

The Molecular Energy in Gases.

BY request of the council of the Royal Society of Edinburgh, an address on "Molecular Energy in Gases" was delivered on May 3 by Principal Sir Alfred Ewing, who began by referring to a series of papers on the foundations of the kinetic theory which were communicated to the society thirty years ago by a great teacher and a great master of the subject, Prof. Tait. Since those days the kinetic theory had received what might be called ocular demonstration through Perrin's investigation of the Brownian movements, which exhibited the buffeting of visible bodies by the blows of the molecules. Much had come to be known regarding the probable structure of the atom. There had been substantial advances in the study of specific heats of gases and of their absorption and emission of heat in the form of infra-red rays. But the difficulty referred to by Tait of reconciling the known facts about specific heat with the theory of the equipartition of energy, as developed by Maxwell and Boltzmann, still remained, and had led to various applications or extensions of Planck's quantum theory, not only to the vibrations of gaseous molecules, but also to their rotations.

Some of these applications of the quantum theory appeared to the lecturer to be highly artificial, and also unnecessary. He proceeded to discuss the correspondence between the observed values of the specific heats and those that might be expected by applying ordinary dynamics to the translations and rotations of the molecules of a gas, and pointed out that the results presented a consistent scheme, which had, however, to be supplemented by taking account of the energy of vibration, especially at high temperatures. Vibratory energy became developed in a manner which was clearly not consistent with the principle of equipartition. It was now known that in all except monatomic gases the specific heat became notably increased at high temperatures, when the vibrations within the molecules began to be an important part of the whole energy. The experimental facts as to this increase were no doubt well expressed by means of Planck's quantum formula, but the type of curve which it gave was one that was found in other departments of physics. It was therefore open to question whether, if the nature of the constraints were understood, the development of vibratory energy in the molecules might not be interpreted in terms of other ideas than those of quanta, and without disturbing the old-fashioned principles of Newtonian dynamics.

University and Educational Intelligence.

BIRMINGHAM.—In common with other universities, that of Birmingham has been overcrowded with students during the past session, and, in order that the necessary arrangements may be made to accommodate the maximum number for the ensuing year, public notice has been given that intending students should make application for entry not later than June 30. Already temporary buildings are being erected to cope with the certain increase in number of second-year students. The problem of adapting the number to be admitted to the available accommodation is undoubtedly difficult, but any method of restriction adopted will be devised with the object of securing admission to the fittest.

CAMBRIDGE.—Announcement is made in the *Times* that the directors of the Commercial Union Assurance Co. have allotted the sum of 165,000*l.* for a building of biochemistry, on a site provided by the University,

for the provision of adequate incomes for the professor and his staff and for the endowment of research.

LIVERPOOL.—At a meeting of the Senate of the University held on June 2 the following resolution was passed: "The Senate records with profound regret the death of Prof. Leonard Doncaster, F.R.S., Derby professor of zoology in the University. But a short time in Liverpool, Prof. Doncaster had taken a prominent place in the University, serving on the University Council as representative of his faculty, and had added to the reputation of the University by his contributions to science, and notably by his text-book upon cytology, published within the last few weeks. As colleague and friend he will be mourned by all members of the University. To Mrs. Doncaster and the members of his family the Senate would offer its most sincere sympathy."

THE Ramsay Memorial Trustees will proceed to the election of not more than three fellows at the end of this month. Applications must be received not later than June 15. Application forms, containing full particulars of the award, can be obtained from the Organising Secretary of the Ramsay Memorial Fund, University College, London. The fellowships are of the value of 300*l.* a year each, and tenable for two years. They are for the advancement of chemical research.

THE annual vacation course in Snowdonia for field-work in geography, geology, botany, map-making, and regional survey methods is being held under the auspices of the Geographical Association on August 7-21, with Llanberis as a centre. Particulars of the arrangements may be obtained by sending a stamped addressed envelope to Mr. H. Valentine Davis, "Noddfa," Wistaston, Crewe. The course is primarily intended for teachers of geography in public and other secondary schools.

LORD ERNLE presided at a meeting held last week at Chelsea House, Cadogan Square, to establish the training of women as skilled scientific cultivators on a national basis. In recognition of the magnificent work achieved, especially during the war, by Swanley Horticultural College in increasing every class of home-grown foods, and also in food preservation, the Ministry of Agriculture proposes to allot a Treasury grant of 10,000*l.* for the re-equipment and further development of this unique training college, provided the public contributes an equal sum. Never has the national need for scientific food production on one hand, and for remunerative and healthy employment for educated women on the other, been greater. Swanley has full capacities for carrying out both these works of national importance once the ravages of five years of war-shortages have been repaired, and the urgently needed new laboratories, lecture-rooms, library, and students' hostels have been erected and equipped. The great demand for women workers in agriculture and horticulture is proved by the fact that the applications from employers for Swanley students rose from 130 in 1914 to 648 in 1918. Prof. Keeble, of Oxford University, pointed out that the future cultivation of England would become more and more intensive, and that this intensive cultivation is now of the greatest national value, significance, and economic justification. Plans for the new science buildings at Swanley are now ready and the site is selected. It only remains for the public to provide the 10,000*l.* required to secure the Treasury grant for this urgent work of national utility. The appeal recently issued is signed by Lord Ernle, late President of the Board of Agriculture and Fisheries; Lord Lambourne,

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. ii., 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