

president of the Royal Horticultural Society; Prof. J. Bretland Farmer; Prof. Keeble; Lady Northcliffe; and Viscountess Falmouth, chairman of the governing body, Swanley College. Donations may be sent to Messrs. Child and Co., 1 Fleet Street, London, E.C.4. Ten thousand pounds is needed at once, and 50,000l. for the complete installation of the science department and for the reconstruction of the college and of the intensive training grounds.

Societies and Academies.

LONDON.

Physical Society, May 14.—Sir W. H. Bragg, president, in the chair.—Dr. F. Lloyd Hopwood: Experiments on the thermionic properties of hot filaments. The experiments shown were some of those described by Dr. Hopwood in the *Philosophical Magazine* for March, 1915, p. 362, in which the glowing filament of a carbon lamp and glowing filaments of nichrome and platinum in air are made to move under the influence of positively and negatively charged rods brought into or withdrawn from their vicinity, the character of the effects observed being such as to give a qualitative indication of the thermionic emission from the filaments. In addition, he showed a type of tilted electrocope in which the gold-leaf was replaced by a narrow loop of Wollaston wire. When a current is passed through the wire so as to make it glow, it forms an electrocope of different sensitivity for +ve and -ve charges.—G. D. West: A modified theory of the Crookes radiometer. The paper gives a short account of a theory of the Crookes radiometer worked out by Sutherland in 1896, but, unfortunately, much neglected. The theory as it stands will not explain many radiometric phenomena, but it is shown that when modifications depending on the modern knowledge of thermal surface conditions are made, such explanations become possible. Radiometer action, especially at the higher gas pressures, would appear to depend essentially on the formation of gas currents near the radiometer vane. These currents are distinct from convection currents, but are closely associated with the phenomena of thermal transpiration.—A. Campbell: The magnetic properties of silicon iron (stalloy) in alternating magnetic fields of low value. Measurements are described of the hysteresis losses in silicon iron sheet and wires in very low alternating magnetic fields at low and telephonic frequencies, using an alternating-current method described in a former paper. The equations giving the hysteresis losses as a function of B_{max} are deduced in the case of the sheet material at low frequencies for ranges of H_{max} from 0.0002 to 0.02. Comparisons are made between sheet material and wires of different diameters, and curves are given showing the great improvement in the permeability of wires when they are annealed. The behaviour of the material is studied, both by ballistic tests and at telephonic frequencies, as regards the alternating field when direct-current fields of various values are applied at the same time.—T. Smith: Tracing rays through an optical system. Equations for tracing rays in an axial plane through an optical system have the normal refraction terms separated from those representing aberrations. By expressing the latter as a fraction with the first-order aberration as the numerator and a correcting factor, which may take various forms, as the denominator, rays may be traced exactly through the system, using a short table of cosines in terms of sines in place of the extensive tables, giving sines in terms of angles generally employed. A considerable saving of time is effected in the calculations, and the estimation, without calculation, of the aberrations of other rays is facilitated.

NO. 2641, VOL. 105]

Geological Society, May 19.—Mr. R. D. Oldham, president, in the chair.—Dr. H. H. Thomas, with chemical analyses by E. G. Radley: Certain xenolithic Tertiary minor intrusions in the Island of Mull (Argyllshire). The paper deals with a series of minor intrusions, generally tholeiitic but occasionally composite in character, which are well represented in the western peninsula of Mull, lying between Loch Scridain and Loch Buie, and are remarkable for the number and mineralogical peculiarities of the xenoliths that they contain. Xenoliths of a highly siliceous nature (quartzites, sandstones, etc.) are met with, but more commonly the inclusions are of a type rich in alumina (shales and clays). Cognate xenoliths of noritic and gabbroic affinities occur in several of the intrusions, and these, together with the accidental siliceous xenoliths, are briefly described; but the communication deals more particularly with the aluminous inclusions which are crowded together in most of the intrusions, range up to several feet in diameter, and are characterised by well-crystallised minerals such as sapphire, spinel, sillimanite, cordierite, and anorthite. These xenoliths offer the clearest evidence of the modification of a more or less pure aluminous sediment by permeation of magmatic matter, more particularly by the diffusion of lime, ferrous iron, and magnesia. It is held from the evidence afforded by the xenoliths that the metamorphism is of a deep-seated character, and has been effected by a tholeiitic magma on the walls of its basin, which were composed mainly of aluminous sedimentary rocks.

CAMBRIDGE.

Philosophical Society, May 3.—Sir Ernest Rutherford, vice-president, in the chair.—W. J. Harrison: Notes on the theory of vibrations. (1) Vibrations of finite amplitude. (2) A theorem due to Routh. Rayleigh determined, in trigonometric form, the approximate effect of small terms varying as the square and cube of the displacement in the equation of simple harmonic motion. In the former of these notes exact Fourier series are determined by the theory of elliptic functions, and tables are computed. The latter note relates to the theorem that an increase of inertia of any part of a vibrating system increases all the periods in such a way that the new periods are separated by the original periods. If the effect of the increased inertia be represented by an addition to the kinetic energy of the square of a linear function of the velocities, it is pointed out that the theorem does not hold unless this linear function involves all the velocities.—W. Burnside: On cyclical octosection. The complete solution of the problem of cyclical quartisection was first given by V. A. Le Besgue in *Comptes rendus*, vol. li., 1860, without proof; he forms the quartic equation satisfied by the sum of $\frac{1}{4}(p-1)$ distinct primitive p th roots of unity, p being a prime number of the form $4n+1$. If $p=L^2+4M^2$, where $L \equiv 1 \pmod{4}$, the equation involves p and L , being

$$\{y^2 + p[2(-1)^{\frac{p-1}{4}} - 1]\}^2 = 4p^2 y - L^2,$$

where y is one more than four times the sum in question. The only proof as yet published appears unnecessarily long. The present paper deals with the case when p is a prime of the form $8n+1$; it forms and solves the equation satisfied by the sum of $\frac{1}{4}(p-1)$ distinct primitive p roots of unity, which is capable of eight values, by a method capable of extended application. Expressing p in both the forms a^2+b^2 , $a'^2+2b'^2$, this equation involves p , a , and a' .—Dr. G. F. C. Searle: (1) A bifilar method of measuring the rigidity of wires. The upper ends A, C of two equal

wires are attached to two torsion heads, and the lower ends B, D to a bar loaded with a considerable mass. When the wires are free from torsion, they are in a vertical plane. The distances $AC=2a_1$, $BD=2a_2$, are nearly equal. If the torsion heads are turned through ϕ from their zeros, the bar will turn through θ in the same direction, until the bifilar couple balances the couple due to the torsion of the wires. Then $\sin \theta=C(\phi-\theta)$, where C is, for practical purposes, independent of ϕ and θ . By observing θ and ϕ , C is found. Then, if r is the mean radius of the wires and M the load supported by them, the rigidity, n , is given by

$$n = \frac{g^2 a_1 a_2}{\pi r^4} \cdot MC.$$

A damping device is provided so that steady readings can be obtained in a room subject to vibration. Bends in the wires near the upper ends have the same effect as if the points A, C described small horizontal circles. Errors due to this cause are eliminated by a rough harmonic analysis. (2) An experiment on a piece of common string. When a mass M is suspended by a piece of common string from a fixed support, it begins, when set free, to rotate about the axis of the string. The string, therefore, exerts a couple, G, on the body, and the relation of this couple to M is studied in the experiment. If, starting from rest, the body makes n revolutions in time t , the angular acceleration α , assumed constant, is given by $\frac{1}{2}\alpha t^2 = 2\pi n$. If K is the moment of inertia of the body, $G=K\alpha$. If the length of the string is of the order of 2 metres, the angular acceleration is approximately uniform for at least the first 10 or 20 revolutions. The load is supplied in the form of a number of equal inertia bars which can be threaded on a light rod carried by the string. Then K is practically proportional to M. It is found that the time for, say, 10 revolutions from rest is nearly constant. Hence G is nearly proportional to M. (3) Experiments with a plane diffraction grating, using convergent light. A lens forms a real image B of a vertical slit S illuminated by sodium light. A plane diffraction grating, with its rulings vertical, is placed between the lens and B, so that the vertical central plane of the beam, which cuts the grating in O, makes an angle θ with the normal to the grating, and $BO=u$. If C is one of the "real" diffracted images of order p , and if CO or v makes an angle ϕ with the normal, then

$$u \sec^2 \theta = v \sec^2 \phi \dots (1)$$

If the grating interval is d , the wave-length is given by

$$p\lambda = d(\sin \phi - \sin \theta) \dots (2)$$

In the experiment the relation (1) is tested, and the wave-length is found by (2). The images are received on a glass scale moving along an optical bench, the length of the scale being horizontal and perpendicular to the bench.—Major P. A. MacMahon: Congruences with respect to composite moduli. This paper deals with the primitive roots of the binomial congruence the exponent of which is any divisor of the totient of a composite modulus. Numbers being divided into categories according to the number of their different prime divisors, tables of primitive roots are given for the cases of the second and third categories.—A. Kienast: Equivalence of different mean values. This is a continuation of a former paper by the author, and deals with the equivalence of conditions for the existence of the limit of the mean sum of a continually increasing number of terms.—Prof. H. F. Baker: Construction of the ninth intersection of two cubic curves passing through eight given coplanar points. Let A, B, C, M, N and P, Q, R be the given points; take T external to their plane; let TP, TQ, TR meet a quadric containing

A, B, C and the lines TM, TN, in further points P', Q', R'; let the twisted cubic curve through T, A, P', Q', R' which has BC for chord meet the quadric again in O'; then TO passes through the required ninth point.—W. E. H. Berwick: Quintic transformations and singular invariants. This paper deals with the arithmetical solution of a certain sextic equation arising in the theory of modular functions, the coefficients of which are functions of a certain algebraical number. The arithmetical character of the number of fields which arise is determined in detail.

MANCHESTER.

Literary and Philosophical Society, May 4.—Mr. William Thomson, vice-president, in the chair.—Major T. Cherry: The origin of agriculture. The annual flood-cycle of the Nile provided perfect conditions for the growth of cereals. Since none other of the great rivers on the banks of which civilisation first appeared afforded such natural possibilities for the growth of cereals, it was claimed that man must have learned in Egypt irrigation and the cultivation of cereals. The author, in discussing the origins of wheat and barley, claimed that the originals of our cultivated barley probably evolved in the Nile Valley, and those of our wheat on one of the islands of the Ægean Archipelago.

Literary and Philosophical Society (Chemical Section), April 30.—Mr. J. H. Lester, chairman, in the chair.—Dr. J. A. R. Henderson: Alchemy and chemistry among the Chinese. The early objects of the alchemists were discussed, and their discoveries in metallurgy, mineralogy, and botany detailed. The latter included the manufacture of pigments, lacquers, porcelain, paper, and the early discovery of the explosive properties of gunpowder. The exploitation of vast coal deposits and of iron and other metallic ores, and the production of oils and medicinal substances, are taking place.

May 14.—Mr. J. H. Lester, chairman, in the chair.—Prof. F. L. Pyman: The relation between chemical constitution and physiological action.

DUBLIN.

Royal Irish Academy, May 10.—The Most Rev. the Right Hon. J. H. Bernard, president, in the chair.—J. N. Halbert: Acarina of the Intertidal Zone. The various forms, several of which are new to science, were studied in their relation to the well-known zones, or belts, of the orange lichen, *Pelvelia*, and *Fucus* usually present, where there is sufficient foothold for them, on the sea-shore. Excluding the families Halacaridæ and Hydrachnidæ, the species are distributed in the four terrestrial families as follows: Gamasidæ 28, Oribatidæ 17, Tyroglyphidæ 2, and Trombididæ 18.—Miss Jane Stephens: The fresh-water sponges of Ireland. The fresh-water sponges of Ireland number only five species. Their habitat, mode of growth, and distribution are discussed. Among the points of interest are the following: It has been found that the sponges do not occur in mountain streams, unless there is a lake, however small, in the course of the stream, and that, on the other hand, they occur most luxuriantly in a stream just below its exit from a lake. One species avoids the limestone areas. The variations of the commoner species are traced at some length. The paper is illustrated by numerous drawings of spicules and by maps showing the distribution of the species.—T. A. Stephenson: The genus *Corallimorphus*. *Corallimorphus* is a genus of deep-sea Actiniaria, first described by Moseley in 1870, and later by Hertwig in 1882 and 1888. There are two specimens of *C. rigidus* in the collection of anemones made by the Fisheries Branch

of the Department of Agriculture and Technical Instruction for Ireland from 1899 to 1913. These specimens are described externally and anatomically in the paper, and compared with the eight other specimens described by Moseley and Hertwig. The possibility of all these specimens belonging to one species is suggested and discussed, with the conclusion that it is quite likely that the genus contains one variable species only. On the other hand, further material is required for a final decision, and if the three species, *C. rigidus*, *profundus*, and *obtectus*, should prove valid, the Irish specimens would probably require a fourth species. It is further pointed out that the thick and rigid body of the anemones in question seems to be correlated with deep-sea life, and that although the genus has sometimes been regarded as a primitive one, it has a number of characteristics which it would seem can be considered only as specialisations or advanced features.

PARIS.

Academy of Sciences, May 25.—M. Henri Deslandres in the chair.—E. Goursat: Some transformations of partial differential equations of the second order.—G. Bigourdan: The instruments and work of the Sainte-Geneviève Observatory: Historical account of the work of Pingré and of Lechevalier done between 1755 and 1836.—J. Bossert: Catalogue of the proper motion of 5671 stars, annotated and published by L. Schulhof.—J. Baillaud: The method of the scale of tints in photographic photometry.—C. Guichard: Congruences belonging to a linear complex such that the lines of curvature correspond on the two focal surfaces.—G. Julia: Families of functions of several variables.—M. Janet: Systems of partial differential equations and systems of algebraic forms.—G. Sagnac: The real relativity of the energy of the elements of radiation and the motion of waves in the æther.—F. Viès: Ultra-violet spectrophotometry of the nitrophenols. Seventeen nitro-derivatives were examined and the spectra found to be, in general, constituted of three elements: a constant band, due to the NO₂ group; a band related to the presence of the benzene ring; and a third band the origin of which is doubtful.—M. de Broglie: The fine structure of X-ray spectra. Details of a doublet given by rhodium, and comparison with the K spectrum of tungsten.—J. L. Pech: Phenomena of antagonism between various radiations (ultra-violet, visible spectrum, and infra-red).—L. Thielemans: Regulation of cables for the transport of electrical energy to long distances.—P. Bunet: The transport of energy to great distances. Remarks on a recent communication by M. Brylinski on the same subject.—M. Toporescu: The lime and magnesia carried down by precipitates of ferric oxide. Varying weights of ferric oxide were precipitated in presence of constant quantities of calcium and magnesium salts, and the proportions of lime and magnesia carried down were determined. A second precipitation of the ferric oxide is sufficient to remove calcium salts, but this is not the case with magnesia.—L. Guillet and M. Gasnier: The plating with nickel of aluminium and its alloys. The aluminium or alloy is cleaned and roughened by sand-blasting, and then takes a satisfactory deposit of nickel. The influence of the size of the sand grains and the time elapsed between the sand-blasting and the deposit have been examined, and results are given.—A. C. Vournazos: A new series of complex combinations: the antimony oxydides. The mercury compound may be taken as a type of these substances; it has the composition Hg(ShIO₃).—R. Cornubert: The constitution of some dialkylcyclohexanones. A study of the ketones obtained by treating cyclohexanone with sodium and then with alkyl halides.—C. Dufraisse:

The stereo-isomeric forms of benzoylphenylacetylene di-iodide. The conditions under which either of the two isomers can be isolated are given.—A. Mailhe: The catalytic hydrogenation of the ketazines.—L. Moret: The tectonic of the eastern bank of Lake Annecy.—A. Brives: Some results of a new journey in Morocco. A completion of geological work commenced in 1919.—P. Bonnet: The Permo-Triassic limit in the Himalayan-Armenian geosynclinal.—L. Dunoyer and G. Reboul: The prediction of the weather.—G. Truffaut and H. Bezssonoff: The influence of partial sterilisation on the composition of the microbial flora of the soil.—R. Souèges: The embryogeny of the Solanaceæ. Development of the embryo in Hyoscyamus and Atropa.—P. Bertrand: The constitution of the vascular system in ferns, in Pteridosperms, and in all ancient Phanerogams.—L. Blaringhem: The stability and fertility of the hybrid *Geum urbanum* × *G. rivale*. From the morphological point of view the descent of this hybrid is uniform and regularly fertile. Its mixed characters are sufficiently distinct from those of its parents to give a precise diagnosis, and as it propagates without variation in the wild state it can be described as a good systematic species.—J. Feytaud: The kings and queens of *Leucotermes lucifugus*.—A. Mayer, A. Guieysse, and E. Fauré-Fremiet: Pulmonary lesions determined by suffocating gases.—A. Trillat and M. Mallein: The projection of micro-organisms into the air. The influence of humidity.

Books Received.

- Calcutta University Commission, 1917-19. Report. Vol. vi. Appendices and Index. Pp. vii+341+plates. (Calcutta: Superintendent, Government Printing, India.) 1 rupee or 1s. 6d.
- A Monograph of the British Orthoptera. By W. J. Lucas. Pp. xii+264+xxv plates. (London: The Ray Society.) 1l. 5s. net.
- The British Charophyta. By J. Groves and Canon G. R. Bullock-Webster. Vol. i. Nitelleæ. Pp. xiv+141+xx plates. (London: The Ray Society.) 1l. 5s. net.
- Ozone. By Prof. E. K. Rideal. Pp. ix+198. (London: Constable and Co., Ltd.) 12s. net.
- Thomas Henry Huxley. By Dr. L. Huxley. Pp. vii+120. (London: Watts and Co.) 3s. 6d. net.
- Auguste Comte. By F. J. Gould. Pp. v+122. (London: Watts and Co.) 3s. 6d. net.
- Is Spiritualism Based on Fraud? By J. McCabe. Pp. vii+160. (London: Watts and Co.) 3s. net.
- The Systematic Treatment of Gonorrhœa in the Male. By N. Lumb. Second edition. Pp. viii+123. (London: H. K. Lewis and Co., Ltd.) 5s. net.
- Optical Projection. By Lewis Wright. Fifth edition. Rewritten and brought up to date by R. S. Wright. In two parts. Part i.: The Projection of Lantern-Slides. Pp. viii+87. (London: Longmans and Co.) 4s. 6d. net.

Diary of Societies.

THURSDAY, JUNE 10.

- INSTITUTION OF MINING ENGINEERS (at Geological Society), from 11 a.m. to 5.—(General Meeting.)—Prof. H. Louis: Compensation for Subsidence.—W. Maurice: The Fleissner Singing-flame Lamp.—W. Maurice: The Wolf-Pokorny and Wiede Acetylene Safety-lamps.—G. Oldham: The "Oldham" Cap Type Miner's Electric Safety-lamp.—Discussion on First Report of the Committee on "The Control of Atmospheric Conditions in Hot and Deep Mines."—D. S. Newby: A New Method of Working Thick Seams of Coal at Baggeridge Colliery.—T. G. Bocking: Protractors.—T. G. Bocking: Magnetic Meridian Observations: A Method of Utilising the Kew Observatory Records.
- ROYAL SOCIETY, at 4.30.—Prof. A. V. Hill and W. Hartree: The Thermo-Elastic Properties of Muscle.—Sir James Dobbie and J. J. Fox: The Absorption of Light by Elements in the State of Vapour: (1) Selenium and