on aeronautics in connection with the engineering classes at the Universities of St. Andrews, Glasgow, and Edinburgh. The University Court voted a grant of 50*l.* to defray the cost of the lectures in Edinburgh, and suggested that the lectures should be open to the public.

M. l'Abbe Breuil, of Paris, has been appointed Munro lecturer on prehistoric archæology for the academical year 1920–21.

LIVERPOOL.—The University, through its Chancellor, Lord Derby, has just issued an appeal to its constituency, the counties of Cumberland, Lancashire, Cheshire, and North Wales, for funds that will enable it to come abreast of present needs. Some of the laboratories have been in existence since 1881, and are obviously inadequate, while all of them are now too small; thus the practical course in elementary physics is being repeated eleven times each week. The library needs to be extended; the chemical laboratories are so overcrowded that work is being carried on in Army huts; new departments are contemplated and interesting developments are being thought out. A chair in the mathematical theory of statistics, a ship-model tank, a department of colloidal chemistry, and a department of marine food industry are among the "futurist" ideas that make this appeal so relevant to a great industrial and commercial centre. It is hoped that the sum of a million pounds may be obtained, and of this about 500,000*l.* is urgently required for pressing expansions. Already about 200,000*l.* has been promised.

ON Saturday last, March 20, the third annual dinner of the metallurgy department of the Sir John Cass Technical Institute was held, Mr. G. Patchin, the head of the department, being in the chair. Dr. C. A. Keane, the principal, replying to the toast of the institute, stated that at the present time there are more than a thousand individual students attending the various courses. In 1904 there were three courses and twenty-two students in the metallurgy department, and this year there are eleven courses and one hundred and twenty students.

ONE of the most valuable provisions of the new Army scheme is that which relates to the education of the rank and file. The intention is to provide men in the Army with an educational training equal, or even superior, to what is available in civilian life. Every officer in command of a company will be held responsible for the instruction of his men, not only in drill and discipline, but also in the class-room and workshop, and the result will certainly be increased intelligence and efficiency. For the introduction of this substantial reform Col. Lord Gorell, who since 1918 has been Deputy Director of Staff Duties (Education) at the War Office, Sir Henry Hadow, and Mr. P. A. Barnett are largely responsible, and they are to be congratulated cordially that the scheme of Army certificates of education is to come into operation on July 1, 1921. Four classes of certificates are to be awarded on the results of examination. For the third-class certificate candidates must be able to read intelligently a selected piece of English prose, write a simple letter, work simple sums up to and including vulgar fractions in reference to concrete examples, and answer questions on a course of citizenship and history. The second-class certificate will apparently require a standard of attainment comparable with those of the former Preliminary Local Examinations of Oxford and Cambridge; and the first class, involving English, mathematics, geography and map-reading, and (optional) an ancient or modern language, approximately that of the First School Examination. By taking, in addition, two or three single subjects from different groups, a special certificate may be obtained. Various practical subjects may be taken for the second-class certificate, and the groups for the special certificate include mechanics, chemistry, physics, botany, zoology, geology, physiology, civil, mechanical, and electrical engineering, agricultural chemistry, and commerce. We shall watch with close attention the application and results of this educational scheme.

Societies and Academies.

LONDON.

Royal Society, March 11.—Sir J. J. Thomson, president, in the chair.—W. G. **Duffield**, T. H. **Burnham**, and A. A. **Davis**: The pressure upon the poles of metallic arcs, including alloys and composite arcs. In a previous communication (Phil. Trans., A, ccxx., p. 209, 1919) the authors showed that the poles of a carbon arc behaved as though they repelled one another, and methods were described by which the pressure upon each pole could be measured. Reasons were given for attributing this effect to the reaction consequent upon the emission of electrons from the poles under the influence of thermionic or photo-electric action. The present experiments relate to arcs between iron, copper, and silver terminals, the rate of variation of the pressure with current density being measured for the anodes and cathodes. The pressures were greater than in the carbon arc, that within the copper arc being the largest. Assuming that the pressure is due to the projection of electrons, a comparison between the kinetic energy of the electron and that of the metallic atom at the temperature of the poles showed sufficient agreement to suggest that the electrons before projection were in thermal equilibrium with the metal of the pole. The reactions upon electrodes composed of an alloy of silver and copper were also measured, likewise those within an arc between a silver and a carbon pole. In this case the pressure was determined mainly by the material of the pole under examination. The problem of the mechanism whereby a gas may be heated is briefly discussed. Some account is also given of the variation in the potential difference between the poles when the material of one is altered.—J. H. **Vincent**: Further experiments on the variation of wave-length of the oscillations generated by an ionic valve due to changes in filament current. Eccles and Vincent have found that in an oscillatory circuit maintained by a thermionic valve with a grid coil coupling, the wave-length has a maximum value for a certain filament current. This effect is studied further in this paper. In order to vary the filament current, rheostats were designed and used in which the change of resistance was unaccompanied by any sensible change in the self-induction of the filament circuit. The methods of measuring the change of wave-length due to the variation of filament current were different from that employed by Eccles and Vincent, but it was found that the results obtained were independent of the particular method by which the wave-length was studied. It is suggested that changes in several of the variables of a valve-maintained circuit produce effects of the same sign on the wave-length and the amplitude of the oscillations. The wave-length and amplitude decrease with the decrease of the grid voltage or of the plate voltage. They also decrease when the coupling of the grid coil with the main oscillator coil decreases. Increasing the resistance in either the condenser branch or the induction branch of the main oscillating circuit lessens the amplitude and wave-length; while altering the filament current

in either direction from that giving the maximum wave-length gives also a decreased amplitude.—H. A. **Daynes**: The theory of the katharometer. A historical introductory note by Dr. G. A. Shakespear gives a description of the katharometer and an account of its development by him for hydrogen purity measurements and similar work in connection with lighter-than-air craft. The paper discusses the conditions which determine the temperature of the hot wire in the katharometer cell, and shows that loss of heat by conduction through the gas is the most important factor, convection and radiation being quite unimportant. Equations are given expressing the experimental law of heat loss in a single katharometer wire, and these are applied to the case of two wires in parallel in the arms of a Wheatstone bridge. These equations are then used to show what are the conditions for greatest sensitiveness and precision in various cases arising in practice.—H. A. **Daynes**: The process of diffusion through a rubber membrane. The nature of diffusion of gases through rubber membranes is discussed in the light of some recent work. This all points to a simple process, determined by the case of diffusion through the rubber, and by the absorption of the gas by the rubber. This is introduced mathematically into the problem of diffusion through a membrane. The unsteady state is considered, in which the membrane, after being exposed to air, is suddenly exposed on one side to, say, hydrogen, and the rate of emission of hydrogen from the other side calculated. The passage of gas through the material is treated purely as a diffusion problem, the boundary conditions only being determined by absorption. It is shown that measurements of the permeability of a membrane and of the lag on reaching a steady state are sufficient for the determination of both absorption and diffusion constants. Experiments are described in which these conditions are fulfilled. The measurements of the diffusion are made by means of a katharometer. From these experiments the constants of diffusion and absorption for hydrogen, nitrogen, oxygen, carbon dioxide, nitrous oxide, and ammonia are determined. Temperature coefficients for the constants are given for hydrogen, and the high temperature coefficient of permeability of rubber is shown to be due chiefly to the high temperature coefficient of the diffusion constant. The extraordinarily high permeability of rubber to carbon dioxide, ammonia, etc., is shown to be due entirely to the high absorption. A relation is also suggested between absorption and critical temperature of the gas.

Physical Society, February 27.—Prof. W. H. Bragg, president, in the chair.—T. **Smith**: The balancing of errors. In calculating functions from Taylor expansions or otherwise, the results obtained by summing any finite number of terms will differ to a greater or less extent from the true results. It is shown in the paper that by suitable modifications of the coefficients the results obtained, even when comparatively few terms of the expansion are taken, can be made to approximate very closely to the true results for all values of the variable between selected limits.—Dr. N. W. **MacLachlan**: Notes on the testing of bars of magnet steel. The paper describes the results of experiments with the Ewing double permeameter. It is shown that the assumption underlying the theory of the method, viz. that the end effects are the same with the long and short bars, is not justified, and that the value of H, as found by calculation on this assumption, is in error. The error did not, however, exceed 1 per cent. for any of the bars tested, but the author concludes that the method is inferior as regards accuracy and convenience to the differential-coil method.—G. D. **West**: The forces acting on heated metal-foil surfaces in rarefied gases. The present paper arises out of two previous papers by the author on the pressure of light (Proc. Phys. Soc., xxv., p. 324, 1913, and xxviii., p. 259, 1916), and consists of an experimental investigation of the nature of certain peculiar movements of strips of thin metal foil surrounded by rarefied gases and exposed to radiation. The experiments deal chiefly with phenomena at gas pressures below 1 cm. of mercury, and it is shown that the apparently diverse results obtained can be connected by a theory based on the work of a previous paper (Proc. Phys. Soc., xxxi., p. 278, 1919). The author concludes that at the highest rarefactions the pressures on the strips arise from the fact that, if differences of temperature exist in an enclosure, the pressure of the gas is not uniform, but varies approximately as the square root of the latter's absolute temperature. The simple conditions that exist at low gas pressures are complicated at the higher pressures by gas currents which differ fundamentally from convection currents, but are closely connected with the phenomena of thermal transpiration.

March 12.—Prof. W. H. Bragg, president, in the chair.—F. H. **Newman**: Absorption of gases in the electric discharge tube.—J. S. G. **Thomas**: A directional hot-wire anemometer. The instrument consists of two fine platinum wires mounted close together, and forming two of the arms of a Wheatstone bridge. These are heated by the current in the bridge. When a stream of gas moves in a direction perpendicular to the wires, but parallel to the plane containing them, the leading wire is cooled, while the second wire, being shielded by the first, is not cooled so much, and may actually be heated on account of the air flowing past it being warmed by the first wire. A deflection of the galvanometer is obtained, therefore, which is reversed if the flow of gas is in the reverse direction. The instrument is much more sensitive than the non-directional hot-wire anemometer.

Linnean Society, March 4.—Dr. A. Smith Woodward, president, in the chair.—R. H. **Compton**: A contribution to our knowledge of the botany of New Caledonia. The subject of this communication is the collection made by Mr. Compton in New Caledonia and the Isle of Pines during 1914 with the aid of money grants from the Royal Society, the Percy Sladen Trust, and the Wort's Travelling Fund of Cambridge University. The specimens collected have been presented to the British Museum, and the greater part have been worked out in the department of botany at that institution. Dr. Rendle gave a short account of the position and physical character of the island, and referred to previous work on its flora and its general characters. Important features are the igneous rocks which form a mountain chain of gneiss in the north-east, and the serpentine formation which covers the southern portion and occurs in larger or smaller areas throughout the island. The flora is rich, and the proportion of endemic forms exceptionally high. The main affinities of the flora are with Indo-Malaya and South-East Australia, the former represented chiefly in the forest regions and the latter in the scrub and savannah regions; and a study of it suggests that New Caledonia is a very ancient land mass which has been isolated for a very long period. Dr. Rendle also gave a *résumé* of Mr. Compton's account of the ferns and gymnosperms. The latter are of great interest; they number about twenty-seven, and are all endemic. Mr. Baker referred to a number of interesting specimens among the dicotyledonous flowering plants, which included

many novelties. Miss Lorrain Smith gave an account of the lichens, which include a new genus and a fair proportion of new species. Miss E. M. Wakefield referred to the fungi, the geographical distribution of which showed points of interest; and Miss G. Lister described the small collection of Mycetozoa.

Geological Society, March 10.—Mr. R. D. Oldham, president, in the chair.—Prof. A. H. **Cox** and A. K. **Wells**: The Lower Palæozoic rocks of the Arthog-Dolgelley district (Merionethshire). This paper gives an account of the geology of the country between the Cader Idris range and the Mawddach Estuary. The physiography of the district was described, and a summary of the work of previous investigators given.

MANCHESTER.

Literary and Philosophical Society, February 17.—Sir Henry A Miers, president, in the chair.—Dr. T. Graham **Brown**: The function of the brain. The activity of an animal, as seen by an observer, consists in movements of its limbs, changes of its attitude, changes in its expression, and so on. This activity is usually called "behaviour." In itself the action is a physiological one, and may be analysed and described in terms of physiological mechanism. It is also used as an *index* of the mental processes. The separate movements of the parts of the body are *integrated* by the nervous system in the total behaviour. This integration may occur at different levels in the central nervous system. The great brain must be present if the animal is to exhibit all the finer shades of behaviour which characterise the normal animal. The two general methods of examination were described and illustrated by experimental observations. Brain injuries and their results in men and animals, with consequential paralysis, and the theory of the "cerebral localisation of functions" were discussed.

Literary and Philosophical Society (Chemical Section), February 27.—Mr. R. H. Clayton, chairman, in the chair.—J. **Allan**: Engineering as applied to the buildings and plant in chemical works.

DUBLIN.

Royal Dublin Society, February 24.—Dr. F. Hackett in the chair.—Prof. Wm. **Brown**: Note on the decay of magnetism in bar magnets. Twenty-one bar magnets of different chemical composition were retested for magnetic moment per gram after being laid aside for ten years. The most retentive were found to be magnets with about 1 per cent. of C. and those with about 3 per cent. of Cr. The general results show that in ten years the manganese group lost about 25 per cent. of their magnetism, the tungsten group 20 per cent., and the chromium group about 28 per cent.—T. G. **Mason**: The inhibition of invertase in the sap of *Galanthus nivalis*. The inversion of sucrose in the sap extracted from the leaves of *Galanthus nivalis* takes place with extreme slowness, so that at the end of five days, at a temperature of 29° C., it is still incomplete. The delay is observed whether the sap is pressed from untreated leaves or from leaves the cells of which have been rendered permeable by exposure to intense cold or to toluene vapour; but the delay is least marked in the sap extracted by the first method. It is shown that inversion such as occurs is due neither to the acids of the cell-sap nor to the enzymes of organisms external to the cells, and hence the presence of invertase in the sap seems established. Efforts were made to demonstrate the presence of an invertase-inhibitor by dialysis, and by testing the effect of the sap on yeast-invertase, with negative results. Possibly the greater part of the invertase of the sap is thrown down with the colloids coagulated by extraction, especially during exposure to cold or to toluene vapour. The inversion of the sucrose was traced by thermo-electric observations of the depression of freezing point of the sap. These observations usually showed a comparatively rapid inversion during the first few hours, followed by a slight reversal or suspension of the process for the next few hours, and then a steady inversion at a very slow rate. The reversal is remarkable, and may be attributed to a condensation of hexoses to form sucrose or to oxidation of the hexoses.

Books Received.

Spring Songs. By T. J. W. Henslow. Pp. 54. (London: Electrical Press, Ltd.) 1*s*. 6*d*. net.

The Propagation of Electric Currents in Telephone and Telegraph Conductors. By Prof. J. A. Fleming. Third edition. Pp. xiv+370. (London: Constable and Co., Ltd.) 21*s*. net.

The Arctic Prairies. By E. Thompson Seton. Pp. xii+308. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

Paper Making and its Machinery. By T. W. Chalmers. Pp. xi+178+vi plates. (London: Constable and Co., Ltd.) 26*s*. net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, and Papers in Elementary Engineering for the Royal Air Force for the Years 1910–1919. Edited by R. M. Milne. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*.

Annual Reports on the Progress of Chemistry for 1919. Vol. xvi. Pp. ix+234. (London: Gurney and Jackson.) 4*s*. 6*d*. net.

A Manual of Elementary Zoology. By L. A. Borradaile. Third edition. Pp. xviii+616+xxi plates. (London: Henry Frowde and Hodder and Stoughton.) 18*s*.

The Ghost World: Its Realities, Apparitions, and Spooks. By J. W. Wickwar. Pp. 158. (London: Jarrolds, Ltd.) 2*s*. 6*d*. net.

Treatise on General and Industrial Inorganic Chemistry. By Prof. E. Molinari. Second edition. Translated from the fourth Italian edition by T. H. Pope. Pp. xix+876+2 plates. (London: J. and A. Churchill.) 42*s*. net.

Industrial Organic Analysis. By P. S. Arup. Second edition. Pp. xi+471. (London: J. and A. Churchill.) 12*s*. 6*d*. net.

Electricity: Its Production and Applications. By R. E. Neale. Pp. viii+136. (London: Sir Isaac Pitman and Sons, Ltd.) 2*s*. 6*d*. net.

Aviation: Theorico-Practical Text-book for Students. By B. M. Carmina. Pp. ix+172. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 11*s*. net.

The Link between the Practitioner and the Laboratory. By C. Fletcher and H. McLean. Pp. 91. (London: H. K. Lewis and Co., Ltd.) 4*s*. 6*d*. net.

A Memorial Volume containing an Account of the Photographic Researches of Ferdinand Hurter and Vero C. Driffield. By W. B. Ferguson. Pp. xii+374. (London: The Royal Photographic Society of Great Britain.) 25*s*.

Common Diatoms. By T. K. Mellor. Pp. 16+ plates. (London: W. Wesley and Son.) 6*s*. net.

Legal Chemistry and Scientific Criminal Investigation. By A. Lucas. Pp. viii+181. (London: E. Arnold.) 10*s*. 6*d*. net.

A Map of Europe and Africa (on Mercator's Projection), having Special Reference to Forest Areas