exist for philanthropic purposes. But the first year of peace has been a disappointment. Building operations, which form a very large part of the activities assisted by the Trust, are kept back because building is now so costly. The outstanding obligations already undertaken by the Trust are sufficient to absorb the greater part of the available income during the next five years. It is evident that further sums will be required to supplement grants already made for building libraries. The committee is, therefore, disinclined to consider new requests for grants in aid of library building. The committee considers that the assistance given to rural library schemes is among the most important and satisfactory of the Trust's activities. Under these schemes a box containing fifty books is sent to a small town or village and there used as a lending library until, the books having been read, it is time to exchange them for a fresh supply. Reports from those in charge of rural centres show that the scheme really provides a means for spreading education in thinly populated districts. The Carnegie Trust has made a grant towards the maintenance of the School of Librarianship recently established at University College, London. The highly trained students who pass through this school should do much to make our libraries more useful. The committee of the Carnegie Trust also reports on the part it has taken in physical welfare schemes and in the promotion of music.

AN appeal has just been issued by the University of London through its Military Education Committee inviting subscriptions to the war memorial which it is proposed to raise to the former officers and cadets of the University of London Officers Training Corps who have fallen in the war. The services rendered by the Officers Training Corps during the war are too little known or appreciated. When war broke out the cadets came forward practically as one man, and to their heroism and the unremitting labours (often in the teeth of great discouragement and difficulties) of their pre-war instructors we owe the fact that what might have proved a most dangerous gap in the supply of officers during the earlier part of the war was successfully bridged. The record of the University of London contingent appears to be second to none. The number of past and present officers and cadets who served in the war as officers is 4197, of whom we have to deplore the loss of no fewer than 657. The number of distinctions gained is 1650, including five V.C.'s (the only two surviving V.C.'s, Major Cloutman and Major White, both graduates of the University, are honorary secretaries of the appeal). In particular the gratitude of Londoners must go out to Major Sowrey, who brought down a Zeppelin in flames, and later a Gotha aeroplane. The scheme is to include a memorial in London, and, in addition, a permanent hall in connection with the new standing camp of the University of London O.T.C. at Great Kimble, near Princes Risborough, where special memorials to individuals may be put up, of which the first will commemorate Lt.-Col. Arthur Egerton, Coldstream Guards, the first adjutant of the contingent, whom all the original officers and cadets mourn as a personal friend. The appeal committee is a strong one, and includes many honoured names outside the University itself—in particular, those of Marshal Foch and of Field-Marshals Lord French and Sir Henry Wilson. It is to be hoped that every patriotic person who realises the part played by the British universities in the great national struggle and the importance of maintaining this splendid tradition will contribute generously towards the 30,000*l.* asked for. Contributions should be sent to the hon. treasurer at 46 Russell Square, London, W.C.1.

## Societies and Academies.

### LONDON.

**Royal Society,** February 26.—Sir J. J. Thomson, president, in the chair.—L. F. **Richardson**: Some measurements of atmospheric turbulence. The eddy-shearing stress on the ground is deduced from pilot-balloon observations. Values on land in any consistent dynamical units are found to range from 0·0007 to 0·007 times the value of $m^2/\rho$, where $m$ is the mean momentum per volume up to a height of 2 km. and $\rho$ is the density. Evidence is given to show that the eddy viscosity across the wind at Lindenberg increases with height, and, except near the ground, is much greater than the eddy viscosity along the wind. In parts iv. and v. the spreading of a lamina of smoke is considered. Osborne Reynolds's eddy stresses are studied. For one occasion an attempt was made to measure simultaneously all six components of stress by observing the motion of thistledown. The three direct stresses are easily measured. Not so the shearing stresses; however, one was found to be 2·4 times its probable error. The theory of the scattering of particles is summarised, and numerical values are derived from scattering. The "turbulivity" $\xi$ is estimated from the rising cumuli in calm weather and found to be $10^6$, applicable only in the sense of friction. Thus the whole range of $\xi$ observed in the free atmosphere was from seven to a million, in contrast with 0·2 in perfectly still air. The eddy stresses observed have ranged in absolute value from 0·004 to 110 dynes $cm^{-2}$.—J. H. **Hyde**: The viscosities and compressibilities of liquids at high pressure. In the first place, experiments were made to determine the change in the value of the kinematical viscosity ($\eta/\rho$) of the various oils, and after this investigation was completed apparatus was designed for the determination of the change in density with pressure. The apparatus used for the determination of the kinematical viscosity consisted essentially of a system of two horizontal (the upper one of capillary dimensions) and two vertical tubes forming a closed circuit of liquor under pressure, the lower half of the circuit containing mercury and the upper half the liquid under test. One end of the tubular frame rests on a horizontal knife-edge, and the frame is supported in a horizontal position by a spiral spring. On the mercury being displaced by a given amount, flow will take place round the circuit owing to the difference of head, and it is evident that if the spring be so designed that its rate of extension is equal to the rate of change of head of the mercury, flow of the liquid under test will take place through the capillary tube under a constant pressure-difference and at a velocity which can be calculated from the rate of extension of the spring. In this way all the data required for the determination of the absolute kinematic viscosity of the fluid were determined. The determinations of the variation in density under pressure were made by measuring the decrease in volume of known quantity of the liquid enclosed in a steel cylinder sealed at one end and closed at the other by a long steel plunger. The cylinder and plunger were enclosed in a pressure vessel and the motion of the plunger for any particular pressure was measured. The density was calculated from the decrease in the volume thus measured. From the values of the density ($\rho$) and those of the kinematical viscosity ($\eta/\rho$) obtained for the oils, the values of the absolute viscosity ($\eta$) were calculated. The results show that the absolute viscosity of all the oils tested increases considerably with pressure.—A. **Russell**: The capacity coefficients of spherical conductors. It is proved that the capacity coefficient of a spherical

conductor equals its radius, together with the capacity of the condenser formed by the spherical surface on one side and the images in it of all external objects connected in parallel on the other. This theorem leads at once to relations between the capacity coefficients of a system of two spheres and the capacities of certain spherical condensers which lessens very appreciably the labour involved in computing the values of these coefficients which are required in practical work. The mutual coefficient also is given in terms of the capacity of a spherical condenser, and other relations between the various capacities used by engineers and physicists are proved. Finally, a method of finding the approximate value of the capacity between a sphere and distant large conductors is given.—C. **Cuthbertson** and Maude **Cuthbertson**: The refraction and dispersion of carbon dioxide, carbon monoxide, and methane. The refractivity of the above-named gases has been measured at eight points in the visible spectrum between λλ 6708–4800. The work was undertaken with the object of ascertaining the refractive power of the carbon atom, on the assumption of the validity of the additive law. By deducting the refractivity of the oxygen or hydrogen atoms from that of the carbon compound values are obtained from which the refractivity of carbon can be expressed in the form

$$\mu - 1 = \frac{C}{n_0^2 - n^2}.$$

For $1/\lambda = 0$ the expressions obtained are:

| | From carbon dioxide | Carbon monoxide | Methane |
|---|---|---|---|
| $(\mu-1)_{\infty}$ carbon | $\frac{2\cdot7705}{16042} = 0\cdot000173$ | $\frac{1\cdot988}{10213} = 0\cdot000195$ | $\frac{1\cdot672}{10623} = 0\cdot000157$ |

There are thus wide differences, not only between the quotients, which give the refractivity, but also between the numerators, which should be proportional to the number of "dispersion electrons," and the denominators, which give the squares of the hypothetical free frequencies. The result affords a further proof that the "additive law" is untrustworthy except as a rough guide.—A. A. **Griffith**: The phenomena of rupture and flow in solids. Difficulties which had been experienced in predicting the fracture of machine parts under certain types of loading suggested the desirability of a fundamental inquiry into the mechanism of rupture. A theoretical criterion of the rupture of an elastic solid, based on the "theorem of minimum energy," is enunciated in the paper. This has been shown experimentally to be true in the case of a glass plate which contains a crack when unstrained. The calculation involves the surface tension of the material. In the experiments the maximum stress in the glass was estimated to be more than ten times the normal tenacity of the material. It is shown that this result is compatible with the general criterion of rupture unless the material is weakened by discontinuities of flaws the dimensions of which are at least of the order ten thousand times the molecular spacing. Evidence is adduced to show that the strength of other substances, including metals and liquids, is governed by similar considerations, and that an enormous increase in the tenacity of materials would be possible if the flaws could be eliminated. Experiments are described showing how the elimination may be performed in the case of glass and fused silica, it having been found possible to prepare samples of these materials with nearly fifty times their normal tenacity. The strong phase of these materials is, however, unstable, and changes spontaneously in a few hours to the normal modification. It is shown that many of the phenomena associated with the mechanical properties of materials, including those described in the present paper, are capable of explanation in general terms if it be supposed that intermolecular attraction is a function of the relative orientation of the attracting molecules. Some consequences of this theory are discussed in the paper. The paper concludes with a short discussion of the bearing of the work on engineering practice.

**Geological Society**, February 20.—Mr. G. W. Lamplugh, president, in the chair.—Annual general meeting.—G. W. **Lamplugh**: Presidential address: Some features of the Pleistocene glaciation of England. The address dealt principally with the changes brought about by the ice in the surface-features of our country. More than five thousand square miles of English land, or about one-tenth of the whole country, would vanish if the drifts were removed, as the "solid" rocks lie below sea-level in tracts of this extent. A further area of about ten thousand square miles is overspread by drift of sufficient thickness wholly to mask the "solid" land-forms, so that rather more than one-quarter of the country owes its present shape to Glacial and post-Glacial deposits. Another twenty thousand square miles was glaciated, and more or less modified, but without losing the dominating features of its rocky framework. The remainder of the country was affected only by the intensification of the atmospheric agencies, whereby its original features were accentuated. In a general sense, the hill-districts have not been greatly changed, but the lowlands have been in most parts completely altered. The source of the huge mass of material contained in certain of the lowland drift-sheets was considered, and the opinion was expressed that a large portion of this was an addition to the land, brought in by the ice from outside our present coast-line. Comment was made on the curious rarity of peat or other land-detritus in Boulder Clay known to have been derived entirely from the land, and this was thought to indicate that the conditions for a long period before the actual glaciation had been unfavourable for the growth of timber or peat-producing vegetation.

February 25.—Mr. R. D. Oldham, president, in the chair.—H. C. **Sargent**: The Lower Carboniferous chert-formations of Derbyshire. The chert-formations occurring in the Carboniferous Limestone and associated rocks of Derbyshire may be classified under two heads: (1) Those which owe their silica to gaseous or aqueous emanations from igneous rocks. (2) Those which derived their silica from the land by means of chemical denudation. The author considers that in both cases the silica was precipitated direct, and did not, to any considerable extent, pass through an intermediate stage of secretion by organisms with subsequent solution and redeposition. He adduces evidence to show that simultaneous deposition of silica and calcium carbonate often took place, and it is believed that, in such cases, segregation ensued, and sometimes resulted in the formation of nodules and lenticular masses of chert. It is suggested that the bedded cherts of terrestrial origin resulted from heavier precipitation of silica, comparatively free from calcium carbonate, and spread over the sea-floor by gentle currents. Metasomatic replacement of limestone and calcareous organisms by silica has taken place at their contact with the chert. Impurities in the silica have tended to limit such replacement. Organisms existing in the sea or on the sea-floor would be entangled in the precipitated silica, and their presence in the chert is thus explained. The blackness of some chert is shown to be due to the presence of carbonaceous matter. Ferrous iron may possibly have operated sometimes in the same way.

PARIS.

**Academy of Sciences,** February 16.—M. Henri Deslandres in the chair.—G. **Humbert**: The positive quadratic forms of Hermite in an imaginary quadratic body.—M. **Hadamard**: Certain solutions of a functional differential equation.—G. **Bigourdan**: Coordinates, instruments, and work of the Observatory of the Collège de France.—A. **Rateau**: The greatest range and maximum realisable velocities of aeroplanes.—M. Ciamician was elected a foreign associate in succession to the late Sir William Ramsay, and M. L. Bianchi a correspondant for the section of geometry in succession to M. Volterra, elected foreign associate.—G. **Cerf**: Remarks on a generalisation of Pfaff's problem.—B. **de Fontviolant**: Calculation of circular bridges.—D. **Pompeiu**: A condition equivalent to monogeneity and the demonstration of the fundamental theorem of Cauchy.—J. **Boccardi**: A diurnal variation of latitude.—A. **Guillet** and M. **Aubert**: An absolute bispherical electrometer. The numerical calculation of its characteristics.—S. **Procopiu**: Diffraction grating spectra in the case where the incident light is oblique with respect to the principal plane of the lines.—A. **Pérard**: A method for the comparison and measurement in absolute value of standards with plane ends by an interference method.—Ch. **Boulin** and L. J. **Simon**: The action of water on dimethylsulphate.—F. **Canac**: The determination of the parameters of a crystal by the X-rays.—M. **Zeil**: The ascending movements of the earth's crust and the evolution of fossil remains.—G. **Denizot**: The existence of two peneplains in the Paris basin.—P. **Guerin** and Ch. **Lormand**: The action of chlorine and various vapours upon plants. After one or two hours' exposure to an atmosphere containing 1/2000 of chlorine, bromoacetone, and other poison gases, most plants resist; they lose their leaves, but new ones appear, and the plants finish their normal growth.—H. **Coupin**: The production of chlorophyll by plants exposed to a discontinuous light.—J. **Amar**: The index of respiratory endurance. This is defined as the ratio of the volume of air entering the lungs at each inspiration to the body-weight.—H. V. **Vallois**: Evolution of the muscle system of the episome in vertebrates.—L. **Mercier**: Variation of *Corophium volutator* according to its place of origin.—E. **Chatton**: The existence in Radiolaria of parasitic Periclinians considered as forms of reproduction of their hosts.

## Books Received.

The Story of Milk. By J. D. Frederiksen. Pp. xx+188. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 9*s*. net.

The Handbook of Cyprus. Eighth issue. Edited by H. C. Luke and D. J. Jardine. Pp. xii+300. (London: Macmillan and Co., Ltd.) 12*s*. net.

A First-Year Physics for Junior Technical Schools. By G. W. Farmer. Pp. x+183. (London: Longmans and Co.) 4*s*. 6*d*.

Practical Hardy Fruit Culture. By R. Staward. Pp. 216. (London: The Swarthmore Press, Ltd.) 6*s*. net.

A First Book of School Celebrations. By Dr. F. H. Haywood. Pp. 167. (London: P. S. King and Son, Ltd.) 5*s*.

The Chemical Age. June–December, 1919. Pp. xi+750. (London: Benn Bros., Ltd.) 15*s*.

Mauka Polska Jej Pstrzeby, Organizaeja i Rozwój. Tom i. Pp. xvi+558. (Warszawa.) Cena M.P. 15.

The Elementary Differential Geometry of Plane Curves. By R. H. Fowler. Pp. vii+105. (Cambridge: At the University Press.) 6*s*. net.

The Foundations of Einstein's Theory of Gravitation. By E. Freundlich. Authorised English translation by H. L. Brose. Preface by A. Einstein. Introduction by Prof. H. H. Turner. Pp. xvi+61. (Cambridge: At the University Press.) 5*s*. net.

Through Deserts and Oases of Central Asia. By Miss Ella Sykes and Brig.-Gen. Sir Percy Sykes. Pp. xii+340. (London: Macmillan and Co., Ltd.) 21*s*. net.

The Origin and Development of the Compositæ. By Dr. J. Small. Pp. xi+334+6 plates. (London: W. Wesley and Son.) 15*s*. net.

A Text-book on Machine Drawing for Electrical Engineers. By E. Blythe. Pp. vii+81. (Cambridge: At the University Press.) 20*s*. net.

La Molécule Chimique. By Prof. R. Lespieau. Pp. iii+286. (Paris: F. Alcan.) 3.50 francs.

L'Unité de la Science. By Prof. M. L. du Sablon. Pp. iii+284. (Paris: F. Alcan.) 3.50 francs.

The Examination of Materials by X-rays. Pp. ii+64. (London: Faraday Society.) 13*s*. 6*d*.

The Physiology of Vision: With Special Reference to Colour Blindness. By Dr. F. W. Edridge-Green. Pp. xii+280. (London: G. Bell and Sons, Ltd.) 12*s*. net.

## Diary of Societies.

*THURSDAY*, MARCH 11.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lt.-Col. E. Gold: The Upper Air: (ii) Results and their Interpretation.

INSTITUTE OF METALS (at Institution of Mechanical Engineers) (Annual General Meeting), at 4.—Eng. Vice-Admiral Sir George Goodwin: Inaugural Address.

ROYAL SOCIETY, at 4.30.—W. G. Duffield, T. H. Burnham, and A. A. Davis: The Pressure upon the Poles of Metallic Arcs, including Alloys and Composite Arcs.—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.—H. A. Daynes: (1) The Theory of the Katharometer; (2) The Process of Diffusion through a Rubber Membrane.

LONDON MATHEMATICAL SOCIETY, at 5.—G. S. Le Beau: A Property of Polynomials whose Roots are Real.—B. M. Sen: Double Surfaces.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. J. L. Birley: The Principles of Medical Science as applied to Military Aviation (Goulstonian Lecture).

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Dr. H. M. Berry: X-rays in the Diagnosis of Tuberculosis.

ROYAL SOCIETY OF MEDICINE (Occasional Lecture), at 5.—Sir Jagadis Bose: Plant and Animal Response (with Demonstrations of Growth by the Magnetic Crescograph).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. M. Jane Reaney: The Educational Needs of Adolescence.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—W. H. Patchell: Operating a By-product Producer-gas Plant for Power and Heating.—S. H. Fowles: Production of Power from Blast-furnace Gas.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 2 Furnival Street), at 7.—J. B. Shaw: Various Points in the Manufacture of Lake and Pigment Colours.

OPTICAL SOCIETY, at 7.30.—A. C. W. Aldis: Portable Electric Signalling Lamps.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduate Section), at 8.—C. A. Chappell: Magnetos.

INSTITUTE OF METALS (at Institution of Mechanical Engineers) (Annual General Meeting), at 8.—Dr. G. D. Bengough, R. M. Jones, and Ruth Pirret: Fifth Report to the Corrosion Research Committee.—R. Seligman and P. Williams: The Action on Aluminium of Hard Industrial Waters.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Prof. J. S. B. Stopford: Results of End-to-end Suture of Peripheral Nerves.

SOCIETY OF ANTIQUARIES, at 8.30.

*FRIDAY*, MARCH 12.

INSTITUTE OF METALS (at Institution of Mechanical Engineers) (Annual General Meeting), at 10.30.—J. Neil MacLean: The Art of Casting in High Tensile Brass.—H. Moore and S. Beckinsale: The Removal of Internal Stress in 70:30 Brass by Low-temperature Annealing.—Dr. W. Rosenhain, J. L. Haughton, and Kathleen Bingham: Zinc Alloys with Aluminium and Copper.—Dr. W. Rosenhain: A Model for Representing the Constitution of Ternary Alloys.—A. C. Vivian: Tin-Phosphorus Alloys.—W. C. Hothersall and E. L. Rhead: Some Notes on the Effect of Hydrogen on Copper.

INSTITUTE OF METALS (at Institution of Mechanical Engineers) (Annual General Meeting), at 2.30.—W. E. Alkins: The Effect of Progressive Drawing upon some Physical Properties of Commercially Pure Copper.—F. Johnson: The Influence of Cold Rolling on the Physical Properties of Copper.—J. L. Haughton: The Study of Thermal Electro-motive Force as an Aid to the Investigation of the Constitution of Alloy Systems.—H. H. Hayes: The Polishing and Etching of Zinc for Micro-examination.—W. E. Hughes: Idiomorphic Crystals of Electro-deposited Copper.

ROYAL ASTRONOMICAL SOCIETY, at 5.—N. Liapin: Some Remarkable Properties of Diurnal Motion.—H. C. Plummer: The Nature of Short-period Variables.—L. Becker: (1) Capture Orbits; (2) The Capture Hypo-