

stated that, so far as these additional experiments have been carried, the first results have been borne out in regard to the advantage of using a suitable mixture, and in showing the importance of making an accurate analysis of the exhaust gases.

The discussion which took place on the presentation of the report did not add materially to information on the subject. Some of the criticisms were very wide of the mark, more especially in regard to one point, upon which much stress was laid, viz. the leakage of gas through the indicator. This was supposed by some speakers to be sufficient to vitiate the value of the experiments, but, according to Prof. Burstall's tests, made in order to elucidate this point, the consumption of gas by the indicator was so minute as to be imperceptible. It was stated during the discussion by Mr. Burstall, a brother of the author, that, according to calculation, if diagrams were taken every five minutes, when running at 200 revolutions, and if the whole of the gas escaped on the stroke, the loss would be one-fiftieth of 1 per cent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A combined examination of non-resident candidates for open scholarships, exhibitions, &c., will be held at Trinity College, Clare College and Trinity Hall, beginning on November 1. At Trinity College there will be offered for competition about ten scholarships, about ten exhibitions, and about three sizarships. Scholarships include (1) major scholarships, of the value of 80*l.* a year, (2) minor scholarships, of the value of 75*l.* a year or of 50*l.* a year. Exhibitions are generally of the value of 40*l.* a year. Scholarships and exhibitions are tenable for two years from the commencement of residence. Sizarships are of the value of about 100*l.* a year (namely, a payment in money of 80*l.*, and a remission of College fees and dues to the extent of about 20*l.*). They are tenable until the expiration of nine terms from the commencement of residence, unless the holder is previously elected to a major scholarship. Candidates for sizarships must send satisfactory evidence to one of the Tutors that they are in need of the assistance given to sizarships. The subjects of examination will be classics, mathematics, natural sciences, moral sciences, and history. A candidate may take any one of these subjects, or any combination of subjects so far as the arrangement of the papers in the examination permits. At Clare College about eight scholarships of values varying from 80*l.* to 40*l.*, and at Trinity Hall six scholarships at least, ranging between the same values, will be awarded. These scholarships are offered for proficiency in classics, or mathematics, or natural science, or history. Deserving candidates who do not attain the standard for these scholarships may be awarded exhibitions of the annual value of 30*l.* Forms of application for admission to the examination may be obtained from any of the Tutors of the Colleges named.

IN the House of Commons on Thursday, in reply to a question whether it was the intention of the Government to take the second reading of the London University Commission Bill before Whitsuntide, Mr. Balfour said he could not give any definite promise in view of the present state of public business, but he would not discourage the hope that they might have a chance of reaching the Bill as early as some time before Whitsuntide.

A PARLIAMENTARY paper issued by the Science and Art Department states that the total amount expended on technical education during the year 1895-96 in the United Kingdom was 787,467*l.*, and that the estimated total expenditure for the year 1896-97 was 847,620*l.*, exclusive of the sums allocated to technical education under the Welsh Intermediate Education Act, 1889. The total amount of the residue received under the Local Taxation Act by counties and county boroughs in England in 1895-96 was 775,944*l.*, of which 616,607*l.* was appropriated to educational purposes, and 159,336*l.* to relief of rates, the latter sum including 121,558*l.* devoted by the London County Council to that purpose. In Wales the whole of the residue grant of 37,236*l.* paid to thirteen counties and three county boroughs is devoted to intermediate and technical education. The amount of residue received by Scottish authorities was 38,262*l.*, of which 28,999*l.* was apportioned to technical education, and 9158*l.* to relief of rates. In Ireland the residue is not applicable to technical education, but eleven local authorities are making grants out of the rates for that purpose.

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SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xx. No. 2.—On the focal surfaces of the congruences of tangents to a given surface, by A. Pell. This paper is based upon two theorems given by Darboux ("Théorie générale des Surfaces," vol. iii. p. 121) and Königs ("Sur les propriétés infinitésimales de l'espace réglé"), viz.: the locus of the centres of geodesic curvature of lines of curvature of any surface is the edge of regression of the developable surface, generated by the tangent planes of the surface at all points of the lines of curvature, and the edges of regression of the developable surfaces of a congruence form two families of curves on the focal surfaces (say S_A and S_B corresponding to the focal surfaces A and B), the osculating planes of which are tangent to the surfaces B and A respectively, and the points of contact describe on these surfaces two families of conjugate lines S_A and S_B . Other theorems discussed are due to T. Caronnet (*Comptes rendus*, 1892), E. Cosserat (*C.R.*, 1894) and A. Demoulin (*C.R.*, 1894).—Displacements depending on one, two and three parameters in a space of four dimensions, by T. Craig. This is a concise generalisation to a space of four dimensions of the kinematical methods developed by Darboux in the first two volumes of his "Théorie générale des Surfaces." The author employs Poincaré's nomenclature (cf. "Sur les résidus des intégrales doubles," *Acta Math.*, t. 9, p. 385).—Further researches in the theory of quintic equations, by Emory McClintock. The paper contains four parts. The first part is a preliminary classification of quintics into reducible and irreducible, and again into resolvable and unresolvable quintics. The second is a simplified restatement of the author's earlier discoveries. The third contains a presentation of the necessary form of the coefficients of the general resolvable quintic; and the last part is occupied with the development of a theorem according to which any given resolvable quintic engenders another for which the author's sextic resolvent has the same rational value. The memoir was read at the Toronto meeting of the American Mathematical Society in August last.

Symons's Monthly Meteorological Magazine, April.—The climate of Paris, by M. J. Jaubert. This is an account of an interesting and useful book by the meteorologist of the Montsouris Observatory, compiled from all available sources in the Paris district. The mean temperature at the National Observatory is 51°·3, but in the suburbs it is less, e.g., Parc St. Maur, 50°·0. The lowest temperature recorded in the neighbourhood was -17°·5, in December 1871, and the highest was 101°·1 in 1874 and 1881. Fogs are rather frequent, about forty in a year, but a foggy day is defined as one on which objects at a distance of a mile cannot be distinguished. The mean rainfall is about 22 inches, but the amount varies in different parts of the city. About thirty thunderstorms occur in a year, mostly in summer. Very little hail falls, and the stones are seldom more than $\frac{3}{4}$ of an inch in diameter. The yearly average amount of cloud is 6°·0.—Results of meteorological observations at Camden Square for forty years, 1858-97. The average rainfall was 1·71 inches; the amount last March was 1·46 inches. The mean of all the highest shade temperatures was 61°·9, and the mean of all the lowest minimum temperatures was 25°·3. In March last the absolute extremes were 59°·1 and 25°·1, while the temperature on the grass fell below freezing point on twenty-four nights.

Bollettino della Società Sismologica Italiana, vol. iii. No. 7.—Some modifications of the doubly sensitive electric seismoscope, and instructions for its installation and working, by G. Agamennone.—The seismic recorder with increased velocity on the occasion of the earthquake of September 21, 1897, by P. Tacchini.—Diurnal movement of the obelisk of Washington, by E. Oddone.—Notices of earthquakes recorded in Italy (May 14-23, 1897), the most important being an elaborate account of the earthquake of the Tyrrhenian Sea on May 15.

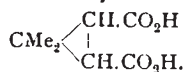
SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 10.—"On the Rotation of Plane of Polarisation of Electric Waves by a Twisted Structure." By Jagadis Chunder Bose, M.A., D.Sc., Professor of Physical Science, Presidency College, Calcutta. Communicated by Lord Rayleigh, F.R.S.

"On the Production of a 'Dark Cross' in the field of Electromagnetic Radiation." By Jagadis Chunder Bose, M.A., D.Sc., Professor of Physical Science, Presidency College, Calcutta. Communicated by Lord Rayleigh, F.R.S.

Chemical Society, April 21.—Prof. Dewar, President, in the chair.—The following papers were read:—The carbohydrates of barley-straw, by C. F. Cross, E. J. Bevan and C. Smith. The ratio of the furfural-yielding carbohydrates to total carbohydrates in barley-straw is not affected by removing the ears at the flowering stage; the constancy of this ratio under wide variations of the conditions of growth has now been established.—Isomeric bornylamines, by M. O. Forster. The base obtained from the formyl derivative got by heating camphor with ammonium formate, and from the reduction of camphoroxime, is a mixture of bornylamine and an isomeride which the author terms neobornylamine.—Some derivatives of benzophenone, by F. E. Mathews. The author has obtained a benzophenone hexachloride, $C_{10}H_6Cl_6.COPh$, which yields a mononitro-derivative and a sulphonic acid.—Experiments on lauronic acid, by S. B. Schryver.—The drying of ammonia and of hydrogen chloride, by H. B. Baker. A repetition of the author's previous work shows that ammonia and hydrogen chloride can be dried by phosphorus pentoxide, and that dry ammonium chloride is not dissociated at 350° ; Gutmann's strictures on the work are hence unfounded.—Note on some of the properties of methylene diiodide, by H. G. Madan. Methylene iodide darkens appreciably in colour on a few hours' exposure to sunlight, and in the cold dissolves sufficient sulphur to raise its refractive index for the D line from 1.756 to 1.778; it dissolves phosphorus readily, giving a light yellow solution which has the refractive index for D of 1.95 at 14° , and is not spontaneously inflammable on evaporation in the air.—The condensation of chloral hydrate with orcinol, by J. T. Hewitt and F. G. Pope. Chloral hydrate and orcinol condense on heating in aqueous solution, yielding an acid of the composition $C_{18}H_{14}O_8$, which is easily converted into a lactone $C_{18}H_{14}O_5$.—Note on hexamethylene and its derivatives, by Miss E. C. Forsey. Gallician petroleum, like American light petroleum, contains hexamethylene; it boils at 81.75° , and has the specific gravity of 0.7899 at $0^\circ/0^\circ$. Its mono- and dichloro-derivatives have been prepared and investigated.—The yellow colouring matter of the leaves of *Arctostaphylos uva ursi*, by A. G. Perkin. In addition to gallic acid, arbutin, ericolin and gallotannin, the author has separated a yellow colouring matter of the composition $C_{15}H_{10}O_7$ from the leaves of this plant, and has also demonstrated the presence of ellagitannin.—The yellow colouring matters of various adulterants of Sicilian sumach, Part iv., by A. G. Perkin and P. J. Wood.—The hydrolysis of starch by acids, by H. Johnson.—Synthesis of cis- and trans-caronic acids, by W. H. Perkin, jun., and J. F. Thorpe. On hydrolysing the alkyl salts of α -bromodimethylglutarate, a mixture of cis- and trans-caronic acid is obtained; caronic acid is therefore, as Baeyer concluded, a dimethyltrimethylenedicarboxylic acid of the constitution



—Preparation of solid ammonium cyanate, by J. Walker and J. K. Wood. On mixing a solution of ammonia and of cyanic acid in anhydrous ether at -20° and filtering, a residue of solid ammonium cyanate is obtained.—The chlorine derivatives of pyridine, Part i., by W. J. Sell and F. W. Dootson.—Simple experimental illustrations of the law of multiples, by A. W. Jones. Equivalent weights of potassium chlorate and perchlorate are heated, and it is shown that the residues of potassium chloride are equal in weight, and that the volumes of the oxygen evolved are as three to four, in the two cases.—Lauronic acid, by R. W. Collinson and W. H. Perkin, jun. Lauronic acid yields a hydrobromide, $C_9H_{15}O_2Br$, and when oxidised gives a syrupy acid of the composition $C_9H_{14}O_5$.—The action of aluminium chloride on camphoric anhydride, by F. H. Lees and W. H. Perkin, jun.—On the action of bromoacetal on the sodium derivative of ethylic malonate, by W. H. Perkin, jun., and C. H. G. Sprankling. On heating bromoacetal with ethylic sodiomalonate at 140–150, ethylic acetalmalonate, $(CO_2Et)_2CH.CH_2.CH(OEt)_2$, is obtained.—The sulphonation of benzophenone and of diphenylmethane, by A. Lapworth.—The separation of optical isomerides, by F. S. Kipping and W. J. Pope. It is shown that enantiomorphously related substances are not equally soluble in a solution containing a third enantiomorphous substance.

Zoological Society, April 19.—Prof. Howes, F.R.S., in the chair.—Mr. Ernest W. L. Holt read a paper on the breeding of the Dragonet (*Callionymus lyra*) in the Marine Biological Association's aquarium at Plymouth, and made some remarks

on the significance of the sexual dimorphism of this fish, the courtship and pairing of which were described in detail.—A communication from the Rev. H. S. Gorham contained an account of the Serricorn Coleoptera of St. Vincent, Grenada, and the Grenadines, obtained through the operation of the West India Committee of the Royal Society and the British Association, for the exploration of the fauna of the West Indies.—A second communication from the Rev. H. S. Gorham on the Coleoptera of the families *Erotylidae*, *Endomychidae*, and *Coccinellidae* from the West Indies, obtained in the same manner, was also read.—A communication was read from Dr. Bashford Dean, describing further evidence of the existence of possible paired fins in the problematical Devonian organism *Palaespondylus*. He maintained his former views, as opposed to those of Dr. R. H. Traquair expressed in a former communication to the Society.

Mathematical Society, April 7.—Dr. Hobson, F.R.S., Vice-President, in the chair.—The following communications were made:—An essay towards the generating functions of ternariants, by Prof. Forsyth, F.R.S.—On systems of forces in space of n dimensions, by W. H. Young.—Zeroes of the Bessel functions, by H. M. Macdonald.

PARIS.

Academy of Sciences, April 25.—M. Wolf in the chair.—The Secretary announced to the Academy the death of M. Demontzey, Correspondant in the section of Rural Economy.—Influence of the place and mode of introduction on the development of the immunising effects of anti-diphtheric serum, by M. S. Arloing. When the anti-diphtheric serum is administered separately its complete antitoxic action is at a maximum when it is introduced into the blood, at a minimum when introduced into the conjunctive tissue.—On rectilinear congruences, by M. C. Guichard.—On differential equations of the second order with fixed critical points, by M. Paul Painlevé.—On groups which occur in the generalisation of analytical functions, by M. P. Medolaghi.—On the resistance of thick plates, by M. Ribièrre.—On a new standard of light, by M. Ch. Féry. The flame proposed is that of acetylene burnt from a special jet of thermometer tube, 0.5 mm. in diameter. For flames whose heights are between 10 mm. and 25 mm., the relation between the intensity and the height of the flame is a linear one. The apparatus is suggested as a suitable one for rapidly determining the quality of a commercial calcium carbide.—On the thermo-electric electromotive forces in crystallised bismuth, by M. Louis Perrot. The chief difficulty in these determinations was obtaining the bismuth in large, clearly-defined crystals, a difficulty surmounted by slowly cooling the pure metal in a Perrot furnace. The other metal chosen for the couple was copper, measurements being made at temperatures varying from 11° to $100^\circ C.$ on surfaces parallel and perpendicular respectively to the principal axis. The ratios found for the electromotive forces in the two positions of the crystal were between 2.0 and 2.4 according to the temperature, the crystalline structure thus exerting a greater influence than had been previously supposed upon the thermo-electric constants of bismuth.—On the constitution of the explosive spark in a dielectric liquid, by M. L. Décombe. Photographs from a rapidly revolving mirror of a spark between metallic poles in melted vaseline, show that the spark differs from that obtained in air in possessing a uniform brightness throughout its whole length.—Remarks on the cathode rays, by M. E. Goldstein. A discussion of some results of M. Deslandres, and more especially of the relation between the cathode rays, and the repulsion of the tails of comets by the sun.—Study of the speaking voice by the phonograph, by M. Marage. The quality of each vowel is due to a certain number of harmonics, I, U, OU being formed by one only, A by three.—On the industrial treatment of the emerald in the electric furnace, by M. P. Lebeau. A mixture of 100 kilograms of emerald with half its weight of coke, submitted for an hour to a current of 1500 amperes in the electric furnace, gave two layers, the upper consisting of silicides of aluminium and beryllium, the lower of impure crystallised silicon.—On the quinoneoximes, by M. Anand Valeur. A thermochemical paper giving the heats of combustion and formation of quinone-oxime, thymoquinoneoxime, and α - and β -naphthoquinoneoximes. As a general result it is found that the replacement of the quinonic oxygen atom by the residue $N(OH)$ raises the heat of combustion about sixty calories.—On the products of hydrolysis of ouabaine, by M. Arnaud. A study of the sugar produced shows that the crystals were identical in form

and habit with rhamnose, with which the other physical constants and chemical properties also agreed. The other product of hydrolysis was a resin, the further study of which is deferred.—Chlorinating action of ferric chloride in the aromatic series, by M. V. Thomas. By the action of ferric chloride upon boiling benzene, monochlorobenzene is readily obtained. This again, submitted to the action of more ferric chloride, gives a mixture of dichlorobenzenes. The reaction can be pushed as far as the hexachloride. Toluene behaves similarly, the substitution being always in the ring and not in the side chain.—On the dialkyl phosphoric ethers, by M. J. Cavalier.—On the acid phosphoglycerates, by MM. Adrian and Trillat.—On the saccharification of starch by malt, by M. Henri Pottevin. The experiments given show that the transformation of starch into maltose is the result of two distinct operations, dextrine being always an intermediate product. The differences observed between the various dextrines are differences in physical state only.—Hepatic pigments in the Vertebrates, by MM. A. Dastre and N. Floresco.—On the ferments causing the diseases of wines, by M. J. Laborde.—On some points of external morphology of the *Aphrodite*, by M. G. Darboux.—On the nitrogenous nutrition of phanerogamous plants by the aid of amines, salts of ammonium compounds, and alkaloids, by M. L. Lutz. The amines can be assimilated directly without previous conversion into ammoniacal salts or nitrates. Amines of low molecular weight are more easily taken up by the plant.—Influence of some poisons on the antitoxic power of the blood, by MM. C. J. Salomonsen and Th. Madsen.—Remarks on a paper of M. Daniel Berthelot, entitled "On the rigorous determination of the molecular weights of gases," by M. G. Marqfoy.

DIARY OF SOCIETIES.

THURSDAY, MAY 5.

ROYAL SOCIETY, at 4.30.—Observations on the Action of Anæsthetics on Vegetable and Animal Protoplasm: Dr. Waller, F.R.S., and Prof. Farmer.—On certain Structures formed in the Drying of a Fluid with Particles in Suspension: Miss C. A. Raisin.—On Photographic Evidence of the Objective Reality of Combination Tones: R. W. Forsyth and R. J. Sower.—The Relations between the Hybrid and Parent Forms of Echinoid Larvæ: H. M. Vernon.

LINNEAN SOCIETY, at 8.—On some Spitsbergen Collembola: Sir John Lubbock, Bart., M.P., F.R.S.—On the Structure and Development of *Sorauthera*: Miss Ethel Barton.—The Species, the Sex, and the Individual: J. T. Cunningham.

CHEMICAL SOCIETY, at 8.—The Reactions of the Carbohydrates with Hydrogen Peroxide: C. F. Cross, E. J. Bevan, and Claud Smith.—The Properties and Relationships of Dihydroxytartaric Acid, Part II.: H. J. H. Fenton.—The Affinity Constants of certain Hydroxy-acids: S. Skinner.—Molecular Weights in Solution of Permanganates, Perchlorates, and Periodates: J. Murray Crofts.

INSTITUTION OF ELECTRICAL ENGINEERS (Society of Arts), at 8.—The Prevention of Interruptions to Electricity Supply: Leonard Andrews.

FRIDAY, MAY 6.

ROYAL INSTITUTION, at 9.—Living Crystals: Edward A. Minchin.
GEOLOGISTS' ASSOCIATION, at 8.—Notes on Skye: Horace B. Woodward, F.R.S.—Observations in Lapland: Aubrey Strahan.

SATURDAY, MAY 7.

GEOLOGISTS' ASSOCIATION.—Excursion to Hillmorton and Rugby. Director: Beeby Thompson.

MONDAY, MAY 9.

SOCIETY OF ARTS, at 8.—Electric Traction: Prof. Carus Wilson.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Journey across Tibet from West to East: Captain M. S. Welby.

TUESDAY, MAY 10.

ANTHROPOLOGICAL INSTITUTE, at 8.30.
RÖNTGEN SOCIETY, at 8.—Notes on the Description of a New Induction Coil in *Electrical Review*, February 4, 1898: A. Apps.—Some Notes on Contact Breakers: Dr. J. Macintyre.
ROYAL VICTORIA HALL, at 8.30.—A Simple Experiment and its Explanation: Prof. McLeod.

WEDNESDAY, MAY 11.

SOCIETY OF ARTS, at 8.—Water Gas and its Applications: Vivian B. Lewes.

THURSDAY, MAY 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Electrical Response of Nerve to a Single Stimulus investigated with the Capillary Electrometer. Preliminary Communication: Prof. Gotch, F.R.S., and G. J. Burch.—A Study of the Phyto-Plankton of the Atlantic: G. Murray, F.R.S., and V. H. Blackman.—Effects of Prolonged Heating on the Magnetic Properties of Iron: S. R. Roget.—On the Connection of Algebraic Functions with Automorphic Functions: E. T. Whittaker.
ROYAL INSTITUTION, at 3.—Heat: Lord Rayleigh.

MATHEMATICAL SOCIETY, at 8.—On the Numerical value of $\int_0^h e^{x^2} dx$:

H. G. Dawson.—On the Reflection and Transmission of Electric Waves

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by a Metallic Grating: Prof. Lamb, F.R.S.—Notes on some Fundamental Properties of Manifolds: A. E. H. Love, F.R.S.
INSTITUTION OF ELECTRICAL ENGINEERS (Society of Arts), at 8.

FRIDAY, MAY 13.

ROYAL INSTITUTION, at 9.—Recent Experiments on certain of the Chemical Elements in Relation to Heat: Prof. W. A. Tilden, F.R.S.
ROYAL ASTRONOMICAL SOCIETY, at 8.
PHYSICAL SOCIETY, at 5.—Galvanometers, Part II.: Prof. W. E. Ayrton and T. Mather.
MALACOLOGICAL SOCIETY, at 8.

SATURDAY, MAY 14.

GEOLOGISTS' ASSOCIATION (King's Cross, G.N.R.), at 1.20.—Excursion to Ayot and Hatfield. Directors: J. Hopkinson and A. E. Salter.

BOOKS AND SERIALS RECEIVED.

BOOKS.—A Student of Nature: R. M. Fergusson (A. Gardner).—Royal University of Ireland Calendar, 1898 (Dublin, Thom).—A Course in Mechanical Drawing: J. S. Reid (Chapman).—Quantitative Chemical Analysis by Electrolysis: Drs. A. Classen and W. Löb, translated by W. H. Herrick and B. B. Boltwood (Chapman).—Technical Mycology: Dr. F. Lafar, translated by C. T. C. Salter, Vol. 1 (Griffin).—Electro-Physiology: Prof. W. Biedermann, translated by F. A. Welby, Vol. 2 (Macmillan).—Text-Book of Physical Chemistry: Prof. C. L. Speyers (Spon).—Methods for the Analysis of Ores, Pig Iron and Steel (Easton, Pa., Chemical Publishing Company).—First Stage Magnetism and Electricity: Dr. R. H. Jude (Clive).—A Northern Highway of the Tsar: A. Trevor-Battye (Constable).—Elementary General Science: A. T. Simmons and L. M. Jones (Macmillan).—Journal of the Iron and Steel Institute, Name-Index, Vols. 1 to L: edited by E. H. Brough (Spon).
SERIALS.—National Geographic Magazine, April (Washington).—American Journal of Psychology, Vol. ix, No. 3 (Worcester, Mass.).—Good Words, May (Isbister).—Sunday Magazine, May (Isbister).—Natural Science, May (Dent).—Botanische Jahrbücher, Vierundzwanzigster Band, v. Heft (Leipzig, Engelmann).—Century Magazine, May (Macmillan).—American Naturalist, March (Boston, Ginn).—Humanitarian, May (Hutchinson).—Proceedings of the University of Durham Philosophical Society, Part 1 (Newcastle-on-Tyne).—Journal of the Royal Microscopical Society, April (Williams).—Journal of Botany, May (West).—Bulletin of the American Mathematical Society, April (N.Y., Macmillan).—Contemporary Review, May (Isbister).—Scribner's Magazine, May (Low).—National Review, May (Arnold).—Brain, Part 80, May (Macmillan).—Fortnightly Review, May (Chapman).—Among British Birds in their Nesting Haunts: O. A. J. Lee, Part xi. (Edinburgh, Douglas).—Knowledge, May (High Holborn).—Zeitschrift für Physikalische Chemie, xxv. Band, 4 Heft (Leipzig, Engelmann).

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