

Early Science at the Royal Society.

November 23, 1664. Monsieur Le Febure presented his printed discourse, both in French and English, upon the preparation of Sir Walter Raleigh's cordial. He likewise read a Latin letter sent him from Paris, and signed for attestation by some of the principal physicians and chirurgions of that city, concerning the art practised by one Monsieur Bienaise, of healing tendons and nerves transversely cut, so as to restore the patient to the full use of his limbs. He was desired to leave the letter with the society, which he promised to do, after he had shewn to some of the college of physicians.

November 25, 1663. The president acquainted the society, that he had received a letter sent to a minister in England from a suffragan bishop in Iceland; which letter being produced, the secretary was ordered to peruse it, and give an account of it to the society at their next meeting; against which time the amanuensis was ordered to make a copy of the inquiries formerly drawn up by Mr. Hooke and sent to Iceland, in order that they might be considered of, and fitted by the president to be sent and recommended to the said bishop, as a person conceived to be capable and curious enough to return a proper answer to them.

November 26, 1662. The lord viscount Brouncker acquainted the Society with the approach of St. Andrew's day; and that by reason of the necessity of making some alterations in their charter, there could not be conveniently made an election of new council this year: but it was offered to the Society, whether they would propose some other persons to be presented to the King, and, according to his majesty's pleasure, to be put into the council of the altered patent, instead of some of those, who were in the first. It was put to the question, whether any alteration should be made in the council, or not? and it was carried in the negative.—Dr. Wilkins showed his way-wiser, and the effects thereof upon a coach; and was desired to leave his first engine of this kind with the society.

November 28, 1666. Mr. Henry Howard [afterwards Duke of Norfolk] was elected and admitted, who also received the public thanks of the Society for his respects to them.—Dr. Wallis gave the society some account of what he had lately observed in Kent about tides, viz., that, according to his hypothesis, the tides had been very high about Romney-marsh, three days after the new moon; which though the seamen there ascribed to the high winds, as not thinking of any other cause, yet he thought it might be imputed to the cause assigned in his theory; especially if upon continued observations for several years together it should happen in the same manner.

1667. Mr. Coga, the first person in England, on whom the experiment of transfusion was made by order of the Society, and by the management of Dr. Lower and Dr. King, presented himself before the Society, and produced a Latin paper of his own, giving an account of what he had observed in himself since he underwent the said experiment. It was ordered likewise that Mr. Coga being willing to have the experiment repeated on him, it should be tried again accordingly, when the physicians of the Society should judge it seasonable. [Oldenburg in a letter to Boyle, takes notice that the experiment was performed at Arundel-house, in the presence of many spectators, including Mr. Henry Howard and both his sons. The morning after the lord viscount Brouncker and Mr. Oldenburg went to see Mr. Coga pretty early.]

Societies and Academies.

LONDON.

Royal Society, November 13.—Sir Arthur Schuster: On the total reflection of light. The light which enters the optically rarer medium at or beyond the critical angle is an effect of diffraction originating near the boundary of the refracting surface. It derives its energy from the incident beam and must diminish the intensity of the reflected light. Thus there can be no total reflection in the strict sense of the word. The ratio of the energy dissipated by diffraction to the total energy of the incident light is inversely proportional to the length of the refracting surface, and therefore tends towards zero as the size of the refracting surface increases. At the critical angle the light dissipated by diffraction amounts to about one per cent. of the incident light, when the length of the refracting surface is 5 cm. The numerical value is subject to correction depending on the approximate nature of the investigation.—N. K. Adam and J. W. W. Dyer: The molecular structure of thin films. Pt. VI. Five long-chain alcohols have been examined. The area of cross-section of the chain in the alcohols is the same as in the acids, within $2\frac{1}{2}$ per cent., and the CH_2OH group occupies 21.6 sq. A.U. of area. The acetates of these alcohols pack with the heads occupying 23 sq. A.U., and form expanded films of the same kind as other esters. The methyl ethers of the alcohols do not form stable films. Highly unsaturated acids, with three and five double bonds in the chains, behave much like oleic acid, which only has one double bond. Arachidic acid and its derivatives behave normally. Substituted acetamides show a solid film with chains close-packed at low temperatures, and this melts at a definite temperature, raised by compression, to a liquid film of area 24.2 sq. A.U. This melting seems to be due to the molecules acquiring sufficient kinetic energy other than translational to break up the solid structure. Hydrocarbon chains more than 27 carbons long tend to mask the typical phenomena in condensed films. Pentærythritol tetrapalmitate, which has four chains attached to a common centre through polar groups, and should normally have these four chains directed to the corners of a tetrahedron, orients all the chains vertically in the surface. These are not quite close-packed until a compression of about 20 dynes per centimetre is applied.—T. Alty: The cataphoresis of gas bubbles in water. The velocity of a gas bubble in water is independent of the gas used. It is proportional to the applied field throughout the whole range of diameters, the maximum velocity being 4.1×10^{-4} cm./sec./volt/cm. at a diameter of about 0.1 mm. The highest velocity is only attained in water of specific conductivity 8.5×10^{-6} ohms $^{-1}$. In water of specific conductivity 1.8×10^{-6} ohms $^{-1}$, the charge on the bubble is very small, and is occasionally reversed during the course of an experiment. Two bubbles appear to repel each other.—D. R. Hartree: Some relations between the optical spectra of different atoms of the same electron structure. I.—Lithium-like and sodium-like atoms. Relations between values of corresponding terms of the spectra of different atoms of the same electron structure are worked out for the Bohr atom model with a central field. The relations are different according as the series electron does or does not penetrate into the core. The theoretical relations agree fairly closely with such experimental data as are available.—P. A. M. Dirac: The conditions for statistical equilibrium between atoms, electrons and radiation. The principle that every process which

occurs in an assembly in thermodynamic equilibrium is exactly balanced by the reverse process occurring to the same extent is applied to the general case of n -body encounters, both radiative and non-radiative processes being considered. Van 't Hoff's isochore is of universal validity, even for radiative processes and with relativity mechanics. From Planck's law of radiation it is deduced that every process by which radiation is emitted is stimulated by external radiation of the same frequency, the ratio of stimulated to spontaneous emission being independent of the nature of the process, and inversely proportional to the cube of the frequency.—**Ida Doubleday**: Boundary lubrication—further consideration of the influence of the composition of the solid face.—**Christina C. Miller**: The Stokes-Einstein law for diffusion in solution. Dilute solutions of iodine in a large number of solvents of different viscosity were used. According to the Einstein-Stokes expression, which is based on the assumption of large particles moving amongst relatively small molecules, the product [diffusion-coefficient \times velocity] should be constant for all solvents. The product in the case of organic solvents actually varied between 850 and 1544; for aqueous solutions of alkali halide of different concentrations the variation was between 826 and 1216. According to Sutherland, on the opposite assumption that small dissolved molecules move amongst relatively large molecules, the value of the product in the extreme case should be 1.5 times as great as the value given by the Einstein-Stokes expression. If acetylene tetrabromide be excepted, the ratio for any two products actually falls between 1 and 1.5.—**Helen S. French** and **T. M. Lowry**: Studies of co-ordination, Pt. I. Absorption spectra and co-ordination of some cupric compounds. The absorption-spectra of the cupric compounds, both organic and inorganic, are dominated by (i.) a red or infra-red band, which is characteristic of the cupric atom, and (ii.) an ultra-violet band or general absorption, which depends mainly on the anion or organic radical. The colour of the cupric compounds depends on the character of the narrow region of transmission between these two absorptions.—**L. F. Bates**: On the range of α -particles in rare gases. A scintillation method was used, and the value found for helium, after repeated purification of the gas used, is very different from that found by previous observers, due probably to the big effect of small quantities of impurities in reducing the range. Henderson's theory of the loss of energy of an α -ray in passing through matter, whilst accounting for approximately the same fractional loss of energy in all the rare gases, does not account for the whole loss. There is a rough linear relation between the logarithms of the observed stopping powers and the logarithms of the atomic weights of the rare gases, but it does not take the simple form given by Bragg and Kleeman.—**D. H. Black**: The β -ray spectrum of mesothorium 2. Thirty-one lines were detected and their energies calculated. The majority of these lines are considered to be due to the conversion of γ -rays in the absorption levels of the atom itself. In all, eight γ -rays have been classified, and it has been possible to account for seven of these quite satisfactorily by the system of transitions between levels in the nucleus.—**J. Keith Roberts**: The thermal expansion of crystals of metallic bismuth. The thermal expansion of crystals of metallic bismuth parallel and perpendicular to the vertical axis, by comparison with that of crystalline quartz, are practically constant from ordinary temperatures up to 240° C. Bismuth melts at about 270° C. The constant expansion coefficients over this range are:—Perpendicular to the axis, 12.0×10^{-6} ; parallel to the axis, 16.2×10^{-6} ;

mean, 13.4×10^{-6} . The bending over of the length-temperature curve as the melting-point is approached indicates dissociation of the atoms in the solid.—**R. Stoneley**: Elastic waves at the surface of separation of two solids. A wave, analogous to the Rayleigh wave, exists at the plane surface of separation of two elastic solids, which extend otherwise to infinity, if the velocities of distortional waves in the two media are nearly equal. A transverse wave of the type that Prof. Love has shown to exist in certain circumstances in a surface layer cannot exist at this surface of separation. A wave of this type may exist in a stratum of uniform thickness bounded by media extending to infinity if the stratum is sufficiently thick or the wave-length sufficiently small. Nodal planes may also exist. The geophysical bearing of these results is that some of the energy of deep-seated earthquakes may be "trapped" at surfaces of discontinuity, and eventually be dissipated in solid friction without appreciably affecting seismographs.—**J. H. Jones** and **J. C. Boyce**: The constants of the Rydberg-Ritz equation. The type of atomic field necessary to give observed terms in hydrogen-like spectra must be due to a virtual attracting charge which is additional to the net charge of the atomic kernel. The additional field, strong near the kernel, but rapidly diminishing at greater distances, resembles that of an electric doublet. The doublet seems to be induced in the kernel by the field of the valence electron itself, in its interaction with the screening electrons. This can be pictured as the charge induced on a conducting sphere, and for such a model a Ritz spectral formula may be derived. One of the correcting terms of the Ritz formula has been obtained for a number of spectra of the sodium type, and the values are of the same order of magnitude as those calculated from known spectral data.

Physical Society, October 24.—**Mr. F. E. Smith** in the chair.—**D. Gunnaiya** and **G. Subrahmaniam**: Underblown pipes. The phenomena of underblown pipes have been studied in the case of four wooden pipes ranging over an octave. They present many features of remarkable interest, and a new theory is proposed.—**W. Mandell** and **J. West**: On the temperature gradient in gases at various pressures. Sets of curves indicating these gradients at various pressures have been obtained; they show the existence in contact with the vessel walls—at low pressures—of very large "temperature jumps." The general character of the results may be explained on the assumption of the presence at the walls, of a gas film possessing certain properties due to the attracting forces existing amongst wall molecules and gas molecules. Several thermocouples of differing thicknesses—and therefore differing curvature—were employed under identical conditions. They showed systematic differences which may also be attributed to the presence round the various thermocouples of gas films the thickness and character of which vary with the thickness of the couple.—**J. F. S. Ross**: Vectorial dimensions: The paper directs attention to the deficiency of the present dimensional notation [M] [L] [T], and in particular to the anomalies (a) that it makes the dimensions of work and torque the same, and (b) that it allows the dimensions of angular velocity and acceleration to appear as functions of time alone. These defects are due to the neglect of the vectorial character of length, and it is accordingly proposed that the present notation be modified by using the symbols $[L_x]$, $[L_y]$, and $[L_z]$, where different directions are involved. The proposal by Bartorelli to treat angle as a fourth independent fundamental quantity is open to serious criticism.

Mineralogical Society, November 4.—Dr. H. H. Thomas and afterwards Prof. W. W. Watts in the chair.—M. S. Krishnan: Note on cordierite in a cordierite-gneiss from Madura District, Madras, India. Optically positive cordierite occurs in an Archæan gneiss produced by the metamorphism of biotite-gneiss by an intrusive tongue of charnockite. The associated rocks are crystalline limestones (with lime-silicate minerals), and gneisses containing feldspars, garnet, sillimanite, biotite, and titanoferrite. Cordierite from two other localities in Peninsular India (Vizagapatam and Travancore) is also known to be optically positive. This positive character is suggested to be due to the isomorphous replacement of MgO by FeO, as in the rhombic pyroxenes, olivines, etc.—A. Brammall: Lime as a constituent of certain important rock-forming minerals: its behaviour relative to that of other bases of RO type. A review of the facts governing the extent to which RO-bases replace each other in rock-forming minerals, special reference being made to the antipathetic relationship between lime and magnesia as constituents of the same simple molecule.—L. J. Spencer: (1) An inclusion of magnetite in diamond. A minute black fragment (about 1 mg.) taken from a cavity in a diamond from Bultfontein mine, Kimberley, was definitely identified as magnetite. Black inclusions and spots are of common occurrence in diamond, but usually they are non-magnetic and therefore not magnetite. (2) Biographical notices of mineralogists recently deceased (second series). Notices of fifty-five English and foreign mineralogists. The average age of 303 lives (since 1876) is 64 years, and a curve shows a highest point at 74 years. The greatest age was attained by F. E. Neumann (1798–1895), the German crystallographer.—A. Russell: A notice of the occurrence of native arsenic in Cornwall (with analysis by H. F. Harwood); of bismuthinite at Shap, Westmorland; and of smaltite and niccolite at the Coniston Mine, Lancashire.

MANCHESTER.

Literary and Philosophical Society, November 4.—H. B. Dixon and W. F. Higgins: On the phosphorescent flame of carbon disulphide. In determining the ignition-point of mixtures of carbon disulphide vapour with other gases, e.g. hydrogen, nitrogen, carbon dioxide, methane, it was found that a mixture of 80 per cent. methane with 20 per cent. carbon disulphide immediately inflamed when brought into oxygen in a concentric-tube apparatus at a temperature of 191° C., but did not inflame in air until both gas and air were heated to above 410° and had been in contact 10 seconds. The mixture of methane and carbon disulphide was observed to give a phosphorescent glow when it met the air at temperatures between 200° and 400°, and by regulating the gas supply a steady flame could be maintained. This flame can be studied more easily in a glass tube, or by throwing a steady air current by means of a glass cone on to the gas jet. The phosphorescent flame is due to the partial burning of the carbon disulphide, to carbon mono-sulphide, and sulphur dioxide. The methane is not attacked. The flame does not come down to the jet: it lights some inches above it. When certain gases, such as ethylene, acetylene, coal-gas, nitrogen peroxide, mix with the gas and air near the orifice of the jet, the phosphorescent flame is immediately extinguished—but these "poison" gases have no effect when brought into the flame itself. The phosphorescent flame is accompanied by particles of the red-brown polymer of CS and appears to be due to the partial

burning of CS₂ molecules condensed on these solid particles. The "poison" appears to prevent this condensation.

PARIS.

Academy of Sciences, October 27.—M. Guillaume Bigourdan in the chair.—The president announced the death of Louis Emile Bertin, the oldest member of the section of geography and navigation, past-president of the Academy.—Paul Appell: The nature of the movement of a fluid celestial body round its centre of gravity.—G. Friedel: An experiment demonstrating the symmetry between the increase and decrease of crystals.—Edouard Imbeaux: The great artesian basins of the United States.—Paul Montel: The exceptional involutions of the algebroid functions.—Maurice Fréchet: An intrinsic parametric representation of the most general continuous curve.—S. Stoilow: The continued transformations of a variable.—Alfred Rosenblatt: Varieties of three dimensions the tangent spaces of which satisfy certain differential equations.—R. Jacques: Networks such that the congruences described by the tangents and the congruences derived by the Laplace method belong alternately to linear complexes.—Jean Thibaud: The absorption and diffusion of γ -rays of very great energy in the light elements.—A. Dauvillier: A method of distinguishing natural pearls from culture pearls. The means hitherto available for distinguishing between the pearls produced artificially in the oyster by the Japanese method and natural pearls, necessitate the destruction of the pearl. It is shown that the photographs of the Laue figures produced by X-rays are different for the two classes of pearl, and this examination does not require the mutilation of the pearl.—Jules Stoklasa and Jos. Penkava: The radioactivity of the eruptive gases of Vesuvius and of solfataras and their influence on the development of bacteria and the higher plants. Details of measurements of the electrical conductivity of the air near two craters of Vesuvius, at different altitudes on the Eiffel Tower in Paris, and at the potash mines at Mulhouse.—L. J. Simon: The neutralisation of chloric acid by the alkalis, followed by means of viscosimetry. The minimum viscosity corresponds to equimolecular proportions of alkali and acid.—E. Audibert: A necessary condition for safe mining in an inflammable atmosphere. Doubt is thrown on the efficacy of inert rock dust for preventing the propagation of explosion in mines.—A. Lassieur: The electrolytic separation of copper, antimony, lead and tin.—A. Damiens: The suboxide of tellurium. The experiments described do not confirm the production of tellurium suboxide under the conditions given by Divers and Shimozé. The reaction indicated by them is incomplete when working with pure tellurium, and the body described as the suboxide TeO is only a mixture of tellurium and the dioxide TeO₂.—J. A. Muller and Mlle. E. Peytral: The sudden pyrogenic decomposition of methyl formate and the principle of minimum molecular deformation. Methyl formate, passed rapidly through a hot tube at 1000° C., splits up into two molecules of formaldehyde; secondary decomposition of the aldehyde gives rise to carbon monoxide and hydrogen.—J. Barthoux: Contact metamorphism in the Djebilet ad Rehamna, Morocco.—Sabba Stefanescu: The apparent anomalies of the molars of elephants and the number of plates of their crowns.—A. Maige: The regeneration of the amyloger excitability of the plasts during hydrolysis.—L. Leger: The specific value of the three kinds of European lamprey and the young stages of *Petromyzon fluviatilis*. From a study of the young post-larval stages, the author concludes that the three kinds of European

lamprey, known under the names of *Petromyzon marinus*, *P. fluviatilis*, and *P. planeri*, must be considered as distinct species, since their differential characters, clearly marked in the adult, are already shown from the metamorphosis which follows their long larval life in fresh water.—M. Parat and J. Painlevé: The internal reticular apparatus of Golgi, Holmgren trophosponge and vacuome. The "reticular apparatus" of Golgi or the "trophosponge" of Holmgren results from the precipitation of metallic silver or osmium in the interior, at the periphery, or in the interspaces of the protoplasmic vacuoles. The author concludes that there is no cellular "apparatus."—A. Bonnet: The digestive and absorbing apparatus of some Echinidæ.—Eugène Aubeil and René Wurmser: The utilisation of the energy liberated by oxidations.

BRUSSELS.

Royal Academy of Belgium, May 6.—M. Max Lohest in the chair.—Report on the work of the Committee on "Biographie Nationale" during the year 1923-1924.

June 7.—M. Max Lohest in the chair.—The P. J. and Ed. van Beneden Prize (2nd period, 1921-1923) is awarded to M. Daleg for his researches on the physiology of the egg during maturation: the decennial prize for applied mathematics (period 1913-1922) to M. De Donder for his works on the Einstein gravific and his treatises on thermodynamics and physical chemistry.

August 2.—M. Max Lohest in the chair.—The Edouard Maily Prize is awarded to the Antwerp Astronomical Society.—Th. De Donder: The Weyl-Eddington-Einstein gravific.—Victor van Straelen: An amphipod from the oil-bearing strata of Pechelbronn (Alsace). Details of a new species to which the name of *Gammarus alsaticus* is given.—M. Alliaume: The best approximation in the determination of the instantaneous terrestrial pole and an attempt at the systematisation of researches on the deviation from the vertical.—M. Alliaume: The generalisation of Poisson's theorem relating to the probability of an event the cause of which has undergone an unknown modification.—R. Lucion and A. Brichaux: Experiments undertaken by Ernest Solvay, from 1877 to 1881, on the fundamental unity of matter and energy.—E. Ectors: Contribution to the study of the reaction of organo-magnesium compounds on the nitriles. Benzonitrile. An account of experiments made to elucidate the mechanism of the reaction between benzonitrile and benzylmagnesium chloride.—Suzanne Leclercq: New observations on the anatomical structure of some fossil plants of the Belgian coal measures. Two new species are described, *Botryopteris Fraipontii* and *Sphenophyllum Gilkinetti*.—A. Merten: The calculation of barrage walls.—Victor van Straelen: The first remains of fossil Phacochoerus collected in the Belgian Congo.—J. de Smedt: The diffraction of the X-rays by polymerised liquids.

DUBLIN.

Royal Dublin Society, October 28.—Prof. E. A. Werner in the chair.—H. H. Jeffcott: The determination of the most economic size of pipe line for water-power installations. In choosing the size of pipe lines and tunnels leading from a reservoir to the turbines in a hydroelectric installation, the criterion of greatest economy is that the sum of all the charges in connexion with the pipe lines (including the value of the power lost in the pipes), when reckoned over a long period of years, shall be a minimum. Reducing

the diameter of such pipe line lessens cost, but increases the loss of power due to frictional resistance, and, owing to loss of head at peak loads, it is necessary either to increase the size of the turbines, or to install additional turbine and generator sets to supply the deficiency at large discharge. From these considerations formulæ are obtained for the theoretically best sizes. As practical considerations require the thickness of wall of the pipe to be not less than a specified quantity, the low-pressure portion of the pipe line is of constant size. Thereafter the diameter diminishes, and the thickness of wall increases gradually as the pipe line descends towards the power-house. For the tunnel portion of the system the diameter is constant under the conditions hypothesised. As the output of the power-station varies considerably from time to time, the total frictional loss of energy in the pipe line in a year is proportional to the mean cube of the several discharge rates during equal periods in that year.—W. R. G. Atkins and G. T. Harris: Seasonal changes in the water and heleo plankton of fresh-water ponds. The plankton of two ponds was found to be very different, so the water was analysed and the plankton estimated at intervals for about two years. A new record was obtained for *Elakatothrix gelatinosa*. The electrical conductivity of the water was low when the P_H value was high; the seasonal changes differed in the two ponds. In spring the developing plankton used up all the phosphate, lack of which appeared to limit the increase in growth.—K. C. Bailey: The synthesis of urea from carbon dioxide and ammonia under atmospheric pressure. Urea can be synthesised from carbon dioxide and ammonia at atmospheric pressure by passing the mixed gases through the annular space between a quartz tube heated to a temperature higher than 500° C. and an inner water-cooled glass tube. It is advantageous to use the gases in the ratio of two volumes of ammonia to eight of carbon dioxide. The yield of urea increases with temperature to at least 700°.

Royal Irish Academy, November 10.—Prof. Sydney Young, president, in the chair.—K. C. Bailey: The reaction between ferric chloride and potassium thiocyanate. The reaction between ferric chloride and potassium thiocyanate in various proportions has been reinvestigated, and an explanation is offered of the seeming anomalies in the extraction of ferric thiocyanate by ether or amyl alcohol. No evidence has been found of the existence in the reaction mixture of a dithiocyanate.—K. C. Bailey and J. D. Kidd: Freezing-points of solutions containing ferric chloride and potassium thiocyanate. Freezing-point curves of solutions containing ferric chloride and potassium thiocyanate in varying proportions have been constructed, but no definite evidence was obtained of the formation of double compounds.

Official Publications Received.

Bulletin of the American Museum of Natural History. Vol. 50, Art. 5: Further Notes on Ptilosis. By W. de W. Miller. Pp. 305-331. (New York City.)

Department of Health, Canada. Publication No. 32: Small-Pox and Vaccination; a Popular Treatise. By Dr. J. J. Heagerty. Pp. 27. (Ottawa: Department of Health.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 32 (Division of Chemistry Series No. 33): The Composition of Ripe Wine Grapes from the Government Viticultural Station, Paarl. By G. Frater. Pp. 30. (Pretoria: Government Printing and Stationery Office.) 3d.

Canada. Department of Mines: Mines Branch. Bituminous Sands of Northern Alberta. By Sidney C. Ellis. Pp. 35+6 plates. (Ottawa: F. A. Acland.) 25 cents.

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 291: A Gravimetric Test of the "Roots of Mountains" Theory. By William Bowie. Pp. 8. (Washington: Government Printing Office.)