

Societies and Academies.

LONDON.

Royal Society, December 4.—A. Fowler: The structure of the spectrum of ionised nitrogen. New observations of the second line spectrum of nitrogen (N II or N⁺) have been made in the region $\lambda 6650$ to $\lambda 2200$, and 52 lines have been classified. In this region, all the terms which have been identified belong to singlet or triplet systems. These have been found to combine with each other in agreement with the selection rules which are applicable to other spectra in which p' and d' terms appear. The absolute values of the terms cannot yet be stated, but a value of 70,000 has been provisionally assigned to $2p$, in accordance with the value suggested for $1p$ by astrophysical data. The largest term identified is a p term, and it may be inferred that the series electron in singly ionised nitrogen normally occupies a 2_2 orbit, so that the atom of N II has two electrons in 1_1 orbits, two in 2_1 and two in 2_2 orbits. It is also the probable arrangement of orbits in the neutral atom of carbon, the spectrum of which has not yet been resolved into series. Three groups of lines which involve one of the p terms are remarkable as showing large displacements ($> 0.5 \text{ \AA}$) to the red in vacuum tubes containing nitrogen at relatively high pressures.—H. Jeffreys: On the formation of water waves by wind. The wind presses more strongly on the slopes of the waves facing it than on the sheltered slopes, and when the resulting tendency of the waves to grow is just able to overcome viscosity, waves are first formed. A numerical constant in the theory can be adjusted to make the wind velocity required to produce waves agree with observation; and when this is done the predicted wave-length of the waves first formed agrees with observation without further assumption. To account for the skin friction of the wind over the seas as the resultant drag due to the horizontal thrust of the wind on the exposed sides of the waves, wave velocity must be about three-quarters of the wind velocity, which is in accordance with observation. The formation of waves with such a velocity, however, appears to require values of the eddy-viscosity much smaller than are indicated by observations of ocean currents.—J. E. Jones: (1) On the determination of molecular fields. III. From crystal measurements and kinetic theory data. With the information obtained about argon in earlier papers from its properties as a gas, theoretical calculations are made of the interatomic distances to be expected in argon as a crystal. Crystalline argon has recently been obtained, and its structure measured and examined, and it is thus possible to fix the molecular field of argon. Theoretical calculations are also made of interatomic distances in potassium chloride and calcium sulphide which are in good agreement with observations. (2) On the atomic fields of helium and neon. The atomic field of helium is determined from measurements on its isotherms and viscosity, that of neon from measurements of its viscosity, and heat conduction and the crystal constants of sodium fluoride and magnesium oxide.—F. S. Tritton: A centrifugal method of making small pots of electrically fused refractory materials. A method is described of making small pots of refractory materials (magnesia, alumina, zirconia, and tungsten metal) by electric arc fusion combined with centrifugal action. The material, shrunk by previous fusion and finely powdered, is placed in a silica cup and a deep central depression is made in the powder. Two graphite electrodes fit closely into this depression. In the case of alumina or zirconia, in order to prevent the formation of carbides, a stream of oxygen is blown

between the electrodes and the refractories during fusion. Pots of fused magnesia made in this way have been successfully used for holding molten iron oxide, which penetrates all other known refractories.—J. W. Nicholson: Spheroidal wave functions. The paper develops a new class of solutions of the equation of wave motion, in oblate spheroidal co-ordinates, satisfying boundary conditions which can be made identical with corresponding conditions in problems of solutions of Laplace's equation. The new solutions are not of the form of products of functions of single "normal" co-ordinates appropriate to the spheroid, but they nevertheless can be applied readily to the exact solution, without the use of harmonic series, of problems of diffraction of waves by circular discs.—J. V. Howard and S. L. Smith: Recent developments in tensile testing. When a steel test piece is pulled beyond a limiting stress, the removal and re-application of the load causes a loop to be traced in the load-extension diagram recorded by the Dalby autographic load-extension recorder. The extension which occurs when a loop is being traced is analysed into a proportionally elastic portion and a non-proportionally elastic portion (recoverable slip) which depends only on stress. Permanent set is the ultimate cause of rupture, and is caused by the act of looping. The stress required to produce a standard mean loop-width provides a means of comparing different steels as regards that property of the metal which is revealed by this method of testing. Under certain conditions of heat treatment and composition, no recovery takes place at ordinary temperatures; nor does steel recover if left in a state of stress.—F. C. Harris: The photo-elastic constants of glass as affected by high temperatures and by lapse of time. The stress-optical coefficients of several glasses, of known chemical composition, at different temperatures up to 400°C ., with only one exception, show a general increase with rise of temperature. The exception was an extra dense flint, containing a high percentage of lead. The stress-optical coefficients increase comparatively rapidly during the first year or two after being cast, and finally settle down to a steady value.—A. L. Narayan and D. Gunnaiya: Absorption and dispersion of thallium vapour. The non-luminous vapour of thallium absorbs lines of sharp and diffuse series. At about 900°C . a number of bands of diffuse and complex structure, and some lines, made their appearance, probably due to Ti_2 molecules. The vapour does not exhibit any selective absorption in the region 0.9μ to 1.35μ , and that therefore $1, \pi_2 - 1, \pi$, is not the single-line spectrum of the metal. The work confirms the findings of H. Geisler and Prof. McLennan, that at $\lambda 5350.6$ the vapour exhibits anomalous dispersion, though feebly. Further, the experiments indicate more prominently the existence of anomalous dispersion at $\lambda 3775.7$.—R. d'E. Atkinson: Note on Vegard's theory of the aurora. The presence of solid nitrogen would not account for auroræ at great heights since (1) there probably cannot be a strong enough field to lift crystals; (2) the volume charge they would carry would be impossibly large if enough light were to be obtained; (3) the largest crystals that could be lifted would probably be completely vaporised by one electronic impact; (4) solid nitrogen probably cannot emit a narrow line. The possibility of low enough temperatures is disproved. The experimental evidence of Vegard is inconclusive. Two alternatives, in which the aurora is explained as a purely gaseous luminescence, are outlined, and the possibility that the gas might be oxygen instead of nitrogen (so far as 5578 is concerned) is discussed.—M. Weinberg: The spark spectra of indium and gallium in the extreme

ultra-violet region. The spark spectra were examined in both quartz and vacuum-grating regions. Since they oxidise very easily in air, their spectra in the quartz region were taken in hydrogen. There are altogether 107 indium lines in the quartz region, some of which are extremely faint. They extend over a range of 1855 to 2337 A.U. There are fewer gallium lines in this region. These range over 1855 to 2364 A.U. Both elements in the vacuum grating spectrograph show a great mass of lines in the extreme ultra-violet. On elimination of the impurities, however, it was found that there were 828 gallium lines ranging over region 157-2059 A.U., and 464 indium lines ranging over 161-2082. In gallium there were a few very faint lines extending so far down into ultra-violet as $\lambda = 126.8$ A.U.—S. W. Richardson: The general law of electrical conduction in dielectrics.—T. Lewis: The interpretation of the results of Bucherer's experiments on e/m . The whole of the traces obtained by Bucherer in his e/m experiments may be used in order to verify the mass formula for the electron. The experimental traces confirm the validity of the Lorentz formula for high velocities provided electrons with these high velocities are emitted in sufficient number to produce the desired photographic effect. Electrons must be emitted with velocities up to at least 0.94 of the velocity of light. This is higher than the velocities recorded by Ellis up-to-date, but well within the range observed by Danysz.—A. M. Mosharafa: On the quantum dynamics of degenerate systems. A set of quantum restrictions is suggested for degenerate conditionally periodic systems, in the form $Y_j = \tau_j h$, where Y_j is a specified "adiabatic invariant." The conditions are applied to the case of the hydrogen atom in the presence of an external electric field and lead to the adoption of "half-integral orbits" in the Stark effect. The origin of fractional quantum numbers is to be sought in the mechanism of degenerate systems.—E. G. Dymond: On the precise measurement of the critical potentials of gases. Automatic differentiation of the characteristic curves increases the sharpness of the bends in them. The reasons for the divergence of the value found for the first excitation potential of helium, 20.9 volts, from that calculated from the optical data, are discussed.—I. Langmuir and K. H. Kingdon: Thermionic effects caused by vapours of alkali metals. At high filament temperatures, positive ion emission becomes limited by the rate at which vapour comes into contact with the filament, all atoms striking the filament being converted into ions. This permits quantitative measurements of vapour pressure to be made. At lower filament temperature, electric image force causes a fraction θ of filament surface to be covered by a layer of adsorbed ions, which share electrons with the underlying metal. The resulting double layer causes increase in electron emission and corresponding decrease in positive ion emission. Electron emissions of more than 0.3 amp. per cm.² at 1000° K. may be obtained in caesium vapour 30° C. The theory of dilute adsorbed films ($\theta < 0.2$) is developed. Equation of state for adsorbed film is found to correspond to ideal gas laws. For more concentrated films, attractive forces draw the ions together, and under certain conditions separate 2-dimensional phases appear. Heat of evaporation of adsorbed caesium atoms on tungsten in the form of ions corresponds to 4.0 volts for dilute and 4.3 for concentrated films. From adsorbed oxygen on tungsten, heat of evaporation of caesium ions is 5.1 volts.—C. Tate Regan: Dwarfed males parasitic on the females in oceanic angler-fishes (*Pediculati Ceratioidea*). Dwarfed males parasitic on the females are described in *Cerantias* (female, 1000 mm., male,

105 mm.) and *Photocorynus* (female, 65 mm., male, 10 mm.). Outgrowths from snout and chin of the male unite in front of the mouth and fuse with a papilla of the female. The skin of the two fishes is continuous, and beneath it the outgrowths of the male and the papilla of the female consist of highly vascular fibrous tissue: the blood systems of the two are continuous, a unique type of parasitism. In the male, teeth are absent and the gut is vestigial. Other ceratioids examined are all immature females: no free-swimming males are known in the group. The ceratioids are bathypelagic, piscivorous, solitary, and sluggish: they float about in the darkness of the middle depths of the ocean. It is suggested that the difficulty experienced by mature fish in finding a mate led the immature males to attach themselves to the females at the first opportunity, with the result that in the end the males became dwarfed and parasitic.

Royal Microscopical Society (Industrial Applications Section), October 22.—R. H. Greaves: Super-saturated solid solutions. In many alloy systems, the limit of saturation of the α solution decreases with fall of temperature. This is so with a group of ternary alloys of copper and aluminium with nickel, also with manganese and with other elements. These α solid solutions can be obtained in the super-saturated condition at atmospheric temperature by quenching. Subsequent heat treatment hardens the alloy by precipitating the excess of the dissolved constituent. To obtain maximum hardness, the whole of the excess must be precipitated in extremely fine particles (critical dispersion). These are far below the limit of visibility under the microscope (0.25 μ or 1000 atoms diameter). This does not seem possible with the alloys mentioned, since a treatment which ensures complete precipitation at the same time induces coalescence. It is possible, however, in aluminium alloys and is illustrated by the ageing of duralumin, and some other alloys containing magnesium, at atmospheric temperature. Increased resolving power would enable the study of the precipitated particles into the region of the critical dispersion, but it has been possible to interpret the structure by inference from other tests, and the practical problem of correct heat treatment has therefore not been delayed.

Faraday Society, November 17.—A. P. Laurie: Note on the expansion of water while freezing. Assuming that the atomic diameters based on Bragg's crystal model for ice are true for liquid water, and that liquid water at 0° is a trihydrol, it follows as a geometrical necessity that there will be an expansion from 1 to 1.088 when ice melts. This gives a sp. gr. for ice of 0.918; and the experimental value is 0.917, thus confirming the original assumptions.—R. W. E. B. Harman and F. P. Worley: The hydrolysis of alkali cyanides in aqueous solution. The vapour pressure of hydrogen cyanide over solutions of potassium cyanide was compared with that over solutions of hydrocyanic acid, and it is shown that the degree of hydrolysis of sodium cyanide at 25° at all concentrations is the same as that of potassium cyanide. The effect of temperature was also studied. The constancy of the hydrolytic constants at different concentrations at each temperature, the agreement of the values at different temperatures with the Van't Hoff isochore, and the agreement between the calculated heat of hydrolysis and the measured heat of neutralisation appear to confirm the accuracy of the values arrived at for degree of hydrolysis at the various concentrations and temperatures employed.—S. S. Joshi: Viscosity of reversible emulsions.

Viscosities of water-in-oil emulsions prepared from castor oil, olive oil, and paraffin oil by means of four monovalent soaps are determined. Viscosity increases with increase of the dispersed phase and is a maximum at the reversal point, which is followed by a sudden drop in viscosity upon inversion. The concentration and the specific chemical nature of the emulsifying agent have no effect on the viscosity of the emulsion. Hatschek's equation for the viscosity of the emulsoids is not followed; observed viscosities are in approximate agreement with those estimated by Einstein's equation for suspensoids; Arrhenius' equation applies better still. The size of the grains of the water-in-oil emulsions may increase with increase in the proportion of the aqueous phase.—D. B. Macleod: On the viscosities of liquids at their boiling-points. Boiling-points are unsatisfactory temperatures at which to compare the viscosities of liquids. By correcting the boiling-points to a condition of equal free space, the viscosities of liquids become proportional to their molecular weights in the liquid state. Such a condition of equal free space corresponds very closely to a reduced temperature on the basis of Van der Waal's equation of state.—D. B. Macleod: The kinetic theory of evaporation. It is assumed that the ratio of the density of the vapour above a liquid to the density of the liquid is really the ratio of the number of molecules with sufficient speed to escape from the liquid to the number with insufficient speed. Thus if D_v and D_l are the densities of the vapour and liquid respectively, then

$$\frac{D_v}{D_l} = \frac{N_s}{N_i}$$

where N_s is the number of molecules with sufficient speed to escape and N_i the number with insufficient speed. It is shown that the results which follow from this assumption are so simple and satisfactory as to make the truth of the assumption extremely probable. The experimental data used are those given by Ramsey and Shields.—J. T. Howarth and F. P. Burt: New design for apparatus to measure the coefficient of deviation from Boyle's law and the determination of this coefficient for acetylene. A modified apparatus for measuring the compressibility of gases has been designed in which the whole volume of the gas and also the mercury column which registers the pressure are kept at the temperature of melting ice. The coefficient of deviation from Boyle's law at 0° C. for acetylene between 0 and 1 atmosphere is -0.00884.

MANCHESTER.

Literary and Philosophical Society, December 2.—T. A. Coward: Migration may be visible or invisible. The passage of large bodies of waders, and of swallows, martins, and swifts during daylight, are examples of visible migration; but the majority of species pass unseen in favourable circumstances, probably because they travel at night or at too great an elevation for human vision. When these species are seen in any numbers, as during unfavourable weather at the coastwise lights, migration is abnormal. The fact that birds frequently travel against the wind or with the wind on a flank does not prove that they prefer this method; nor does the fact that airmen but seldom meet with birds at high altitude annul the possibility of high flight; the birds may have wandered into unfavourable currents. Coasts and river valleys are followed, but there are also cross-country migrations. Wind driftage and contrary currents explain many of the occurrences of migrants in unexpected places.

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SYDNEY.

Royal Society of New South Wales, September 3.—Dr. C. Anderson, president, in the chair.—E. Cheel: Notes on *Boronia* in the Pinnate Section, with a description of a new species. The plants, which are from the Richmond River district, have a superficial resemblance to the "Pink *Boronia*" (*B. floribunda*) of the Sydney district, but the leaves are smaller and the whole plant is more or less hairy and not glabrous, as is the case with "Pink *Boronia*." The oil contained in the leaves has a fragrant odour, somewhat resembling safrol, and it is therefore proposed to call the new plant *Boronia saffrolifera*.—T. Hodge Smith and Tom Iredale: Evidence of a negative movement of the strand line of 400 feet in New South Wales. A series of sandstone blocks has been trowled along the 70 fathom line from Long Reef, north of Sydney, to south of Montague Island, a distance of about 200 miles. The soundings along this line show coarse sand and rocks, and the boulders are composed of very coarse sand grains similar to that of a beach, and not like the fine soft sand normally found at such depths. One of these blocks was a mass of scallop and other shells cemented together with this coarse sand. The shells belong to littoral species at present living on the coast of Tasmania, while the existing molluscan fauna at the place differs notably in detail from the association of molluscs in this block. These blocks seem to represent an ancient coastline which has been drowned in recent times, probably simultaneously with the movement that broke through Bass Strait.—S. L. Martin: The change of resistance of molybdenite due to light. If the contacts are shielded, a strip of molybdenite 0.001 cm. in thickness suffers a decrease in electrical resistance, when light is incident on it, the red end of the spectrum producing the greatest change. This change is constant, providing the current density is less than about 0.1 amp. per sq. cm. and is proportional to the intensity for small intensities. For white light, the source being a hundred candle power pointolite lamp at a distance of 75 cm., the change was of the order of 1 ohm in 500.

Official Publications Received.

- Agricultural Research Institute, Pusa. Bulletin No. 153: Tamarind as a Source of Alcohol and Tartaric Acid. By H. N. Batham and L. S. Nigam. Pp. 8+2 plates. (Calcutta: Government of India Central Publication Branch.) 3 annas; 4d.
- Mysore Geological Department. Records, Vol. 22, 1923. Part 1: Annual Report for the Year 1923. Pp. iii+44. (Bangalore: Government Press.) 1 rupee.
- Seconde Assemblée de l'Union Géodésique et Géophysique Internationale, Madrid, Octobre 1924. Espagne. Offert par le Comité Espagnol. Pp. 148+52 plates. (Madrid: Instituto Geográfico.)
- Jahrbücher der Zentralanstalt für Meteorologie und Geodynamik. Amtliche Veröffentlichung. Jahrgang 1920. Neue Folge, 57 Band. Pp. xiv+A36+B36+C41+D11+E11. (Wien: Gerold und Komp.)
- University of California Publications in Zoology. Vol. 26, No. 4: The Boring Mechanism of *Teredo*. By Robert Cunningham Miller. Pp. 41-80 +plates 3-6. (Berkeley: University of California Press.) 60 cents.
- Ministry of Public Works, Egypt: Physical Department. The Discharges and Levels of the Nile and Rains of the Nile Basin in 1919. By Dr. Percy Phillips. (Physical Department Paper No. 11.) Pp. vi+84+3 plates. (Cairo: Government Publications Office.) 5 P.T.
- British Scientific Instrument Research Association. Sixth Annual Report for the Year 1923-24. Pp. 20. (London: 26 Russell Square, W.C.1.)
- Madras Fisheries Department. A Contribution to the Life-History of the Indian Sardine; with Notes on the Plankton of the Malabar Coast. By James Hornell and M. Ramaswami Nayudu. (Report No. 5 of 1923, Madras Fisheries Bulletin, Vol. 17.) Pp. 129-197. 14 annas. Report on the Inspection of Pearl Banks in the Gulf of Mannar and Palk Bay in March and April 1923. By James Hornell. (Report No. 6 of 1923, Madras Fisheries Bulletin, Vol. 17.) Pp. 199-214. 3 annas. (Madras: Government Press.)
- United States Department of Agriculture. Department Bulletin No. 1249: Food Habits of some Winter Bird Visitors. By Ira N. Gabrielson. Pp. 32+5 plates. (Washington: Government Printing Office.)
- Agricultural Experiment Station, Michigan Agricultural College. Special Bulletin No. 183: Fertilizers; What They Are and How to Use Them. By M. M. McCoole and C. E. Miller. Pp. 26. Special Bulletin No. 184: Greenhouse Insects. By E. I. McDaniel. Pp. 75. Special Bulletin No. 185: Seasonal Management for Commercial Apiaries. By Russell H. Kelty. Pp. 58. (East Lansing.)