

not, nor is it infallible; but it is a praiseworthy attempt to organise into one guild the teachers of a growing and most important section of educational work. The labour involved in getting together the facts which make up the contents must have been immense, and it is to be hoped that, now the work has been done, the support required to ensure the annual publication of the directory will not be lacking. If the book only makes teachers in technical schools and institutes realise that they are part of one organic whole, having for its object the extension of scientific knowledge, it will accomplish a much-desired end.

THE Report of the Technical Educational Committee of the Berks County Council is optimistic, but it is not distinguished by descriptions of any very noteworthy developments. Berkshire is an agricultural county, and that is tantamount to saying that little encouragement is given to scientific education. Such counties are not willing to be taught much about principles; what they will tolerate, are subjects like practical butter-making, laundry-work, poultry-keeping, hedging, and horse-shoeing; but to attempt to teach agriculturists anything much beyond manual dexterity, is to court opposition. However, the Technical Education Committees are doing something to educate the agricultural mind to a better appreciation of the benefits to be derived from science, though it must be confessed that the rate of progress is extremely slow. Berkshire, along with Oxfordshire and Hampshire, contribute towards the maintenance of the University Extension College at Reading, and, in recognition of the satisfactory development of the agricultural department of the college, the Board of Agriculture recently granted a sum of £500, and the money could not have been better bestowed. The various courses of study at the college are well arranged, and valuable field experiments are carried on. By paying over the sum of £400 to the college, the Berkshire Committee ensures efficient instruction for the students under their care, and that is a very important consideration, for the supply of good teachers, competent to teach science as it should be taught, is comparatively small, to say nothing of the laboratory accommodation essential for truly scientific instruction. In spite of the facilities thus offered, the lectures in elementary science arranged for teachers were not successful. It would be a great pity if the Committee had to discontinue this part of their work on account of the want of support by the teacher for whom the lectures are intended. The other ways in which the Committee disposes of the funds allocated to technical education are evening continuation classes, scholarships, dairying, fariery, and bee-keeping. Aid is also given to classes in the principles of agriculture, mensuration, botany, drawing, horticulture, chemistry, mechanics as applied to agriculture, and to manual instruction in woodwork and metalwork.

THE Brussels correspondent of the *Times* reports that the electrical and anatomical institutes founded by M. Ernest Solvay, and presented by him and other donors to the University of Brussels, were officially inaugurated on Monday, under the presidency of the Burgomaster, assisted by M. Graux, the Chancellor, and the entire body of professors. Delegations from the English and Continental Universities have responded to the invitation of the Brussels University to take part in the series of *fêtes* organised in celebration of the event.

It was announced a few weeks ago that the Treasury has thoughts of reinstating King's College, London, in the enjoyment of its share of the grants made to University Colleges. In consequence of this decision, the Council of the College have adopted a conscience clause as a standing regulation.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 25.—Mr. Walter Baily, Vice-President, in the chair.—Prof. J. Perry read a paper, by himself and Mr. H. F. Hunt, on the development of arbitrary functions. During the discussion on Prof. Henrici's paper (April 13, 1894), one of the authors described a graphical method of developing any arbitrary function in a series of other normal forms than sines and cosines, such as Bessel's or zonal spherical harmonics. The method consisted in wrapping the curve which represents the function round a specially shaped cylinder, not circular, and projecting this curve on to a certain plane. Many months were wasted in finding with great exactness a sufficient number of coordinates of the trace of the cylinder suitable for a

Zeroth Bessel development. The labour, however, was unnecessary, since the coordinate most troublesome to calculate is not really needed, the projection only taking place in one direction. To develop any arbitrary function of x (say y) in normal forms, the real difficulty consists in finding the value of an integral such as $\int_0^a y \cdot Q(x) \cdot dx$ where $Q(x)$ is some tabulated function. If now z is another tabulated function which is the integral of $Q(x)$, the required integral is $\int y dz$. If the values

for y for 25 equidistant values of x are known, from $x = 0$ to $x = a$. Let the corresponding values of z be tabulated, and let a curve be drawn with the values of y as ordinates and the values of z as abscissæ; the area between the axis of z and this curve gives the value of the integral required. The authors give four tables containing the abscissæ for the four first terms in the development in Zeroth Bessels. They have tested the method by applying it to the calculation of a known function in terms of zonal spherical harmonics, and the agreement between the true value of the coefficients and those found is very satisfactory. Prof. Henrici said the method was a new departure, since in the place of an instrument of complicated design the authors only used a planimeter and pencil and paper, and obtained the same degree of accuracy. The fact that the series employed to test the method consisted of a finite number of terms seemed to him an objection. Prof. Karl Pearson had in a recent conversation informed him of a method for the development of functions which he (Prof. Pearson) had recently discovered. This method was not, however, so simple—at least in most cases—as that of the authors. Prof. Minchin thought it would add to the intelligibility of the paper if it were stated that the method was similar to that employed when expanding in terms of a Fourier series or in spherical harmonics. In these cases you have a function which, when multiplied by other functions of different orders, kills all the terms except one. Graphic methods ought, in his opinion, to be very much oftener employed, and he considered that there was no problem in physical mathematics of which the solution could not be obtained by graphic methods. He would also like to know if Prof. Perry had obtained a graphic method of calculating Bessels. Mr. Trotter agreed with Prof. Minchin as to the neglect of graphic methods. He regretted that Prof. Perry did not continue to consider the method as the projection from a cylinder, as he had found the method of wrapping curves round a cylinder most useful. Prof. Perry in his reply said he had adopted the expansion they had employed, under the impression that the test was a particularly severe one. He had not discovered a graphic method of calculating Bessels. The reason they gave up the cylinder was the immense labour involved in calculating the y coordinates of the trace, which would afterwards be of no use in the development of the function:—Mr. F. W. Lanchester read a paper on the radial cursor, a new addition to the slide-rule. The ordinary form of slide-rule enables calculations to be made which involve multiplication and division, also involution and evolution where the indices are integers. The radial cursor allows of the solution of problems in which fractional indices occur; for example, in questions involving the adiabatic expansion of a gas, where an expression of the form $p v^\gamma = \text{const.}$ has to be dealt with, and where γ is not an integer, nor is it constant for all gases. In this case it is necessary to provide some ready means of dividing the scales on the rule and slider proportionally to the value of γ , which corresponds to the division and multiplication of the respective logarithms of the quantities dealt with in the proportion of the indices of p and v , i.e. 1 and γ . This proportionate division of the scales is effected in the new cursor by a radial index-arm which is arranged to swing about a stud fixed to a sliding-bar running in guides at right angles to the rule. All readings are taken at the points of intersection of a line on the radius arm and the edges of the slide. The distance of the pivot, on which the radius arm turns, from the scale, and therefore the value of the index employed, is read off on a scale fixed to the transverse bar. Mr. C. V. Boys said that owing to the kindness of the author he had been able to try the cursor, and had found it of great service in dealing with questions of adiabatic expansion. The new addition to the slide-rule suffers under the same disadvantage as the rule itself, namely that a verbal or written description seems so very much more complex than is the actual operation when using the rule. The author's device might be described as an india-rubber slide-rule, for it performed the function of a slide-rule in which the graduations

of the slide were made on india-rubber so that the ratio of the length of the scale on the rule to the length of the scale on the slide might be altered at will, and thus involution and evolution with fractional indices performed. Mr. Blakesley asked how powers less than unity were dealt with. Prof. S. P. Thompson and Mr. Trotter expressed their admiration for the author's method of "stretching" the scale. Mr. Burstall said he had attempted to apply a similar method to the Fuller rule, but did not succeed, since in this scale there was only one scale. He hoped the author's method could be applied in a form such that a greater accuracy than one in 300 could be obtained. Mr. Bourne thought the fact that the point of intersection of two lines inclined at an acute angle had to be read was likely to limit the accuracy. The author having replied, the Society adjourned till November 8.

PARIS.

Academy of Sciences, October 21.—M. Marey in the chair.—The decease of M. Hellriegel (Correspondent of the Rural Economy Section), at Bernburg, Anhalt, on September 24, was announced to the Academy.—A study of graphite extracted from a pegmatite, by M. Henri Moissan. The author concludes, from the impressions of markings on the graphite crystals transferred to surrounding quartz and felspar, that the graphite existed before the pegmatite was formed. This graphite much resembles graphite formed in the electric furnace in fused metals, and may have been formed under somewhat similar conditions.—A study of some varieties of graphite, by M. Henri Moissan. Graphites found in nature may be divided, as recommended by M. Luzzi, into intumescent and non-intumescent graphites. The former appear to have been produced in fused metallic masses, the latter by the action of a raised temperature on any variety of amorphous carbon.—On the Mounier Observatory, by M. Perrotin. Details are given concerning observations on the surface of Venus. The lack of alteration in the characteristics of the part of the surface viewed during a considerable time supports Schiaparelli's contention that the planet can only rotate with great slowness.—M. Mascart presented an "Atlas of the 'isanomals' and secular variations of terrestrial magnetism," by M. Al. de Tillo. The general conclusions able to be drawn from a study of the lines of secular variation are: (1) the changes of the elements so occur that in one hemisphere they are positive, and in the other negative; (2) there is a great similarity between the trace of the isanomals and that of the lines of equal secular variation.—Prof. Norman Lockyer presented some photographs of star spectra taken with an objective and prism made by the Brothers Henry. The lines in the spectrum of Bellatrix correspond to those of helium. The absorption due to the atmospheres of stars showing few lines is due mostly to hydrogen and helium.—The following articles, by M. Cruls, are printed in the Correspondence: (1) Posições geográficas. The geographical positions determined are those of Rodeio, Entre-Rios, Juiz de Fora, Joad Gomes, and Barbacena along the Central Railway. (2) Les éléments climatologiques de Rio. Given by a discussion of data from 1851 to 1890. (3) Éclipses de Soleil et occultations.—On a long period inequality in the longitude of Mars, by M. G. Leveau. An empirical correction proposed by Newcomb to the Le Verrier tables of geocentric longitude, and supposed to be due to a want of sufficient precision in the determination of the theoretical value of a coefficient, is shown by the author's calculations by an independent method not to be required by any error in the tables, as his results agree exactly with Le Verrier's figures.—On the deformation of surfaces, by M. Paul Adam.—A correction to be applied to readings of metastatic thermometers, by M. Scheurer-Kestner. The correction discussed is to be applied to the Walferdin or Beckmann thermometer to allow for the mercury in the upper reservoir, which is for the time being inactive as regards expansion shown on the scale.—Study on the latent heats of vaporisation of fatty ketones, of octane and decane, and of diethyl and dimethyl carbonates, by M. W. Longuinine. With regard to Trouton's formula $\frac{MS}{T} = a$ constant (where M is the molecular weight of the substance, S is its latent heat of vaporisation, and T its absolute boiling point), the results so far obtained warrant the general conclusions: (1) For each of the groups that have been studied $\frac{MS}{T}$ is very nearly constant. (2) It varies notably for different groups of substances. Latent heats may be calculated by the general mean value given to the constant within 15 per cent., and by the value obtained from a determination by means of a

substance of the same type within 1.5 per cent.—Peroxidised potassium derivatives of benzoquinone, by M. Ch. Astre. Benzoquinone contains only two atoms of hydrogen in its molecule replaceable by a metal. The diketonic nature of benzoquinone is supported by the author's results.—On the composition of rice imported into France, by M. Balland.—On the toxicity of acetylene, by M. N. Gréhan. Acetylene is poisonous when it occurs in air to the extent of 40 to 79 per cent., but is not nearly so injurious as ordinary lighting gas. M. H. Moissan added that pure liquefied acetylene possesses an agreeable ethereal odour, and causes no inconvenience when breathed in small quantity.—Serotherapy in the treatment of cancer, by MM. J. Héricourt and Ch. Richet.—On a new Lamellibranch (*Scioberetia australis*) commensal with an Echinoderm, by M. Félix Bernard.—On the age of the lignite formation of Southern Chili, the Auracaria group, the Chilian equivalent of the Laramie and Chico-Tejon group of North America, by M. A. F. Noguès.—On the daily variations of relative humidity, by M. D. Eginitis.—On new observations in the Padiriac chasm (Lot), by M. E. A. Martel.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Elementary Physics: J. Henderson (Longmans).—The People of the Moon: T. Carter (*Electrician* Company).—An Account of Palmyra and Zenobia: Dr. W. Wright (Nelson).—Rambles in Japan: Dr. H. B. Tristram (R.T.S.).—Technical Educator, Vols. v. and vi. (Cassell).—Birds of Berkshire: G. Muirhead, Vol. 2 (Edinburgh, Douglas).—Practical Trigonometry: H. Adams (Whittaker).—The Valley of Kashmir: W. R. Lawrence (Froude).—Atlas of the Fertilization and Karyogenesis of the Ovum: Drs. Wilson and Leaming (Macmillan).

PAMPHLETS.—Anleitung zur Molekulargewichtsbestimmung: Dr. G. Fuchs (Leipzig, Engelmann).—Ueber den Zusammenhang Zwischen der Erdmagnetischen Horizontalintensität und der Inclination: Dr. H. Fritsche (St. Petersburg).—Compte Rendu des Travaux de la Société Helvétique des Sciences Naturelles réunie à Schaffhouse, 1894 (Genève).—Congrès de la Science de l'Atmosphère, Anvers, 16-18 Aout 1894, Communications: A. Lancaster (Anvers).

SERIALS.—Tufts College Studies No. 4 (Tufts College, Mass.).—Zeitschrift für Wissenschaftliche Zoologie, lx. Bd. 1 Heft (Leipzig, Engelmann).—Studies in Biology from the Biological Department of the Owens College, Vol. 3 (Manchester, Cornish).—Good Words, November (Isbister).—Sunday Magazine, November (Isbister).—Longman's Magazine, November (Longmans).—Journal of the Royal Microscopical Society, October (Williams).—Mitteilungen der Naturforschenden Gesellschaft in Bern, Nr. 1335-1372 (Bern).—Verhandlungen der Schweizerischen Naturforschenden Gesellschaft, 1893-94 (Schaffhausen).—Scientific Transactions of the Royal Dublin Society, Vol. 9, series 2: The Papillary Ridges on the Hands and Feet of Monkeys and Men: D. Hepburn (Williams).—Humanitarian, November (Hutchinson).—Astrophysical Journal, October (Wesley).—Natural Science, November (Rait).

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