

with the two new professors. At present there are 117 students working specially at chemistry, including its technological applications, of which number thirty-six are engaged in research. In addition, the department provides the subsidiary training in chemistry for about 329 other students.

THE annual prize distribution of the Sir John Cass Technical Institute was held on Wednesday, December 10, when the prizes were distributed by Sir Thomas H. Elliott, K.C.B., Deputy Master and Comptroller of the Royal Mint. The chair was taken by Sir Owen Roberts, chairman of the governing body of the institute. Sir Thomas Elliott, in addressing the students, spoke of the desirability of keeping in view the aim of the instruction provided at the institute, the object of its work, and the extent to which this object was being accomplished. He was himself disposed to say that the primary purpose for which the institute exists is to assist students to do justice to themselves and to those who may be or become dependent upon them, to enable them to perform services which the community requires and for which the community is prepared to pay, and to pay well, to increase their earning powers, and so to help them to secure a better livelihood for themselves than would otherwise be theirs. He counselled the students not to be afraid of selecting a manual occupation and in connection with it to endeavour to learn all the facts connected with the material used, the machinery employed, and the scientific principles upon which the work is based. The Rev. J. F. Marr, chairman of the institute committee, gave a summary account of the work of the institute during the past session, in which he referred especially to the increasing number of students, the research work that had been carried on in the institute, both by students and by members of the staff, and the several developments in the courses of instruction provided. In the latter connection details were given of the work on colloids, on the theory and applications of mathematical statistics, on the fermentation industries, on mine sampling and valuing, on metals used in the motor-car industry, and on the casting of metals, all subjects which had received the special attention of the governing body during the past session.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 28.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—Prof. H. L. Callendar: The expansion of silica. In attempting to deduce the expansion of mercury by the weight thermometer method with silica bulbs it was necessary to determine the expansion of specimens of silica from the same source as the bulbs, and to extend the observations of expansion over the range 0° C. to 300° C. Specimens which had been exposed to high temperatures appeared to give lower results over the range 0° C. to 300° C. than specimens which had not been heated above 300° C. during the measurements. Specimens of the same material, (1) in the form of rods were obtained and were heated and tested by the Newton ring method over the range 0° C. to 300° C.; and (2) in the form of tubes, which were tested by the Fizeau method over the range -20° C. to 150° C. The difference between the axial and radial coefficients of the tube specimens had also been tested. The expansion of the silica rod gave results agreeing with the extrapolation of the curve representing the original observations between 300° C. and 1000° C. The silica rods showed at first some peculiarities due to intrinsic strain, but settled down into a cyclic state which could be repre-

sented over the range 0° C. to 300° C. by the formula $10^8 \times \text{mean coefficient } 0^{\circ} \text{ to } t = 78.0 - 8650/(t + 175)$, but the variation of the coefficient with temperature was rapid and peculiar over this range and could not be represented by a formula of the usual type. The axial expansion of four different specimens had been measured, and could be represented between -20° C. and 150° C., with a little divergence by the formula, $10^8 \times \text{mean coefficient } 0^{\circ} \text{ to } t = 29.0 + 0.250t - 0.00070t^2$, which agreed over this range with the formula found for the rods, but was inadmissible for extrapolation to 300° C. The difference between the radial and axial coefficients was tested. Differences of the order of 5 or 10 per cent. in the expansion in different directions appeared to be persistent, and were not removed by heating the specimens to 1000° C. or cooling in liquid air. It was concluded that the differences in the radial coefficient might be due to distortion of the ring. It was considered that the most probable result for the cubical coefficient would be obtained by assuming it to be three times the linear. Owing to the smallness of the expansion of silica, and its comparative freedom from hysteresis, the possible uncertainty with the silica bulbs was probably less than 1 in 1000, in spite of the imperfect annealing.—F. J. Harlow: The thermal expansions of mercury and fused silica. A more complete set of observations of the relative coefficients of expansion of mercury in silica than those previously published are obtained by the use of an electrically heated oil bath. The observations comprise readings at frequent intervals up to 300° C., and are in good agreement with the earlier observations. Tables are included giving representative observations and the final results. From the values of the coefficients of expansion of silica determined by Prof. Callendar, the coefficients of absolute expansion of mercury are calculated.—Prof. J. A. Fleming: An experimental method for the production of vibrations on strings. An apparatus for the production of vibrations of strings loaded or unloaded was shown. The vibrations are produced on a string by attaching one end to the shaft of a small continuous-current motor of about $\frac{1}{2}$ h.p. The other end of the string is attached to a fixed point which can be moved by means of a screw, in some cases a spring balance being interposed to measure the tension. When the motor is started the string has a circular motion given to its end which is equivalent to two simple harmonic motions at right angles to each other. If the tension is adjusted rightly the string then vibrates in sections, and the number of sections can be adjusted. The distance from node to node can then be measured easily, and the frequency determined from the speed of the motor. In this way the velocity of the wave is measured, and can be compared with the velocity determined by taking the square root of the quotient of the tension by the linear density of the string. This method is useful in studying the properties of loaded strings. When the wave-length on the string extends over a distance of more than eight or ten loads, the string vibrates as if the loading matter were distributed uniformly, but the string cannot propagate vibrations when the half wave-length approaches equality to the distance between two loads. It is possible to show the reflection of a wave at a load placed at any point on the string, and also that this reflection is reduced by tapering off the loading. With this loaded vibrating string all the phenomena of inductive loading in telephone cables on the Pupin system can be imitated.

Geological Society, December 3.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. E. A. Newell Arber: A contribution to our knowledge of the geology of the Kent Coalfield. An account of the

Carboniferous rocks of Kent is given. The Mesozoic cover of the coalfield is ignored. The proved area is 200 square miles. The general strike is about 30° south of east and north of west, and the dip of the Transition Coal Measures is 2° to 3° . The area is a syncline, limited on the north and south by Armorican folds, of which the northern has been located. It is maintained that the Kent Coalfield is not continuous with that of the Pas de Calais. There are reasons for believing that the western boundary is a great fault. The chief surface-feature of the Coal Measures is that of an inclined plane, sloping westwards and south-westwards from an elevated region near Ripple and Deal. The Lower Carboniferous rocks exceed 450 ft. in thickness, and were denuded before the Coal Measures were deposited. The Coal Measures consist of the Transition Series (1700 to 2000 ft. thick), and the Middle Coal Measures (2000 ft.). No Lower Coal Measures or Millstone Grit occur. The coals are well distributed, and are often of considerable thickness. Steam and household coals predominate. The most productive portions of the measures are the higher part of the Transition and the lower part of the Middle Coal Measures.—Dr. E. A. Newell **Arber**: The fossil floras of the Kent Coalfield. The floras of ten further borings in Kent are recorded, and the number of species known from the Kent Coalfield is raised to ninety-six, as compared with twenty-six in 1909. As regards the horizons present in Kent, the plant-remains indicate that, in the area so far proved, only Middle or Transition Coal Measures, or both, occur.

Linnean Society, December 4.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Jane **Longstaff**: A collection of non-marine Mollusca from the southern Sudan. With descriptions of three new species by H. B. **Preston**; and notes on *Veronicella nilotica*, Cockerell, by G. C. **Robson**. This records the Mollusca taken during two visits to the Sudan in February, 1909 and 1912. About fifty-three species were taken, thirty-four Gasteropoda and nineteen Lamellibranchiata, the aquatic, of course, having a wider range than the terrestrial forms. The only terrestrial gasteropod found alive was a *Veronicella nilotica*, Cockerell, the second recorded example.—A. S. **Horne**: A contribution to the study of the evolution of the flower, with special reference to the Hamamelidaceæ, Caprifoliaceæ, and Cornaceæ.

Mathematical Society, December 11.—Prof. A. E. H. Love, F.R.S., president, in the chair.—Prof. E. W. **Hobson**: The linear integral equation.—H. E. J. **Curzon**: Generalised Hermite functions and their connection with the Bessel functions.—J. **Proudman**: Limiting forms of long-period tides.—Lieut.-Col. **Cunningham**: The number of primes of the same residuacity.—R. H. **Fowler**: Some results on the form near infinity of real continuous solutions of a certain type of second order differential equation.—S. **Brodetsky**: The potential of a uniform convex solid possessing a plane of symmetry with application to the direct integration of the potential of a uniform ellipsoid.—G. R. **Goldbrough**: The dynamical theory of the tides in a polar basin.—Prof. J. C. **Fields**: Proof of the complementary theorem.

CAMBRIDGE.

Philosophical Society, November 24.—Prof. Newall in the chair.—Prof. A. S. **Eddington**: The distribution of the stars in relation to spectral type. It is well known that the concentration of stars to the galactic plane is not shown equally by the different spectral classes. Type B is the most condensed, and the others follow in the order A, F, G, K, M, i.e. the sequence coincides with the usually accepted order of evolution. Formerly it seemed probable that this result was due

to a progression in the average distance of these classes of stars, for, on the hypothesis that the stellar system is of oblate form, the greater the distance the greater will be the concentration to be expected. Recent determinations by Boss and Campbell of the average distances of the stars of different spectral types negative this explanation in a most decided manner. It appears, for instance, that the M stars are on the average more remote and more luminous than type A. There is an outstanding question of great difficulty. In parallax investigations it is found that the M stars are the faintest of all the types; in statistical discussions of proper motions, &c., they are found to be the brightest except type B. Similar difficulties occur with the other types. Russell has put forward the theory that type M consists of two divisions, one being the very earliest and the other the latest stage in evolution. Against this it may be urged that both divisions of type M are characterised by very high velocities in space; this seems to indicate a close relation between them.—Dr. G. F. C. **Searle**: (1) The comparison of nearly equal electrical resistances. Four resistance coils, A, B, C, D, are arranged to form the four sides of a Wheatstone's quadrilateral. The coils C, D are approximately equal, but, as their ratio is eliminated, it is not necessary to know it. A balance is obtained by shunting A, B with large resistances a_1, b_1 . The coils A and B are then interchanged and a fresh balance is obtained by shunting them with a_2 and b_2 . (2) An experiment on the harmonic motion of a rigid body.—G. T. **Bennett**: A double-four mechanism.—F. E. **Baxandall**: The presence of certain lines of magnesium in stellar spectra. In a recent paper on new series of lines in the spark spectrum of magnesium, Prof. Fowler gives spark lines of magnesium at wave-lengths 4384.86, 4390.80, 4428.20, 4434.20, which do not fall into series. Weak lines in apparently corresponding positions have been found in the spectra of α Canis Majoris (type A₀) and α Cygni (type A₂, Pec.), and the suggestion is made that the stellar and laboratory lines are identical. It is in such stellar spectra as those mentioned that the well-known Mg spark line at wave-length 4481.3 occurs at its maximum intensity. The new lines have not been traced in any other types of stellar spectra.

MANCHESTER.

Literary and Philosophical Society, November 18.—Mr. Francis Nicholson, president, in the chair.—Prof. G. Elliot **Smith**: The controversies concerning the interpretation and meaning of the remains of the dawn-man found near Piltdown. The author explained the nature of the controversies concerning other bearings of the Piltdown discovery on the history of ancient man: (1) the age of the remains; (2) the question of the association of the jaw and the skull; (3) the significance of the jaw and teeth and the reconstruction of the missing parts; (4) the reconstruction of the brain-cast and the nature of the brain; and (5) the place which Eoanthropus should occupy in the phylogeny of the Hominidæ. (1) It is practically certain that the fragments are of the Pleistocene date. (2) There is definite internal evidence that the jaw is not really an ape's; the teeth it bears are human, and the skull, although human, is much more primitive than any skull assigned to the genus Homo. (3) The reconstruction of the jaw and teeth has now been practically settled once for all by the subsequent discovery of the canine tooth. (4) He considered that there was no longer room for doubt as to the position the fragments originally occupied in the skull; and it is very improbable that the complete brain-cast could be more than 1100 c.c. in capacity. (5) There seems ample justification for

putting the Piltown remains into a genus separate from all the other Hominidæ. *Eoanthropus* must represent a persistent and very slightly modified descendant of the common ancestor of *Homo sapiens* and *H. primigenius*. There is no positive evidence that the genus *Homo*, or even *Eoanthropus*, had come into existence in Pliocene times. The fact of *E. dawsoni* being found in a deposit that may perhaps be as late as the Mid-Pleistocene does not invalidate the conclusion that the genus to which it belonged was ancestral to the Heidelberg man. When man was first evolved the pace of evolution must have been remarkably rapid, and it is quite possible that amidst the turmoil incidental to the inauguration of the Pleistocene period a new group of anthropoids rose superior to the new difficulties, and became "dawn-men." It is almost certain that man began to speak when his jaw was in the stage represented in that of *Eoanthropus*. The brain already shows considerable development of the parts associated in modern man with the power of speech.

NEW SOUTH WALES.

Linnean Society, October 29.—Mr. W. S. Dun, president, in the chair.—Dr. J. M. Petrie: Hydrocyanic acid in plants. Part ii., Its distribution in the grasses of New South Wales. The existence of hydrocyanic acid in the Gramineæ was discovered by Jorissen, in 1884. Since then, about thirty species have been recorded as containing a cyanogenetic compound. The author's work is a continuation of investigations into the cause of sudden fatalities among sheep in this State. More than 200 species of grasses were tested systematically. Glucosides, capable of yielding hydrocyanic acid, were detected in twenty species, eleven of these being native grasses, the others introduced. The acid existed free in only two species, *Cynodon incompletus* and *Diplachne dubia*; in the rest, it is mainly combined as glucoside, and, therefore, only liberated by contact with the natural ferment of the plant under favourable conditions.—Archdeacon F. E. Haviland: Notes on the indigenous plants of the Cobar district, N.S.W. No. 2. In this second contribution the number of natural orders represented in the Cobar district is increased from 64 to 71; of genera, from 197 to 275; and of species, from 337–504.—E. Turner: New fossorial Hymenoptera from Australia and Tasmania.

BOOKS RECEIVED.

Exercises from A New Algebra. Parts i.-iv. By S. Barnard and J. M. Child. Pp. 274. (London: Macmillan and Co., Ltd.) 2s. 6d.

Hunting the Elephant in Africa, and other Recollections of Thirteen Years' Wanderings. By Capt. C. H. Stigand. Pp. xv+379. (London: Macmillan and Co., Ltd.) 10s. 6d. net.

Examples in Physics. By H. Freeman and E. Jobling. Pp. 96. (Cambridge: W. Heffer and Sons, Ltd.) 1s. net.

La Technique de la Radiotélégraphie. By Dr. H. Rein. Translated by G. Viard. Pp. x+262+v plates. (Paris: Gauthier-Villars.) 9 francs.

Leçons de Mathématiques Générales. By Prof. L. Zoretti. Pp. xvi+753. (Paris: Gauthier-Villars.) 20 francs.

Paléontologie végétale. By Dr. F. Pelourde. Pp. xxviii+360. (Paris: O. Doin et Fils.) 5 francs.

Die Brownsche Bewegung und einige verwandte Erscheinungen. By Dr. G. L. de Haas-Lorentz. Pp. 103. (Braunschweig: F. Vieweg und Sohn.) 3.50 marks.

Der heutige Stand der Synthese von Pflanzenalkaloiden. By Dr. H. Bauer. Pp. viii+144. (Braunschweig: F. Vieweg und Sohn.) 4.50 marks.

Tensoren und Dyaden im dreidimensionalen Raum. By E. Budde. Pp. xii+248. (Braunschweig: F. Vieweg und Sohn.) 6 marks.

Industrial Mathematics. By H. W. Marsh, with the collaboration of A. G. F. Marsh. Pp. viii+477. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 8s. 6d. net.

Smithsonian Institution. U.S. National Museum. Bulletin 80. A Descriptive Account of the Building Recently Erected for the Department of Natural History of the U.S. National Museum. By R. Rathbun. Pp. 131+34 plates. (Washington: Government Printing Office.)

History of Geography. By Dr. J. Scott Keltie and O. J. R. Howarth. Pp. ix+154. (London: Watts and Co.) 1s. net.

Guide to the Materials for U.S. History in Canadian Archives. By D. W. Parker. Pp. x+339. (Washington: Carnegie Institution.)

The Sabanu. The Studies of a Sub-Visayan Mountain Folk of Mindanao. Part i., by Lieut.-Col. J. P. Finley. Part ii., by W. Churchill. Pp. v+236+2 plates. (Washington: Carnegie Institution.)

Heredity in Skin Color in Negro-White Crosses. By C. B. Davenport. Pp. 106+4 plates. (Washington: Carnegie Institution.)

Guide to Materials for the History of the U.S. in the Principal Archives of Mexico. By Prof. H. E. Bolton. Pp. xv+553. (Washington: Carnegie Institution.)

Metallographie. Erster Band. Die Konstitution. Zweiter Teil. Heft. 1. Die Konstitution des Systemes Eisen-Kohlenstoff sowie der sonstigen binären Kohlenstofflegierungen. By Dr. W. Guertler. Pp. x1+648+plates. (Berlin: Gebrüder Borntraeger.) 32 marks.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief 64-68. (Jena: G. Fischer.) 2.50 marks each Lief.

The Englishwoman's Year Book and Directory, 1914. Edited by G. E. Mitton. Pp. xxxii+431. (London: A. and C. Black.) 2s. 6d. net.

Who's Who, 1914. Pp. xxx+2314. (London: A. and C. Black.) 15s. net.

Who's Who Year-Book for 1914-15. Pp. vii+178. (London: A. and C. Black.) 1s. net.

The Writers' and Artists' Year-Book. Edited by G. E. Mitton. Pp. x+154. (London: A. and C. Black.) 1s. net.

The American Annual of Photography, 1914. Edited by P. Y. Howe. Pp. 328. (New York: American Annual of Photography Inc.; London: G. Routledge and Sons, Ltd.) 3s. 6d. net.

Union of South Africa. Mines Department. Annual Reports for 1912. Part iv., Geological Survey. Pp. 193+ xvii plates. (Pretoria: Government Printing and Stationery Office.) 7s. 6d.

Who's Who in Science. International, 1914. Edited by H. H. Stephenson. Pp. xx+662. (London: J. and A. Churchill.) 10s. net.

Transactions of the Royal Society of Edinburgh. Vol. xlix. Part 2. Session 1912-13. Pp. 229-529+plates. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 32s. 6d.

Continuity. By Sir Oliver Lodge. Pp. 118. (London: J. M. Dent and Sons, Ltd.) 1s. net.

Elementary Practical Electricity and Magnetism. By J. C. Kirkman. Pp. 136. (London: G. G. Harrap and Co.) 2s. 6d. net.