

table is the numerical preeminence of attendance at Berlin, where the total exceeds that of Munich, Leipzig, Bonn and Breslau combined. But 42 per cent. of Berlin's attendance is made up of non-matriculated students, representing a floating element to a considerable extent. Elsewhere in Germany this feature is a minor one in university attendance.

In his presidential address at the annual conference of the National Association of Manual Training Teachers, held at Hastings on April 5, Sir John Cockburn dealt with the psychological importance of manual training. It is now recognised, said Sir John Cockburn, that the hand is one of the best channels to the intelligence, and that in training the hand we minister most effectually to the requirements of intellectual, moral, and physical development. Time in giving intellectual studies would be saved if half the school hours were spent in the workshop. Pupils detect their errors in actual work more readily than in abstract processes, and learn to despise inaccuracy and slovenliness. Nothing so clearly demonstrates the difference between right and wrong as manual training. A lie in wood stands self-exposed. The constructive imagination is strengthened, and invention is stimulated by manual work. Psychologists are agreed that in developing the mind manual training must rank as an indispensable element in all primary and secondary schools.

To celebrate the seventieth birthday of President Eliot, president of Harvard University, the graduates and students of the university have subscribed a thousand pounds for a portrait or bust to be placed in the Union. A very eulogistic letter with ten thousand signatures was presented to President Eliot on his birthday. After enumerating the distinguishing characteristics of his thirty-five years of presidency, the letter continues:—"Through you the American people have begun to see that a university is not a cloister for the recluse, but an expression of all that is best in the nation's thought and character. From Harvard University men go into every part of our national life. To Harvard University come from the common schools, through paths that have been broadened by your work, the youth who have the capacity and the will to profit by her teaching. Your influence is felt in the councils of the teachers and in the education of the youngest child. . . . Fearless, just, and wise, of deep and simple faith, serene in affliction, self-restrained in success, unsuspected by any man of self interest, you command the admiration of all men and the gratitude and loyalty of the sons of Harvard." British men of science will join in the congratulations to President Eliot that he has passed the age of seventy with undiminished power.

At the ordinary meeting of the Society of Arts on April 13, Mr. J. C. Medd read a paper on agricultural education. He said it has now been realised that success in farming demands extensive scientific knowledge quite as much as thorough practical training. The development in the facilities for instruction since 1888 has been remarkable. Figures were quoted to show there had been a total outlay by the Government and by local authorities of nearly 100,000l. per annum. Mr. Medd thinks that it is to the evening school that the authorities must look for the improvement of the labourer and the recovery of the skilled or "handy" man. The paper concluded with a scheme to coordinate and place upon a satisfactory basis the rural and agricultural education of every county. Small village schools should be closed and their children conveyed daily to some central school. Better buildings and equipment, more regular attendance, and a more efficient staff would thus be ensured. A few favourably situated schools should be developed upon the model of the *écoles primaires supérieures*. A continuation school should be organised in every village. Winter schools of agriculture and horticulture should be established in selected districts according to the particular requirements and characteristics of each county, and the services of their directors should be made available for all farmers and gardeners during the summer. Demonstration plots should be placed in the charge of men who combined scientific accuracy with some actual knowledge of practical farming, and were in touch with the farmers of the district.

NO. 1799, VOL. 69]

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 17.—"Physical Constants at Low Temperatures. (1) The Densities of Solid Oxygen, Nitrogen, Hydrogen, &c." By Prof. James Dewar, M.A., LL.D., D.Sc., F.R.S.

The observed densities of solid oxygen and nitrogen, taken at the boiling point of hydrogen, are 1.425 and 1.026 respectively. Similarly the density of solid hydrogen between 13° and 14° absolute was found to be 0.076. From the observations given in the paper, the "Matthias Diameter Line" is deduced in each case, and from these the critical density and molecular volume at the zero of temperature follow. The molecular volume at zero of oxygen is 21.2, of nitrogen 25.5, and of hydrogen 24.2. From these results it follows that if solid water could result from a combination of solid hydrogen and oxygen taking place at the zero of temperature the reaction would involve a volume contraction of 45 per cent. A discussion follows of the critical constants of hydrogen in which the want of agreement between theory and experiment is pointed out. The conclusion reached is that in the case of the constants of hydrogen a marked variation from what in the case of other substances may be regarded as fairly general results must be anticipated, and that further experiments are required to clear up the difficulties.

Linnean Society, April 7.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. E. P. Stebbing exhibited lantern-slides of the metamorphoses of *Clania Cramerii*, a Psychid moth from the Madras Presidency, showing its use of its food-plant, *Casuarina equisetifolia*, in the making of its protective case.—Mr. F. Enock displayed a series of more than fifty slides of natural colour photography of living insects and flowers by the Sanger-Shepherd three-colour process, the president adding a few remarks on the results.—Mr. C. E. Jones then gave an abstract of his paper, the morphology and anatomy of the stem of the genus *Lycopodium*.

Faraday Society, April 13.—Mr. J. Swinburne, vice-president, in the chair.—Alloys of copper and arsenic: Arthur J. Hiorns. The object of the author's investigations was to ascertain the exact relation between copper and arsenic in binary alloys, and the limit of proportion of arsenic that can be retained in copper in the cold solid state. The addition of arsenic lowers the melting point of copper uniformly down to about 14 per cent., when a steep fall in the freezing point curve occurs, reaching its lowest point at 68.5° C. This alloy contains 19.2 per cent. of arsenic, which corresponds to the formula Cu_3As_2 . The alloy with 22 per cent. of arsenic freezes at 70.8°, and the temperature gradually rises until the alloy with 28.34 is reached at 74.7°. This is the compound Cu_3As . At 81.0° another chemical compound freezes, having the chemical formula Cu_2As_3 ; it contains 32.2 per cent. of arsenic. Beyond this point the temperature gradually falls again to a minimum at the alloy with about 35 per cent. of arsenic. The curve then rises to another summit at 74.0°, forming the compound Cu_2As , with 37.24 per cent. of arsenic. From this position the curve descends to 70.2° with the alloy containing 41 per cent. of arsenic; this is nearly the practical limit of the direct combination of copper and arsenic.—Experiments with a new primary cell: E. G. P. Bousfield. The cell consists of an inner porous pot containing nitric acid and a carbon pole, and an outer vessel containing sodium hydrate solution and a metal pole, preferably zinc, i.e. with a solution of from 12 per cent. to 15 per cent.; using solutions of maximum conductivity with zinc and carbon poles on open circuit, an E.M.F. of 2.6 volts may be obtained. Not only does the cell possess this comparatively high E.M.F., but it may be short-circuited far longer than most cells before it runs down. A cell short-circuited through a total resistance of 0.61 ohm gave a current of 4.18 amperes, which fell to 2.61 in an hour, 2.38 in 2½ hours, and 1.75 in 6 hours. A smaller cell gave a fairly constant current of about 0.8 ampere for 20 or 25 hours. Discharge curves are given in the paper.—Mr. Bousfield also contributed a note on determining accurately the percentage of ozone in gases not dissociated by moderate heat.

Mathematical Society, April 14.—Dr. E. W. Hobson, vice-president, in the chair.—Mr. G. B. Mathews communicated a paper by Prof. F. Morley on a plane quintic curve. The curve is the locus of the points of contact of tangents from a fixed point to a pencil of cubics. It is of maximum genus (deficiency), viz. 6, and the 45 tangents at points of inflexion pass by nines through 5 points.—Mr. H. M. Macdonald gave an account of his recent researches concerning the singularities of functions determined by Taylor's series. Unless special relations hold among the coefficients of the series every point on the circle of convergence is a singularity, and attention has been directed to the problem of determining the coefficients in order that the function may have singularities at prescribed points on the circle only.—The following papers also were communicated:—Note on a system of linear congruences: Rev. J. Cullen.—The tile theorem: Dr. W. H. Young.—Note in addition to a former paper on conditionally convergent multiple series: G. H. Hardy.—On functions generated by linear difference equations of the first order: Rev. E. W. Barnes. The simplest solutions of linear difference equations with meromorphic functional coefficients are one-valued functions with sequences of poles tending to infinity. When the coefficients are one-valued functions with essential singularities the solutions generally have sequences of such singularities. These functions cannot in general arise as the integrals of differential equations of any finite order and dimensions with coefficients which are not derived from the function itself. Thus linear difference equations give rise to classes of transcendental functions which cannot be generated by differential equations.—Mathematical analysis of wave-propagation in isotropic space of p dimensions: T. H. Havelock. In the case of three dimensions certain methods of integration of the equation of wave-propagation were found by Poisson and Kirchhoff. These are connected with the analytic expression of Huygens's principle. In two dimensions the corresponding integrals are more complicated, and the interpretation of them shows that in general the waves generated at a temporary source have no definite rear surface, but leave a trail behind. Corresponding integrals are obtained in the paper in the case of any number of dimensions, and it is shown that this distinction of properties extends to all cases of uneven and even numbers of dimensions.—On spherical curves, part ii.: H. Hilton.—Perpetuant syzygies of degree four: P. W. Wood.—Extension of Sylow's theorem: Prof. G. A. Miller.—(1) Transformation of the function $F([\alpha][\beta][\gamma]x)$; (2) The extension of Neumann's addition theorem for Bessel functions: Rev. F. H. Jackson.—The following informal communications were made:—Behaviour of a power series near a point on the circle of convergence at which the series diverges: Dr. H. F. Baker.—Transvectant operators in connection with binary forms: R. J. Dallas.—Factorisation of $13^{39}-1$: Lieut.-Colonel A. Cunningham. The factors are 4.3; 3.61; 1803647; 53.264031; 57745124662681*: 79.1093.4603.21841, where the semicolons separate the algebraic factors and the colons separate the Aurifeuillian factors. The factor marked with an asterisk has not been resolved.

MANCHESTER.

Literary and Philosophical Society, January 5.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—Note on a method of preparing hydrobromic acid: R. L. Taylor.

January 19.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—The specific heats and specific volumes of certain alloys: H. E. Schmitz. The calculated and observed values in the cases examined agreed very closely.—On phenomena due to repetitions of stress, and on a new testing machine: F. Foster. When a metal is strained by a steady stress, the crystals of which it is composed undergo no change until the elastic limit is passed, but then an internal slipping takes place, which is permanent. The same slipping takes place if a stress much less than the elastic limit is applied and removed repeatedly, and is due probably to hysteresis in the extension of the metal. In order further to study these phenomena, the author has designed a new testing machine capable of subjecting the metal under test to a great variety of conditions.

February 2.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—A diagnostic key for the genera of recent dibranchiate Cephalopoda: Dr. Hoyle.

NO. 1799, VOL. 69]

February 16.—Mr. Charles Bailey in the chair.—On a suitable arrangement for determining the capacities of condensers by the successive discharge method: H. Morris-Airey and E. D. Spencer. The rotating commutator generally employed in this method was replaced by an electrically excited tuning fork, the prongs of which carried aluminium riders making contact in mercury cups. By this means it was possible to obtain perfectly regular discharges at a much bigger rate than is usually possible with rotating commutators.—Note on the spectrum of the glow discharge at atmospheric pressure: Dr. G. A. Hemsalech. With an alternating discharge the spark spectrum between metallic terminals is affected by heating them, the glow then being obtainable at either pole.

Special Meeting, February 23.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—The Wilde lecture, on the evolution of matter as revealed by the radio-active elements, was delivered by Mr. F. Soddy (see p. 418).

March 1.—Prof. H. B. Dixon, F.R.S., in the chair.—The ionisation of air: Prof. A. Schuster, F.R.S. The author described a method of observation which allowed him to determine the number of ions which are constantly being formed in the atmosphere. All experiments which have hitherto been made only determined the total number of ions present, but not the rate at which they re-combined or formed. Some experiments made in a field near Rochdale on February 28 gave 2400 for the number of ions in each cubic centimetre of air, and a formation of 18 new ones in each second, while on the roof of the physical laboratory at the Owens College on February 29 the numbers were 3600, with a formation of 38 fresh ones each second.

March 15.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—The Falkland Islands revisited: Rupert Valentín. The principal zoological, botanical and geological features of the district were described.—Mendel's principles of heredity: A. D. Darbishire.—On photochemically active chlorine: D. L. Chapman.

PARIS.

Academy of Sciences, April 11.—M. Mascart in the chair.—Theory of the quadrifilar azimuth balance: H. Poincaré. An investigation of the equations of sensibility and stability of the quadrifilar balance described by M. Crémieu.—Note on the graphical method applied to human pathology: M. Lannelongue. The graphical method, the use of which is described in detail in the paper, can be applied with advantage in a number of cases where photography or radiography would not give the same results.—A new general theorem in the theory of analytical functions: G. Mittag-Leffler.—Remarks on the communications of M. A. Charpentier, and the questions of priority to which they have given rise: M. d'Arsonval. The results of Charpentier are held to be new, since it is one of the characteristics of the radiations which he has discovered that they are without effect on a photographic plate, whilst the work of others claiming priority in this matter has been mostly carried out by means of photography.—On a particular class of persistent conjugate systems: D. Th. Egorov.—On groups of operations: G. A. Miller.—On the equations of geometry and the theory of substitutions: Ed. Maillet.—A quadrifilar azimuth balance: V. Crémieu. A description of an entirely new form of balance, in which the beam is supported by a plunger floating in mercury, and in which the pointer of the ordinary balance is replaced by a system supported by four wires in torsion attached to the beam. The theory of this balance is worked out by M. Poincaré in a previous paper. Instead of using a rider, differences below a centigram are measured by means of the electrodynamic repulsion produced between two bobbins, the current being adjusted by means of a resistance until the point of equilibrium is reached.—On the penetrating power of the n_1 -rays emitted by certain sources, and their storage by different substances: Julien Meyer. The n_1 -rays, discovered by Blondlot, the effects of which are the inverse of the n -rays, are given off by vacuous glass tubes, and possess a greater penetrating power than the similar rays given off by a Nernst lamp. Certain substances appear to possess the power of storing up these rays, aluminium being a notable example, and then emit them for as long as twenty-four hours afterwards.—On the earth-

quake in the Balkans, April 4: Th. **Moureaux**.—Electrical osmosis in methyl alcohol: A. **Baudouin**. The method adopted by M. Perrin in studying electrical osmosis in aqueous solutions has been applied by the author to solutions in methyl alcohol. The effects observed are similar to the case of water, but smaller in magnitude, so that higher differences of potential had to be employed. Osmosis is very sensitive to traces of dissolved materials provided that these are electrolytes. Non-electrolytes, even in comparatively large proportions, are without effect.—On the calculation of the heats of combustion of organic compounds containing nitrogen: P. **Lemoult**. A general formula for calculating the heat of combustion of any compound containing carbon, hydrogen, oxygen, and nitrogen is worked out, and numerous examples are given of the degree of approximation obtained.—On the application of the Blondlot rays to chemistry: Albert **Colson**. By means of the effects on a phosphorescent screen the author has been able to detect differences in the interaction of solutions of potash and zinc sulphate according to the order in which they are mixed, and these differences have been subsequently borne out by their chemical behaviour.—On a new mode of formation of calcium carbide: L. M. **Bullier**. Calcium carbide can be obtained by the electrolysis of a mixture of calcium chloride and lime, but the method has no commercial value.—The estimation of nitrogen: Léon **Débourdeaux**. Methods of estimating nitrogen based on the production of ammonia are all liable to be vitiated by the production of amines, notably methylamine. The method now described, which is based on the dry distillation of the nitrogen compound with a mixture of potassium monosulphide and potassium thiosulphate, gives ammonia free from amines. A list is given of the classes of compounds to which this method is applicable.—The influence of hydriodic acid on the oxidation of sulphurous acid: A. **Berg**. Hydriodic acid may either retard or accelerate the oxidation of sulphurous acid according to its concentration. For a given strength of sulphurous acid, there appears to exist a strength of hydriodic acid which is without influence on the rate of oxidation. Other substances besides hydriodic acid can affect the rate of oxidation.—The chlorination of phenyl carbonate in the presence of iodine: Et. **Barral**.—The action of oxidising agents on the purity of industrial fermentations: Henri **Alliot** and Gilbert **Gimel**. Various oxidising agents were tried with a view to see which exerted the greatest effect in reducing the production of butyric acid during an alcoholic fermentation. Manganese dioxide and bleaching powder gave the best results.—On *Randia Lujae*, a new myrmecophyte and acarophyte of the family Rubiaceæ: E. **de Wildeman**.—On the sense of rotation of water eddies in central Europe: Jean **Brunhes**. In more than 90 per cent. of the vortices observed in the small rapids of central Europe, the sense of rotation was always opposite to that of the hands of a watch.—New researches on the static work of a muscle: Charles **Henry**.—The specific reinforcement of phosphorescence by extracts of organs in physiological exploration: Augustin **Charpentier**.—Biological observations made at Chamonix and on Mt. Blanc during August and September, 1903: Raoul **Bayeux**. The quantity of oxyhæmoglobin increases in normal blood with the altitude, but, on the contrary, the speed of reduction of the oxyhæmoglobin diminishes with increasing altitude.—The amounts of catalase in different animal tissues: F. **Battelli** and Mlle. L. **Stern**.—On the origin of lactose: Ch. **Porcher**.—The agglutination and hæmolysis of the blood corpuscles by chemical precipitates: M. **Gengou**.—On the yellow spot disease of the cork oak: F. **Bordas**.

DIARY OF SOCIETIES.

THURSDAY, APRIL 21.

ROYAL INSTITUTION, at 5.—Dissociation: Prof. Dewar, F.R.S.
 LINNEAN SOCIETY, at 8.—On British Freshwater Rhizopoda: J. Cash.—
Exhibitions: Drawings by Mrs. C. Reid of Fruits and Seeds of British
 pre-Glacial and inter-Glacial Plants. II. Calycifloræ: Clement Reid,
 F.R.S.—Holograph Letter of Linnæus to Haller, dated from Upsala,
 May 23, 1747: R. Morton Middleton.
 INSTITUTION OF CIVIL ENGINEERS, at 8.—"James Forrest" Lecture:
 Internal Combustion Engines: Dugald Clerk.
 INSTITUTION OF MINING AND METALLURGY, at 8.—Adjourned dis-
 cussion on the Equipment of Laboratories for Advanced Teaching and
 Research in the Mineral Industries.

NO. 1799, VOL. 69]

FRIDAY, APRIL 22.

ROYAL INSTITUTION, at 9.—Sleeping Sickness in Uganda: Colonel
 David Bruce, F.R.S.
 PHYSICAL SOCIETY, at 5.—Calculation of Colours for Colour Senseto-
 meters and the Illumination of "Three Colour" Photographic Trans-
 parencies by Spectrum Colours: Sir W. de W. Abney, F.R.S.—On
 Normal Pileing as connected with Osborne Reynolds's Theory of the
 Universe: Prof. J. D. Everett, F.R.S.—Note on the Diffraction Theory
 of the Microscope as applied to the Case when the Object is in Motion:
 Dr. R. T. Glazebrook, F.R.S.
 INSTITUTION OF CIVIL ENGINEERS, at 8.—No. 2 River-pier of the Beckton
 Gasworks: A. Trewby.

MONDAY, APRIL 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The German Antarctic Ex-
 pedition: Dr. Eric von Drygalski.
 VICTORIA INSTITUTE, at 4.30.—Old Testament Chronology: F. G. Fleay.
 INSTITUTE OF ACTUARIES, at 5.—On Life Premium Book-keeping: J.
 Chatham.

TUESDAY, APRIL 26.

ROYAL INSTITUTION, at 5.—The Transformation of Animals: Prof. L. C.
 Miall, F.R.S.
 ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Origin of Jewellery: Prof.
 W. Ridgeway.
 INSTITUTION OF CIVIL ENGINEERS, at 8.—Annual General Meeting.

WEDNESDAY, APRIL 27.

SOCIETY OF ARTS, at 8.—The Need of Duty-Free Spirit: Thomas Tyrer.
 GEOLOGICAL SOCIETY, at 8.—On a New Species of Escorpions from the
 Upper Carboniferous Rocks of Lancashire: W. Baldwin and W. H. Sut-
 cliffe.—The Genesis of the Gold-Deposits of Barkerville (British
 Columbia) and the Vicinity: A. J. R. Atkin.

THURSDAY, APRIL 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Further Experiments on the
 Production of Helium from Radium: Sir William Ramsay, K.C.B.,
 F.R.S., and Frederick Soddy.—The Effects of Changes of Temperature
 on the Modulus of Torsional Rigidity of Metal Wires: Dr. F. Horton.
 —The Sparking Distance between Electrically Charged Surfaces. Pre-
 liminary Note: Dr. P. E. Shaw.—Studies on Enzyme Action. Part II.
 The Rate of Change Conditioned by Sucroclastic Enzymes, and its Bear-
 ing on the Law of Mass Action. Part III. The Influence of the Products
 of Change on the Rate of Change Conditioned by Sucroclastic Enzymes:
 Dr. E. F. Armstrong.—Part IV. The Sucroclastic Action of Acids as
 Contrasted with that of Enzymes: Dr. E. F. Armstrong and R. J. Cald-
 well.—Enzyme Action as bearing on the Validity of the Ionic-dissocia-
 tion Hypothesis, and on the Phenomena of Vital Change: Prof. H. E.
 Armstrong, F.R.S.—On the Changes of Thermoelectric Power produced
 by Magnetisation, and their Relation to Magnetic Strains: Dr. Shelford
 Bidwell, F.R.S.—The Behaviour of the Short-period Atmospheric Pres-
 sure Variation over the Earth's Surface: Sir Norman Lockyer, K.C.B.,
 F.R.S., and Dr. W. J. S. Lockyer.

CONTENTS.

	PAGE
Thames Estuarine Fisheries	577
A Study of Genius	578
Text-books of Physical Chemistry. By J. C. P.	579
Our Book Shelf:—	
Gotshall: "Notes on Electric Railway Economics and Preliminary Engineering"; Gonzenbach: "En- gineering Preliminaries for an Interurban Electric Railway."—M. S.	579
Watt and Mann: "The Pests and Blights of the Tea Plant"	580
Lucas: "Highways and Byways in Sussex"	580
Letters to the Editor:—	
Learned Societies.—A. B. Basset, F.R.S.	580
Department of International Research in Terrestrial Magnetism of the Carnegie Institution.—Dr. L. A. Bauer	580
The Formation of Coral Reefs.—Ernest H. L. Schwarz; J. Stanley Gardiner	581
Demonstration of Magnetostriction.—Prof. W. L. Franklin	581
Wawo and Palolo Worms.—Dr. R. Horst; Editor The Base of Napier's Logarithms.—Adolfo Bossetti; G. B. M.	582
Borings into a Coral Reef. (<i>Illustrated</i>).	582
The Forthcoming Cambridge Meeting of the British Association	585
Notes. (<i>Illustrated</i>).	586
Our Astronomical Column:—	
Return of Brooks's Comet	589
Absorption of Star-light by a Comet's Tail	589
The Spectra of Novæ	589
Nebulosity Around Nova Persei	589
Stellar Distribution	589
The Multiple Origin of Horses and Ponies. (<i>Illustrated</i>). By Dr. J. Cossar Ewart, F.R.S.	590
Atmospheric Tides	597
On Lead Poisoning and Water Supplies. By F. C. University and Educational Intelligence	597
Societies and Academies	598
Diary of Societies	600