absorption bands of crystals, and the law of variation of delay of movement of electrons at different temperatures: Jean **Becquerel**.—Nernst's theory and the values of the differences of potential at the point of contact of two electrolytes in solution: J. **Guyot**.—The liquefaction of air: Georges **Claude**.—The phosphorescence of calcium compounds containing manganese.—Influence of the constitution and mass of the molecules on the wave-lengths of the radiation emitted: L. **Bruninghaus**.—Action of fluorine on selenium. Preparation of tetrafluoride of selenium: Paul **Lebeau**. Working with metal vessels, so as to prevent any chance of oxyfluorides being obtained, the author prepared tetrafluoride of selenium by direct union, and found it to be a colourless liquid, boiling about 100° C., and forming a white crystalline solid at about −80° C. Brought into contact with water, the compound decomposes with evolution of heat, giving a solution containing selenious and hydrofluoric acids,

$$SeF_4 + 2H_2O = SeO_2 + 4HF.$$

The compound behaves as if saturated, so that the hexafluoride of selenium mentioned by Prideaux (Chem. Soc., vol. lxxxix., p. 316) might require further investigation.—Spontaneous oxidation of cobalt hydrate in alkaline solution: André **Job**.—The silicates of aluminium and calcium: O. **Boudouard**.—The constitution and properties of samples of steel containing boron: Léon **Guillet**.—Condensation of oxalic esters with tertiary aromatic amines: A. **Guyot**.—Some caoutchouc-bearing plants of the south of Madagascar: J. **Constantin** and H. **Poisson**.—Observations on the constitution of the membrane of the Péridiniens: Louis **Mangin**.—The delimitation and relations of the principal species of *Illipéés*: Marcel **Dubard**.—The influence of light on the assimilation of the reserve organic matter of plants and bulbs by the plantules in the course of their germination: W. **Lubimenko**.—The function of sieve tubes (botanical): M. **Molliard**.—The comparative effect on the heart of different potassium salts of the same molecular concentration: H. **Busquet** and V. **Pachon**.—The occurrence of iron in animal and vegetable tissues: A. **Mouneyrat**. The author states that he has found iron in all tissues, and that, in fact, iron seems to be a constant constituent of all living cells.—The extraction of the pigments from batrachians: A. **Magnan**.—The adipose tissue replacing the vibratory muscles of the wings after the nuptial flight in queen-ants: Charles **Janet**.—The glacial formations of the Chaux-d'Arlier: Paul **Girardin** and Fritz **Nussbaum**.—The oceanic lithology of ancient seas: J. **Thoulet**.

CAPE TOWN.

South African Philosophical Society, March 27.—Mr. S. S. Hough, F.R.S., in the chair.—A property of symmetric determinants connected with the simultaneous vanishing of the surface and volume of a tetrahedron: T. **Muir**.—The development of the ovary and embryo-sac in *Cassia Tomentosa*: W. T. **Saxton**.—The fertility of some colonial soils as influenced by the geological conditions: C. F. **Juritz**. Chemical analyses of the soil may be of three different types, according as they show (1) how much plant food exists in a form immediately available for plants; (2) what proportions are present as a reserve stock; or (3) the aggregates of the plant-food constituents in the soil. The third type of analysis may have its value for the geologist, but only the first and second afford the farmer any indications of the land's worth, the former indicating its immediate productiveness and the latter its permanent value. Until recently sufficient samples had not been analysed by a method that could be taken as a trustworthy means of ascertaining the reserve stock of plant food in the colony's soils, nor had the Geological Commission progressed to an extent sufficient to enable it to be used as a working basis. Furthermore, the soils that had been analysed had been selected from definite fiscal divisions without regard to geological conditions. Some 200 soils had, however, been selected from the number hitherto analysed and taken as fairly representative of various geological formations. Of the soils derived from the pre-Cape rocks, those from the Malmesbury slates in the south-western part of the Colony were found to be poor all-round on the average. In the northern portion of the country, where the Campbell Rand series extended over a large area, the soils were rich in lime. The soils derived from the Table Mountain series, which were the lowest rocks of the Cape system and consisted of little else than silica, lacked all the essential mineral ingredients of plant food. Above the Table Mountain series lay the Bokkeveld beds, and these produced soils with satisfactory proportions of plant food. The highest rocks of the Cape system, namely, the Witteberg series, produced soils which may be anticipated to resemble those of the similar Table Mountain series, and the few that had been analysed bore out this view. This was the district in which bone-diseases in cattle prevailed. Of the soils of the Karroo system, those derived from the Burghersdorp beds and Stormberg series were found to be well supplied with potash and phosphates, and contained large proportions of lime. This was also the case with the soils formed from the Uitenhage series, in the Cretaceous system. For hundreds of miles fertile silts were transported by rivers in flood. To the silts thus brought down from the Karroo, the Oudtshoorn division owed its fertility, and the soil of that division was now undergoing transportation to the sea, except where deposited in the Riversdale and Mossel Bay divisions en route.—Some new fossil reptiles from Victoria West: Dr. R. **Broom.** A description is given of three new reptiles found by Mr. T. J. R. Scholtz at Victoria West, in beds which are believed to correspond to the Lystrosaurus beds of Colesberg, Middelberg, and Cradock. Hitherto almost the only fossils known from these beds have been the aquatic Lystrosaurus and fish.—Solifluction: Prof. E. H. L. **Schwarz.** Solifluction is a term coined by Andersson for the flow of saturated soil down mountain sides. Originally used only for regions covered with ice and snow, the object of the present paper is to show that the same action goes on in temperate countries, only to a smaller extent, producing stone courses in the mountainous districts, and a gradual downward creep of soil and subsoil in parts of the country which have less relief. Under the same term must be included the flow of volcanic ashes saturated with water, which are characteristic of the so-called mud-volcanoes in South America, Java, &c.

DIARY OF SOCIETIES.

THURSDAY, MAY 23.

ROYAL SOCIETY, at 4.30.—The Relation of Thallium to the Alkali Metals: a Study of Thallium Sulphate and Selenate: Dr. A. E. H. Tutton, F.R.S.—On the Frictional Resistances to the Flow of Air through a Pipe: Dr. J. H. Grindley and A. H. Gibson.—Chemical Reaction between Salts in the Solid State: Dr. E. P. Perman.—Studies on Enzyme Action, IX., The Nature of Enzymes: Prof. H. E. Armstrong, F.R.S., and Dr. E. F. Armstrong.—Studies on Enzyme Action. The Enzymes of Yeast: Amygdalase: R. J. Caldwell and S. L. Courtauld.—On Light Elliptically Polarised by Reflection especially near the Polarising Angle: a Comparison with Theory: Prof. R. C. Maclaurin.

ROYAL INSTITUTION, at 3.—Chemical Progress—Works of Berthelot, Mendeléeff, and Moissan: Sir James Dewar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Present State of Direct Current Design as Influenced by Interpoles: F. Handley Page and Fielder J. Hiss.—Hot Wire Watt Meters and Oscillographs: J. T. Irwin.

FRIDAY, MAY 24.

ROYAL INSTITUTION, at 9.—Recent Contributions to Electric Wave Telegraphy: Prof. J. A. Fleming, F.R.S.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

PHYSICAL SOCIETY, at 5.—On the Measurement of Mutual Inductance by the Aid of a Vibration Galvanometer: A. Campbell.—Note on the Rate of Decay of the Active Deposit from Radium: W. Wilson and W. Makower.—Exhibition of Apparatus for Relay Working of Long Submarine Telegraph Cables: S. G. Brown.

MONDAY, MAY 27.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.

SOCIOLOGICAL SOCIETY, at 8.—Functional Relations of the Family and the City: Dr. W. Leslie Mackenzie.

VICTORIA INSTITUTE, at 4.30.—Mencius: Rev. F. S. Turner.

TUESDAY, MAY 28.

ROYAL INSTITUTION, at 3.—Malaria, Sleeping Sickness, Tick Fever, and Allied Diseases: Prof. G. H. F. Nuttall, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.

SOCIETY OF ARTS, at 8.—Sheffield Plate and Electro Plate: Sherard Cowper-Coles.

FARADAY SOCIETY, at 7.50.—Annual General Meeting.—At 8.15.—Contributions to the Chemistry of Gold: F. H. Campbell.—Reduction of Oxides, Sulphides, &c., by Means of Metallic Calcium: Dr. F. Mollwo Perkin.—Exhibit of Thermostatic Apparatus: Dr. T. M. Lowry.

WEDNESDAY, MAY 29.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.—Mr. C. Michie Smith on his Work at Kodaikânal.

SOCIETY OF ARTS, at 8.

THURSDAY, MAY 30.

ROYAL SOCIETY, at 4 30.—*Probable Papers*: The Solubility of Air in Fats, and its Relation to Caisson Disease: Dr. H. M. Vernon.—Mitosis in Proliferating Epithelium: Dr. J. O. Wakelin Barrett.—An Experimental Inquiry into the Nature of the Substances in Serum which Influence Phagocytosis: George Dean.—The Correlation of Ovarian and Uterine Functions: E. S. Carmichael and F. H. A. Marshall.

ROYAL INSTITUTION, at 3.—Chemical Progress—Work of Berthelot, Mendeléeff, and Moissan: Sir James Dewar, F.R.S.

SOCIETY OF ARTS, at 4.30.—Irrigation Colonies in India: Laurence Robertson.

FRIDAY, MAY 31.

ROYAL INSTITUTION, at 9.—Recent Journey Across Africa: A. Henry Savage Landor.

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