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ABSTRACTS 1349-1601

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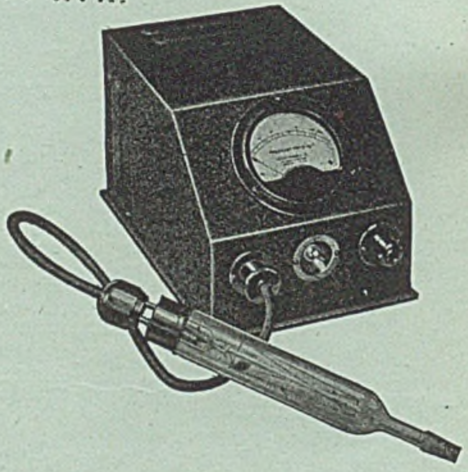


CONTENTS—ABSTRACTS 1349–1601

535.12 : 535.43 1349

The multiple scattering of waves. I. General theory of isotropic scattering by randomly distributed scatterers. Foldy, L. L. *Phys. Rev.*, 67, *pp.* 107–119, *Feb.* 1 *and* 15, 1945.—The problem is considered on the basis of wave treatment. The introduction of the concept of randomness requires averages to be taken over a statistical ensemble of scatterer configurations. Equations are derived for the average value of the wave function, the average value of the square of its abs. value, and the average flux carried by the wave. The second of these quantities satisfies an integral equation which has some similarities to the corresponding equation for particle scattering. The physical interpretation of the results is discussed and possible generalizations of the theory are outlined.

535.14 : 537.533.8 1350

The production of photons relative to ionization by collision in a Townsend gap. Geballe, R. *Phys. Rev.*, 66, *pp.* 316–320, *Dec.*, 1944.—Measurements were made in a Townsend gap to determine the average number of photons liberated by an electron for each secondary electron it liberates. In H_2, this number decreased rapidly with increasing ratio of field strength to gas pressure in the range from 50 to 150 V/cm./mm. and at pressures of 1 mm. Determination of the abs. number of photons per electron depends on the unknown efficiency of the photo-electric cell used to count the photons; this number is estimated as of order unity. The effective radiation has an absorption coefficient of 0·55 cm.$^{-1}$ at 1 mm. Hg. This coefficient indicates that only photons of high energy were counted.

535.14 : 612.84 1351

The quantum character of light and its bearing upon the threshold of vision, the differential sensitivity and visual acuity of the eye. de Vries, H. *Physica, 's Grav.*, 10, *pp.* 553–564, *July*, 1943.—The sensitivity of the sensory cells (rods and cones) is discussed and it is shown that one quantum of light absorbed by the photo-sensitive material in the eye is sufficient to give rise to the perception of light. Statistical fluctuations of the number of quanta falling on the retina are studied, these fluctuations being perceptible because of the great sensitivity of the eye. Absolute lower limits are determined for the differential sensitivity and for the visual acuity, depending upon the illumination, and these limits practically coincide with those actually observed. Evidence is given for the conception that the rods and cones act as counters of light quanta, the more complicated electrical response of single nerve fibres in the optic nerve being caused by the interaction of nerve cells. L. S. G.

535.22 1352

The velocity of light. Dorsey, N. E. *Trans. Amer. Phil. Soc.*, 33, *pp.* 1–106, *Oct.*, 1944.—An attempt to answer two questions, (*a*) whether the decrease in the values obtained for the velocity of light from 1874 to 1940 has any physical significance, (*b*) if there is a drift, whether the break shown by the 1902 value (Perrotin and Prim) is of any significance. A critical study is made of each of the three methods employed (toothed wheel, revolving mirror, Kerr cell), the means adopted for the realization of each method, the systematic errors that might be expected to affect the results, the diligence shown in searching out and eliminating such errors, the degree of concordance of the observations, and the procedure used to derive a definitive value from the experimental data. An objective estimate is made of the accuracy that might be ascribed to the work described in each of the reports and, in each case, a value is inferred from the available data. On the basis of the recalculated values, no evidence is found for any secular change in the velocity of light and the value derived from all of the data available is 299 773 km./sec. (in vacuo) with a probable error less than ±10 km./sec. A. H.

535.23 : 621.327.43 1353

Radiant energy from fluorescent lamps. Luckiesh, M., and Taylor, A. H. *Illum. Engng, N.Y.*, 40, *pp.* 77–88, *Feb.*, 1945.—[Abstr. 1226 B (1945)].

535.23.08 : 621.384.4 1354

Measuring germicidal energy. Taylor, A. H. *Gen. Elect. Rev.*, 47, *pp.* 53–55, *Oct.*, 1944.—[Abstr. 1257 B (1945)].

535.233 : 536.5.081 : 621.326.791 1355

Colour-temperature scale. Forsythe, W. E., and Adams, E. Q. *Gen. Elect. Rev.*, 47, *pp.* 26–34, *Sept.*, *and pp.* 59–62, *Oct.*, 1944.—[Abstr. 1224 B (1945)].

535.241.41 : 771.351 : 535.317 *see Abstr.* 1369

535.243 1356

Spectrophotometric determination of iron with sulphosalicylic acid. Kennard, M., and Johnson, C. R. *Proc. Trans. Tex. Acad. Sci.*, 27, *pp.* 45–51, 1943.—A spectrophotometric method for the determination of iron with sulphosalicylic acid was worked out empirically and compared with other methods for determining small amounts of iron. The method takes into account the effects of variations in the extra salt content, the *p*H, the colour, and the phosphate conc. of the test solutions.

535.243 1357

Intensity scales in spectrographic photometry. Sinclair, D. A. *J. Opt. Soc. Amer.*, 34, *pp.* 689–693, *Nov.*, 1944.—Describes the use of a scale of intensities, instead of a linear scale, on photometers used for examining photographic plates. Although in theory a different scale is required for each plate, it is found in practice that only a few scales are needed to provide for all likely variations between plates, at any rate to an accuracy better than that normally attained by the ordinary method. J. W. T. W.

535.243 1358

The extension of spectrophotometric technique by means of special type cuvettes. Drabkin, D. L. *J. Opt. Soc. Amer.*, 34, *pp.* 771–772, *Dec.*, 1944.—Describes two special cuvettes, one of 3·4 cm. depth and capillary bore, the other of 0·007 cm. depth and 0·021 ml. vol. The increased sensitivity obtained enables certain determinations to be made by direct spectrophotometry where this has not been possible hitherto. Typical applications are described.

J. W. T. W.

535.243 1359

Ultra-violet absorption methods of analysis for polyunsaturated constituents of fats, oils and soaps. Brice, B. A., and Swain, M. L. *J. Opt. Soc. Amer.*, 34, *p.* 772, *Dec.*, 1944.—Ultra-violet spectrophotometric methods have recently been described for determining polyunsaturated constituents in vegetable oils. Modifications have been introduced, making it possible to apply these methods to a wide variety of fats and oils, including those (notably animal fats and their soaps) with small proportions of polyunsaturated compounds. Typical analyses are given and the accuracy obtainable is discussed. J. W. T. W.

535.243 1360

Comparison of the purity of samples of organic solvents by ultra-violet spectrophotometry. Maclean, M. E., Jencks, P. J., and Acree, S. F. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 271–281, *March*, 1945.—Studies of the uniformity of different samples of organic solvents by ultra-violet spectrophotometry are described. The procedure is applicable to the detection of impurities originally present or formed by deterioration and to the study of the effectiveness of purification procedures. Absorption curves are given for *n*-heptane, 2,2,4-trimethylpentane, cyclohexane, methylcyclohexane, decahydronaphthalene, benzene, carbon tetrachloride, methyl alcohol, ethyl alcohol, ethyl acetate, and dioxane, in two or more grades of purity. The absorption curves of tetrahydronaphthalene, toluene, xylene, chlorobenzene, ethylene dichloride, trichloroethylene, acetone, dimethyldioxane, and carbon bisulfide are discussed briefly. The effect of filtration through silica gel on the ultraviolet absorption of several commercial solvents is shown.

535.243 : 545.82 : 535.33 *see Abstr.* 1375, 1376

535.243 : 621.325.13 1361

Performance of a hydrogen arc as a source for photo-electric spectrophotometry. Bosch, W. C., and Anderson, E. W. *Rev. Sci. Instrum.*, 15, *pp.* 347–348, *Dec.*, 1944.—Examines the suitability of the lamps described by Allen and Franklin [Abstr. 4602 (1939)] for use with a photo-electric spectrophotometer using electrometer tube amplification. The various criteria of suitability listed are found to be satisfied. J. W. T. W.

535.243 : 665.4 : 620.193.54 1362

Spectrophotometric study of the oxidation of quenching oils. Clark, G. L., Kaye, W. I., Seabury, R. L., and Carl, F. *Industr. Engng Chem.* (*Analyt. Edit.*), 16, *pp.* 740–745, *Dec.*, 1944.—A spectrophotometric study was undertaken to evaluate the changes in oil with an extension to a study of the rate of oxidation of several commercial oils recommended for quenching, at high temperatures by a laboratory procedure, with and without addition agents and in the presence and absence of the Al alloy as catalyst. Spectrophotometric data are believed related to the light scattered by colloidal particles or precipitables as indicated by absorption curves and electron micrographs. Oxidation stability and absence of precipitable polymer particles are correlated with the quality of quenched castings as measured in terms of residual strain.

535.245 : 535.317 1363

On the luminosity of optical systems. Bouwers, A., and van Heel, A. C. S. *Physica, s' Grav.*, 10, *pp.* 714–719, *Oct.*, 1943.—The relative aperture $\alpha = D/f$ of an optical system (D = dia. of entrance pupil and $1/f$ = power of system) is usually taken to be the decisive factor for the illumination of an image of an object of given brightness and magnification. It is shown that this is not always correct and that the magnitude of α is sometimes ambiguous. The true measure of luminosity is given by $\alpha_m = D_m/f$ where D_m is the diameter of the cone of effective light from the axial object point, measured in the object principal plane. An example is given relating to a mirror system, the main part of which is a spherical mirror with real diaphragm of dia. D in its centre of curvature. It is shown that $\alpha_m = \dfrac{m+1}{m-1}\alpha$. L. S. G.

535.247 1364

A physical photometer for afocal optical systems. McRae, D. B. *J. Opt. Soc. Amer.*, 34, *p.* 775, *Dec.*, 1944.—Describes a physical photometer for measuring the transmission of any afocal optical system. A collimated beam of high-frequency "chopped" light (over 200 per sec.) traverses the system and is picked up by a simple optical device in which image brightness is measured by a vacuum photocell and a.c. amplifier. With this instrument, measurements can be made in a well-lighted room. J. W. T. W.

535.31 : 628.96 1365

From edge to wedge lighting. Ulbrich, M. A. *Illum. Engng, N.Y.*, 40, *pp.* 106–115, *Feb.*, 1945.—[Abstr. 1383 B (1945)].

535.317 1366

The diffraction theory of optical aberrations. I. General discussion of the geometrical aberrations. Nijboer, B. R. A. *Physica, s' Grav.*, 10, *pp.* 679–692, *Oct.*, 1943.—The geometric aberrations of an axially symmetric system are treated by a new method. A spherical surface is introduced with its centre at the Gaussian image (at a distance σ from the axis) and passing through the centre of the exit-pupil. The actual wave front deviates by an amount $V(\sigma, r, \phi)$ (the aberration function) from the sphere, where r and ϕ are plane polar co-ordinates upon the latter. V is expanded in terms $r^n \cos m\phi$, whereas the characteristic function analogous to V is usually expanded in terms containing $r^n \cos^m \phi$. A single aberration is now defined by an aberration function $b_{lnm}\sigma^{2l+m} r^n \cos m\phi$, and as a result, the discussion of the aberration figures is considerably simplified. A simple classification of image errors of all orders is given, according to which the value of m determines the general type to which a given single aberration belongs. We have spherical aberration, coma and astigmatism for $m = 0$, 1, and 2, respectively. L. S. G.

535.317 1367

A convenient virtual-image locator for elementary optics. Taylor, P. K. *Proc. Amer. Phys. Soc., Cleveland, Ohio, Sept.* 11–12, 1944. *Abstr. in Phys. Rev.*, 66, *p.* 357, *Dec.* 1 *and* 15, 1944.—The instrument locates a virtual optical image with reference to the position of a real image on a ground-glass plate, thus avoiding the parallax method.

535.317 1368

Combinations of spherical lenses to replace non-spherical refracting surfaces in optical systems. Houghton, J. L. *Proc. Phys. Soc., Lond.*, 57, *pp.* 84–90, *March*, 1945.—The substitution of lens systems of infinite focal length for non-spherical correcting plates is discussed, and formulae and examples are given for 2- and 3-component systems. Such systems may be used to introduce under- or over-correction of chromatic aberration and coma, in addition to spherical aberration into a system. In the case of lens systems used in conjunction with spherical mirrors, the thicknesses and curvatures of the components are small compared with those found in more orthodox lenses of similar relative aperture, and the state of correction is good, though probably not so good as in the case where a non-spherical correcting plate is used.

535.317 : 535.241.41 : 771.351 1369

Cos^4 law of illumination. Reiss, M. *J. Opt. Soc. Amer.*, 35, *pp.* 283–288, *April*, 1945.—A rigorous theoretical treatment of the relation between illumination and field angle in optical systems, with application to wide-angle photographic lenses. The author considers that in G. Slussareff's work [see Abstr. 1055 (1942)] the assumptions made are such as to render the practical realization very doubtful. J. W. T. W.

535.317 : 535.245 *see Abstr.* 1363

535.317.1 : 771.35 : 526.918.523 1370

Region of usable imagery in airplane-camera lenses. Washer, F. E. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 175–198, *Feb.*, 1945.—The proper placing of a lens with respect to the focal plane in a fixed-focus camera is governed by quality of imagery, depth of focus at a given stop opening, and curvature of field. There is good agreement between observed depth of focus at a given stop opening and that predicted on the basis of geometric optics. Observed values of the max. resolving power at various angular separations from the axis are generally lower at the larger stop openings than values predicted on the basis of physical optics. This lowering is a consequence of residual aberrations, inherent in an actual lens, which are more noticeable at large aperture ratios. A method of presenting the resolving-power characteristics throughout the range of useful imagery in the form of sets of master curves has been developed. These curves show at a glance the variation of resolving power with distance from the plane of best axial imagery, the depth of focus for any observed value of the resolving power, the effect of field curvature on imagery in any given image plane, and the differing performance for tangential and radial imagery at various angular separations from the axis. Successive groups of these master curves show how variations in stop opening affect the performance of a lens.

535.32 1371

Note on low refraction and dispersion of beryllium fluoride glass. Pincus, A. G. *J. Opt. Soc. Amer.*, 35, *p.* 92, *Jan.*, 1945.

535.321 1372

Methods for determining refractive indices in polarized-light microscopy. West, P. W. *Science*, 101, *pp.* 283–284, *March* 16, 1945.—A note describing a simple but effective method for determining refractive indices in polarized-light microscopy. Advantages of the method are that it is rapid and requires little knowledge of geometrical or optical crystallography. The usual Becke line or half-shadow methods are employed. A. H.

535.321 : 535.325 1373

A study of the comparative method of determining gaseous refractivities. Craven, E. C. *Proc. Phys. Soc., Lond.*, 57, *pp.* 97–107, *March*, 1945.—The comparative method for the determination of refractive indices by white-light interferometry yields the ratio of the group refractivities and not the ratio of the phase refractivities. The effective wavelength of the ordinary gas-filled lamp is close to that of Na light. For ordinary gases, any wavelength in the same region may be taken without serious error. Observation of the shift of the central achromatic fringe due to differences of dispersion in the two paths enables the difference of dispersion to be measured. This enables the group index to be corrected and the phase index calcualted at any point in the visual range of the spectrum. The method has been applied to several gases and to mixtures of the vapours of volatile organic solvents with air, and gives results comparing not unfavourably in accuracy with those obtained by the absolute method in monochromatic light.

535.325 : 535.321 *see Abstr.* 1373

535.325 : 535.417 *see Abstr.* 1431

535.326 : 535.824 1374

Phase-difference microscopy. Richards, O. W. *Nature, Lond.*, 154, *p.* 672, *Nov.* 25, 1944.—Detail in uncoloured transparent specimens can be made visible by using the phase differences produced by varying refractive index. The method described for doing this requires the insertion of an annular step into the condenser of the microscope and a phase plate into the objective at its back focal plane. A. H.

535.33 : 535.243 : 545.82 1375

Techniques of quantitative spectrographic analysis. Churchill, J. R. *Industr. Engng Chem.* (*Analyt. Edit.*), 16, *pp.* 655–670, *Nov.*, 1944.—An exhaustive survey article which reviews and evaluates methods and apparatus employed in this field. Reference is constantly made to specific points in connection with the analysis of Al by means of the a.c. spark method. The subject of Calibrations and Calculations is treated very fully. A. H.

535.33 : 535.243 : 545.82 1376

Emission spectrographic equipment used in quantitative analysis. Guettel, C. L. *Industr. Engng Chem.* (*Analyt. Edit.*), 16, *pp.* 670–675, *Nov.*, 1944.—Proposes the establishment of min. requirements for apparatus used in spectrographic analysis and lists these requirements in detail for (*a*) the spectrograph, (*b*) the microphotometer, (*c*) the excitation equipment. An empirical relationship is suggested for the min. acceptable precision. A. H.

535.33 : 544.62 1377

Qualitative spectrographic analysis. Standen, G. W. *Industr. Engng Chem.* (*Analyt. Edit.*), 16, *pp.* 675–680, *Nov.*, 1944.—Describes a method of qualitative analysis from which semi-quantitative estimates can be made by comparison with standard spectra. Variations are discussed in the form of the high-streaming-velocity arc and the moving-plate method. A. H.

535.33.03 1378

A non-mechanical interrupter for controlled spark circuits. FOWLER, R. G., AND WOLFE, R. A. *J. Opt. Soc. Amer.*, 34, *p.* 773, *Dec.*, 1944.—Describes a type of interrupted spark source, involving no mechanical parts, suitable for use in quantitative spectrographic analysis. J. W. T. W.

535.33.03 1379

Ultra-violet ionization of interrupter gaps in spectrographic spark sources. SIMPSON, S. F. *J. Opt. Soc. Amer.*, 34, *p.* 773, *Dec.*, 1944.—Examines the effect of using an ultra-violet lamp of high intensity to irradiate the synchronous interrupter in a conventional spectrographic spark source. J. W. T. W.

535.33.03 1380

Ultra-violet irradiation of interrupter gaps in spectrographic spark sources. SIMPSON, S. F. *J. Opt. Soc. Amer.*, 35, *pp.* 40–42, *Jan.*, 1945.—Gives details of the improved performance of spectrographic spark sources obtained when the gap is illuminated by ultra-violet radiation from a quartz Hg-vapour lamp. A considerable reduction in the size of the error attributable to the method of excitation is claimed. A. H.

535.33.03 1381

Spectrographic determination of sodium, potassium, and lithium in Portland cement with the direct-current carbon arc. HELZ, A. W. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 129–142, *Feb.*, 1945.—For the determination of Na and K, the sample is mixed with a mineral base containing Ag for the internal standard. For Li a standard mixture of graphite and Sr carbonate is added to the cement sample. In either case a fixed amount of the resultant mixture is placed in the crater of a graphite electrode, which is made the lower positive element of a d.c. arc. The Na 8 194·81 Å, K 7 698·98 Å, and Li 3 232·61 Å lines are used for the quantitative calculations. A discussion of the development of the method is given, followed by details of the adopted analytical procedure. The spectrographic analyses of 41 cements for Na and K are given for comparison with the chemical values.

535.33.03 1382

Spectral stability in the condensed spark discharge in air. LEVY, S. *J. Opt. Soc. Amer.*, 35, *pp.* 221–226, *March*, 1945.—Discusses the conditions necessary for reproducibility in the intensity ratios of spectral lines emitted by a condensed spark discharge in air, with particular reference to the use of auxiliary gaps. A circuit designed to give the constancy of line intensity ratios necessary for quantitative spectrum analysis is described and some results obtained in testing it are given. J. W. T. W.

535.33.03 : 535.34 1383

Sources of radiation and absorption cells. THOMPSON, H. W., AND WHIFFEN, D. H. *Trans. Faraday Soc.*, 41, *pp.* 180–181, *April–May*, 1945.—Describes the preparation of absorption cell windows and of the absorption cells themselves. Details are also given of the two sources commonly used in infra-red work—the Nernst filament and a carborundum rod (Globar). A. H.

535.33.072 1384

Direct reading instrument for spectrochemical analysis. HASLER, M. F., AND DIETERT, H. W. *J. Opt. Soc. Amer.*, 34, *pp.* 751–758, *Dec.*, 1944.—The conventional method of quantitative spectrochemical analysis employing bright-line spectra and photographic recording is discussed. The steps which may be eliminated by the application of direct photoelectric recording are considered and a method based on this type of recording is discussed. A detailed comparison of the two methods is made which leads to the conclusion that only by designing an entirely new spectrum-dispersing instrument can direct reading be made sufficiently flexible for general adaptation. Such an instrument is considered in detail together with suitable analytical procedure for its use.

535.33.072 1385

Developments in the technique of infra-red spectroscopy. SUTHERLAND, G. B. B. M., AND THOMPSON, H. W. *Trans. Faraday Soc.*, 41, *pp.* 174–179, *April–May*, 1945.—It is pointed out that the practical limit of resolving power for rotational fine structure is now being approached and that high r.p. is becoming of much less importance than speed of recording. It is now necessary to study the spectra of large numbers of similar molecules, picking out frequencies characteristic of certain groupings and eventually identifying these groupings in complex molecules of unknown structure. From this angle of rapid recording, prism materials are discussed, together with optical systems. Detection and recording come under review and comment is made on the improvement effected by the introduction of the Hilger–Schwarz permanently evacuated thermocouple. Double-beam spectrometers are described and some indication is given of possible lines of development. A. H.

535.33.072 : 535.34 1386

Measurement of cell thickness. SUTHERLAND, G. B. B. M., AND WILLIS, H. A. *Trans. Faraday Soc.*, 41, *pp.* 181–182, *April–May*, 1945.—Emphasizes the necessity for accurate measurement of absorption cell thickness if accurate extinction coefficients are to be obtained readily. After discussing the disadvantages of the interference method used by Smith and Miller [Abstr. 1537 (1944)] it is shown how one of the disadvantages can be overcome by using a double-beam spectrometer. Details are also given of a method now under examination where interference fringes in the visible region are employed. A. H.

535.33.072 : 535.34 1387

An absorption cell for molten solids and heated liquids. RICHARDS, R. E., AND THOMPSON, H. W. *Trans. Faraday Soc.*, 41, *pp.* 183–184, *April–May*, 1945.—Full constructional details are given of an absorption cell usable with liquids up to 200°C. The cell is suitable for studying the change of spectrum with state of aggregation and also for measuring the absorption of molten solids which are either insoluble or for which the only solvents are not suitable spectroscopically. A. H.

535.33.072 : 535.342 1388

Two time-saving devices in the conversion of energy records into percentage absorption curves. WILLIS, H. A., AND PHILPOTTS, A. R. *Trans. Faraday Soc.*, 41, *pp.* 187–191, *April–May*, 1945.—Two devices are described which permit of frequency and percentage absorption being read off directly from the records given by an automatic spectrometer. The first device is a frequency calibrator for spectrometers with prisms rotated at constant speed, the second is a direct-reading percentage absorption scale for energy records. A. H.

535.331 : 669.1 1389

An application of spectrographic methods to chemical concentrations of trace elements in iron and steel analysis. WOLFE, R. A., AND FOWLER, R. G. *J. Opt. Soc. Amer.*, 35, *pp.* 86–91, *Jan.*, 1945.—Describes combined spectrographic-chemical techniques for the determination of trace elements present in amounts below the usual analytical ranges now investigated. In general, the Fe is first removed and then the solutions are concentrated. The accuracy reported is thought to be sufficiently good for both research and control purposes. A. H.

535.331 : 669.18 1390

The application of spectrochemical analysis in the steel mill. IRISH, P. R. *J. Opt. Soc. Amer.*, 35, *pp.* 226–233, *March*, 1945.—Describes what is thought to be the most extensive application of spectrochemical methods to a direct composition control problem. Six operators are used on each shift and in the course of 24 hr. these expose, develop and read 180–190 plates containing about 1 000 spectrograms. Analyses are commonly reported within 15 min. and the elements dealt with include Mn, Si, Ni, Cr, V, Mo, Cu, Sn, Al, W, Ti, B, Co in conc. varying from 0·001% to 10%. The factors necessary for rapid, accurate analyses are discussed. It is found that the photographic plate error is the most important single factor and standardization is discussed at length. Full details regarding sources are given. A. H.

535.338 : 537.523.5 1391

The radial course of the populations of the energy levels in the column of an electric arc, and some relative transition probabilities in the spectra of Ba I and Ba II. KRUITHOF, A. M. *Physica, 's Grav.*, 10, *pp.* 493–501, *July*, 1943.—If the populations of the various levels agree with Boltzmann's distribution law and if correct values are used for the transition probabilities, agreement must follow at each point of a section of the arc, between the temperature deduced from lines with different upper levels and that determined from bands. This method was used both in the a.c. and d.c. arc to show that the population levels in the greater part of the column arc described by Boltzmann's law with good accuracy. In the experiments described, a mixture of $Ba(OH)_2$, ZnO and NaCl was introduced into a hole in the cathode. The results obtained enabled certain transition probabilities to be determined in the spectra of Ba I and Ba II. L. S. G.

535.338 : 538.615 1392

The arc spectrum of iron (Fe I). I. Analysis of the spectrum. II. The Zeeman effect. RUSSELL, H. N., MOORE, C. E., AND WEEKS, D. W. *Proc. Amer. Phil. Soc.*, 34, *pp.* 113–206, *Dec.*, 1944.—A complete term-analysis of the spectrum of Fe I is presented and it is claimed that the analysis has been carried as far as existing material permits. Although the spectrum is complicated (being the only one in which 4 different multiplicities are known) it is found to be highly orderly and almost all of the principal terms predicted by theory are now known. Three main tables are given, Table A—Terms of Fe I, Table B—Classified lines of Fe I, Table C—Predicted lines of Fe I present in the solar spectrum. Details are given of 4 860 classified lines arising from combinations among 464 energy levels; all but 19 of these have been grouped into 146 terms which combine to give 1 342 multiplets. Table B is a compilation from all available sources which gives the wavelengths of the lines comprising the spectrum. It also includes temperature classifications taken entirely from King's work and intensity estimates which are but rough general indications. In the discussion, apart from details concerning the observational data, the analysis of the spectrum, the spectral structure and electron configurations, much attention is devoted to the question of the sun as a source for the Fe spectrum. Part II presents an analysis of the Zeeman patterns of the spectrum of Fe I based upon photographs due to Harrison, field strengths of up to 87 000 oersteds being used. Two main tables are given, Table D—Observde Zeeman patterns of Fe I, which gives data for 1 038 lines, Table E—Observed and corrected g-values. A. H.

535.338-1 1393

The infra-red spectra of compounds of high molecular weight. THOMPSON, H. W., AND TORKINGTON, P. *Trans. Faraday Soc.*, 41, *pp.* 246–260, *April–May*, 1945.—A summary of typical measurements and results for compounds of high mol. wt. It is intended to illustrate the broad principles of the method. The types of substances examined are illustrated by polythene, crepe rubber, styrene, squalene, vinyl acetate, nylon and acetobutyrate. A. H.

535.338-1 : 54 1394

The application of infra-red spectra to chemical problems. *Trans. Faraday Soc.*, 41, *pp.* 171–297, *April–May*, 1945.—A symposium of papers with the the following titles: Introduction, Rideal, E. K.; General introduction, Ingold, C. K. [Abstr. 1395 (1945)]; Developments in the technique of infra-red spectroscopy, Sutherland, G. B. B. M., and Thompson, H. W. [Abstr. 1385 (1945)]; Sources of radiation and absorption cells, Thompson, H. W., and Whiffen, D. H. [Abstr. 1383 (1945)]; Measurement of cell thickness, Sutherland, G. B. B. M., and Willis, H. A. [Abstr. 1386 (1945)]; An absorption cell for molten solids and heated liquids, Richards, R. E., and Thompson, H. W. [Abstr. 1387 (1945)]; Solvents for use in the infra-red, Torkington, P., and Thompson, H. W. [Abstr. 1424 (1945)]; Two time-saving devices in the conversion of energy records into percentage absorption curves, Willis, H. A., and Philpotts, A. R. [Abstr. 1388 (1945)]; A thermocouple-bolometer detector, Conn, G. K. T. [Abstr. 1483 (1945)]; The use of infra-red absorption in analysis. A. Introduction, Thompson, H. W., and Sutherland, G. B. B. M. [Abstr. 1417 (1945)]; The use of infra-red absorption in analysis. B. Examples of analyses, Whiffen, D. H., Torkington, P., and Thompson, H. W. [Abstr. 1418 (1945)]; The assignment of the vibrational frequencies, and the force field of the ozone molecule, Simpson. D. M. [Abstr. 1407 (1945)]; The C–C valency vibrations of organic molecules, Kellner, L. [Abstr. 1575

(1945)]; The force constants of some CH, NH and related bonds, Linnett, J. W. [Abstr. 1576 (1945)]; The infra-red spectra of fluorinated hydrocarbons. I, Torkington, P., and Thompson, H. W. [Abstr. 1414 (1945)]; The infra-red spectra of compounds of high molecular weight, Thompson, H. W., and Torkington, P. [Abstr. 1393 (1945)]; Some infra-red studies on the vulcanization of rubber, Sheppard, N., and Sutherland, G. B. B. M. [Abstr. 1396 (1945)]; The infra-red absorption spectra of coals and coal extracts, Cannon, C. G., and Sutherland, G. B. B. M. [Abstr. 1413 (1945)]; Some new peculiarities in the infra-red spectrum of diamond, Sutherland, G. B. B. M., and Willis, H. A. [Abstr. 1419 (1945)]; Bond torsion in the vibrations of the benzene molecule, Bell, R. P. [Abstr. 1406 (1945)].

535.338-1 : 54 1395

The application of infra-red spectra to chemical problems. A general discussion. Introduction. Rideal, E. K., Ingold, C. K. *Trans. Faraday Soc.*, 41, *pp.* 171–173, *April–May*, 1945.—The field to be covered in the discussion is broadly surveyed. Recent advances in infra-red spectroscopy, both in technique and applications, are touched upon together with some of the directions in which further advances may be anticipated. A. H.

535.338-1 : 678 1396

Some infra-red studies on the vulcanization of rubber. Sheppard, N., and Sutherland, G. B. B. M. *Trans. Faraday Soc.*, 41, *pp.* 261–279, *April–May*, 1945.—Infra-red spectra have been obtained for natural rubber, natural rubber + sulphur and/or various accelerating agents, natural rubber mixes containing carbon black. Some new bands are detected in natural rubber. Evidence is obtained for the existence of stearate ions in rubber mixes to which zinc oxide and stearic acid have been added. Addition of stearic acid alone to natural rubber also produces a band in the position associated with the stearate ion. Vulcanized rubber shows 2 bands not present in uncured rubber, probably associated with C—S bonds. Vulcanization produces very little effect on the C═C frequency of rubber at 6 μ, so that appreciable unsaturation appears to exist in highly vulcanized rubber. Carbon black produces no marked alteration in the spectrum, save effects due to scattering. The variation of this scattering with wavelength suggests that the size of the carbon aggregate in rubber is of the order of 1 μ. A. H.

535.338.1 : 537.531 = 3 *see Abstr.* 1511

535.338.3 1397

The relative probabilities of transitions in the zinc atom. Schuttevaer, J. W., and Smit, J. A. *Physica, 's Grav.*, 10, *pp.* 502–512, *July*, 1943.—Transition probabilities of spectral lines may be determined by measuring their intensities in a radiating gas with known populations of the energy levels. In an arc column, these populations correspond to thermal equilibrium (under proper conditions) so they may be computed from the temperature of the gas. In the case of Zn, measurements were made of the intensities of lines and bands in the spectrum of a d.c. carbon arc in air with one electrode containing a mixture of ZnO and $MgCO_3$ or MgO. The triplets measured were $5^3S_1 - 4^3P_{2,1,0}$ and $4^3D_{3,2,1} - 4^3P_{2,1,0}$. Some measurements were also made in the singlet system and the resonance intercombination line $4^3P_1 - 4^1S_0$ ($\lambda = 3\,075{\cdot}90$ Å) was measured relative to the triplet $5^3S_1 - 4^3P_{2,1,0}$. The results are in good agreement with the multiplet intensity rules. L. S. G.

535.338.3 1398

Determination of the relative transition probabilities of some triplet lines in the atomic spectra of calcium and strontium. Schuttevaer, J. W., de Bont, M. J., and van den Broek, T. H. *Physica, 's Grav.*, 10, *pp.* 544–552, *July*, 1943.—The investigation is restricted to the $n^3S_1 - 4^3P_{2,1,0}$ and $n^3D_{3,2,1} - 4^3P_{2,1,0}$ transitions in the triplet system. The probabilities are determined with the aid of the relative intensities of the lines in the emission of the column of an electric arc, the intensity measurement being made according to the photographic-photometric method. The temperature of the emitting gas was found from the intensity ratio of two Cu lines with known relative transition probabilities. The results are compared with the relative transition probabilities of transitions in the triplet system of the Mg, Zn and Cd atoms [Abstr. 1397 (1945)]. L. S. G.

535.338.3 : 539.153.4 : 537.56 1399

Auto-ionization in doubly excited helium and the $\lambda 320{\cdot}4$ and $\lambda 357{\cdot}5$ lines. Wu, T. Y. *Phys. Rev.*, 66, *pp.* 291–294, *Dec.* 1 *and* 15, 1944.—The probabilities of auto-ionization of the $2s^2\,{}^1S$, $2s2p^3P$, $2p^2\,{}^1D$, $3d^2\,{}^1G$ states of He are calculated with continuous wave functions obtained by numerical integration of the wave equation including the effect of exchange. The probabilities are 4×10^{14}, 5×10^{13}, 1×10^{14}, $4{\cdot}9 \times 10^{13}$ per sec., respectively. On the basis of these calculations and the theoretical energies of the doubly excited states, the identification of the lines $\lambda 320{\cdot}4$ and $\lambda 357{\cdot}5$ is discussed. The former has been ascribed to the transition $1s2p\,{}^3P - 2p^2\,{}^3P$, the state $2p^2\,{}^3P$ not being subject to auto-ionization. The position and width of the latter line cannot be satisfactorily accounted for [see Abstr. 398 (1941)].

535.338.3 = 3 1400

Measurement of the transition probabilities of mercury lines. Schouten, J., and Smit, J. A. *Physica, 's Grav.*, 10, *pp.* 661–671, *Oct.*, 1943.—The photographic photometric method used is described, the light source being a d.c. arc between a Cu and C electrode in air at atm. pressure into which Hg was introduced. The temperature of the arc gas (determined from the CN molecular spectrum which is also emitted by the arc) was 5 500–6 000°K. The Hg atoms in the various excited states show a Boltzmann distribution, relative transition probabilities were calculated from the measured intensity ratios of the lines and the known relative populations of the various levels. The ratios of the probabilities for the triplet $\lambda = 4\,047$, $4\,358$ and $5\,461$ Å are $(135 \pm 4) : 100 : (38 \pm 1)$ [see Abstr. 1401 (1945)]. There is a comparison of the probabilities of the lines $\lambda = 5\,770$ Å and 5 790 Å with that of the line 4 358 Å. A similar comparison is made between the latter line and the lines $\lambda = 3\,650$, $\Sigma 3\,131$, $\Sigma 2\,967$ and $2\,537$ Å. The abs. transition probability of the line $\lambda = 2\,537$ Å is known and this permits calculation of the absolute values for the other lines from the relative values. L. S. G.

535.338.3 = 3 1401

The intensity ratios of the lines of the mercury triplet $\lambda = 5\,461$, 4 358 and 4 047 Å. SCHOUTEN, J. *Physica, 's Grav.*, 10, *pp.* 672–678, *Oct.*, 1943.—The lines have a common upper level so the intensity ratios should be independent of the method adopted for producing the lines. Three methods are used, (i) an arc discharge in air at atmospheric pressure, with the addition of Hg, (ii) a gas discharge in 0·4 mm. He + Hg, (iii) an electron beam in about 5×10^{-4} mm. Hg. The values obtained agree well and yield an average for the ratio of the intensities of 108 : 100 : 41. There is a comparison with the results of previous workers. L. S. G.

535.338.4 1402

New bands of the Hg Br molecule. RAO, K. R., AND RAO, G. S. V. R. *Curr. Sci.*, 14, *p.* 19, *Jan.*, 1945.

535.338.4–31 1403

The ultra-violet bands of HgCl. RAO, K. R., AND RAO, G. V. S. R. *Curr. Sci.*, 13, *p.* 279, *Nov.*, 1944.

535.338.42 1404

Vibrational-rotational spectrum and potential function of a linear asymmetric triatomic molecule. KIANG, A. T. *Chinese J. Phys.*, 5, 1, *pp.* 49–63, *July*, 1944.—The perturbation method of wave mechanics is used to find expressions for the energy of vibration and the convergence factors of the rotational lines of the bands in terms of the anharmonic potential constants. The results are used to find the potential constants of the HCN molecule, and satisfactory values are obtained [Abstr. 2038, 2899 (1938)]. L. S. G.

535.338.42 1405

A difficulty in analysis of some ClO_2 bands. COON, J. B. *Proc. Amer. Phys. Soc.*, *Chicago*, *Dec.* 1 *and* 2, 1944. *Abstr. in Phys. Rev.*, 67, *p.* 63, *Jan.* 1 *and* 15, 1945.—The rotational structure of the violet absorption spectrum can be explained using the levels $F = \frac{1}{2}(B + C)\,[L(L + 1) - K^2] + Ak^2$. Replacing k by K gives levels of a rigid, approx. symmetrical top. A refers to the quasi-symmetry axis of the approx. prolate top model. L, K and k refer, respectively, to the total angular momentum excluding spin, component of this along the axis, and the component of the angular momentum of molecular rotation along the axis. Though k is not integral, it is assumed that any change in k is integral. $\nu = F' - F''(\Delta L = \Delta K = \Delta k = 0)$ was fitted to the observed Qq branches. Within a given band it was found that $2\Delta A$ is constant. Using constants of the spectrum, k was calculated and $k - K$ was found to be a pos. const. within a given band, 1·68 for (000←000) band.

535.338.42 1406

Bond torsion in the vibrations of the benzene molecule. BELL, R. P. *Trans. Faraday Soc.*, 41, *pp.* 293–295, *April–May*, 1945.—Suggests that large discrepancies between observed and calculated out-of-plane frequencies can be greatly reduced by taking a more reasonable physical picture of the torsional potential energy, especially by making allowance for the relative twist of the bonds C_2–H_2 and C_3–H_3. By doing this, the agreement for the out-of-plane frequencies becomes about as good as for the planar vibrations. A. H.

535.338.42 : 535.343–1 *see Abstr.* 1414

535.338.42 : 539.13 1407

The assignment of the vibrational frequencies, and the force field of the ozone molecule. SIMPSON, D. M. *Trans. Faraday Soc.*, 41, *pp.* 209–217, *April–May*, 1945.—Summarizes the available evidence on the size and shape of the molecule. Considers briefly its possible electronic configurations, and then uses this to discuss the assignment of the observed vibrational frequencies and employs these frequencies to calculate the force constants of the molecule using valency and 3 constant force fields. A critical comparison is made with the previously suggested interpretations of the frequencies. A. H.

535.34 1408

Thickness control of colour of sharp cut-off type of glasses. GAGE, H. P. *J. Opt. Soc. Amer.*, 34, *p.* 771, *Dec.*, 1944.—For glasses of the sharp cut-off type it is found that, to a close approximation, the relation between log log transmittance and wavelength is a straight line. Hence the change of thickness required to produce any desired change in the y colour coordinate of the glass can be deduced. The paper describes the method by which this can conveniently be done. J. W. T. W.

535.34 : 535.33.03 *see Abstr.* 1383

535.34 : 535.33.072 *see Abstr.* 1386

535.342 : 535.33.072 *see Abstr.* 1387, 1388

535.343 1409

The absorption of light in aqueous solutions of neodymium salts. HOOGSCHAGEN, J., SNOEK, A. P., AND GORTER, C. J. *Physica, 's Grav.*, 10, *pp.* 693–698, *Oct.*, 1943.—A photo-electric method is described for determining the absorption spectra of $NdCl_3$ and $Nd(NO_3)_3$ and the abs. intensities of the absorption bands from 11 000 Å down to 2 900 Å. The wavelengths of the maxima of absorption in the infra-red are compared with previously determined values. The probabilities of absorption are calculated and tabulated for various ranges of wavelength. L. S. G.

535.343 1410

The absorption spectra of certain aldazines. BLOUT, E. R., AND GOFSTEIN, R. M. *J. Amer. Chem. Soc.*, 67, *pp.* 13–17, *Jan.*, 1945.—The ultra-violet absorption spectra of 14 aromatic aldazines were measured. The band-splitting found in 2 : 2′-substituted benzal- and naphthal-azines is attributed to new absorption bands arising from the non-linearity of such molecules as compared with the unsubstituted and p-substituted azines. W. R. A.

535.343 1411

Studies in the pyridazine series. The absorption spectrum of pyridazine. EVANS, R. C., AND WISELOGLE, F. Y. *J. Amer. Chem. Soc.*, 67, *pp.* 60–62, *Jan.*, 1945.—The absorption spectrum of pyridazine solutions in hexane and water from 2 400 to 3 800 Å is reproduced.

535.343 1412

Observations on the absorption spectra of terpenoid compounds. V. Umbellulone. GILLAM, A. E., AND WEST, T. F. *J. Chem. Soc.*, *pp.* 95–98, *Feb.*, 1945.—Umbellulone and certain of its derivatives were prepared from oil of Californian laurel such that their physical and analytical constants were identical with those of the previously described ketone. The absorption spectra of the ketone and its semicarbazone are found to be quite different from those expected of a simple $\alpha\beta$-unsaturated ketone. Since a carbonyl group in conjugation with a *cyclo*propane ring produces a measure of hyperconjugation as in carone, it is concluded that the abnormal absorption spectrum of umbellulone is due to the unusual chromophoric group consisting of a *cyclo*propane ring in crossed conjugation with a carbonyl group and an ethylene linkage.

535.343 : 537.531 *see Abstr.* 1512

535.343-1 1413

The infra-red absorption spectra of coals and coal extracts. Cannon, C. G., and Sutherland, G. B. B. M. *Trans. Faraday Soc.*, 41, *pp.* 279–288, *April–May*, 1945.—Infra-red absorption spectra have been obtained from 1 to 14 μ for a low-rank coal (*a*) very thin section, (*b*) pyridine extract, (*c*) a "shock-heater" film. Spectra have also been obtained of humic acids from the same coal and of pitch distillates. The following chemical groups can be identified in these spectra, OH (with H bonded), CH (aliphatic and aromatic), C=O (in humic acids) and —C=C—C=C— in aromatic rings. A. H.

535.343-1 : 535.338.42 1414

The infra-red spectra of fluorinated hydrocarbons. I. Torkington, P., and Thompson, H. W. *Trans. Faraday Soc.*, 41, *pp.* 236–246, *April–May*, 1945.—The infra-red absorption of a number of fluorinated ethylenes and related compounds has been measured. Band contours have been correlated with molecular structure and an attempt has been made to assign magnitudes to the normal vibration frequencies. Various peculiarities, apparently connected with changes in electronic structure consequent upon the introduction of F atoms, have been noticed. A. H.

535.343-1 : 541.651 1415

The infra-red spectrum of phenylacetylene. Thompson, H. W., and Torkington, P. *J. Chem. Soc.*, *pp.* 595–597, *Nov.*, 1944.—The spectrum was measured between 3 and 20 μ. The results are correlated with data from the Raman spectrum, and a consideration of several related molecules suggests a series of magnitudes for some of the vibrations of the phenyl nuclear skeleton.

535.343-1 : 541.651 1416

The vibrational spectra of acrylonitrile and perbunan. Thompson, H. W., and Torkington, P. *J. Chem. Soc.*, *pp.* 597–600, *Nov.*, 1944.—The spectrum was measured over a wide range in the infra-red. A consideration of the results together with Raman data suggests a probable assignment of magnitudes to the normal vibrational modes. The spectrum of a sample of perbunan was also measured and some suggestions are made about the structure of this molecule.

535.343-1 : 543 1417

The use of infra-red absorption in analysis. A. Introduction. Thompson, H. W., and Sutherland, G. B. B. M. *Trans. Faraday Soc.*, 41, *pp.* 197–200, *April–May*, 1945.—Discusses the application of infra-red spectroscopy to problems of qualitative and quantitative analysis, an application of growing importance for analytical purposes in chemical laboratories. A brief outline is given of the application to the qualitative and quantitative analysis of molecules in general. Attention is drawn to the detection of impurities not detectable by other methods and to the following of reactions such as polymerizations. A. H.

535.343-1 : 543 1418

The use of infra-red absorption in analysis. B. Examples of analyses. Whiffen, D. H., Torkington, P., and Thompson, H. W. *Trans. Faraday Soc.*, 41, *pp.* 200–209, *April–May*, 1945.—Typical examples of analyses are given which have been worked out in recent years. These, chosen to indicate the different types of system to which the method is applicable, are—cresols and xylenols, anilines, methyl anilines and toluidines, dimethyl butadienes, impurities in 2.4 dichloro-benzoic acid, alkyl thiocyanates and isothiocyanates, mixtures of four stereoisomers, impurities in solvents and analytical reagents, substances of biological importance and pharmaceuticals. A. H.

535.343-1 : 549.211 1419

Some new peculiarities in the infra-red spectrum of diamond. Sutherland, G. B. B. M., and Willis, H. A. *Trans. Faraday Soc.*, 41, *pp.* 289–293, *April–May*, 1945.—Infra-red absorption spectra of six diamonds have been examined from 1 to 14 μ. In the three type I diamonds a new absorption band has been detected at 9·05 μ, whilst one diamond shows a new band at 7·08 μ but lacks a band at 7·27 μ common to the other two diamonds. Discrepancies between the current theories of diamond structure and the infra-red absorption data are discussed. A. H.

535.343-31 : 541.651 1420

The structure of polyisoprenes. III. Ultra-violet absorption spectra. Bateman, L., and Koch, H. P. *J. Chem. Soc.*, *pp.* 600–606, *Nov.*, 1944.—The spectra correspond closely to those of simple ethylenes having the same degree of alkyl substitution at the double bond. This is also true of geranylamine hydrochloride, which shows no obvious characteristic that can be identified with the structural anomaly revealed by X-ray crystal analysis. The extent to which spectral variations are a measure of the electronic properties of groups and molecules of this type is discussed—with the conclusion that, for formally saturated substituents, the correlation is still obscure. Inductive influence is slight, and interpretations hitherto advanced on the basis of hyperconjugation are unsound.

535.343.3 1421

Absorption of light in a solution of samarium nitrate. Franzen, P., Woudenberg, J. P. M., and Gorter, C. J. *Physica, 's Grav.*, 10, *pp.* 365–368, *May*, 1943.—The intensities of the absorption bands in the visible region are determined, using a Hilger constant-deviation glass spectrograph. L. S. G.

535.343.3 : 541.651 1422

The absorption spectra of some mononitronaphthylamines, with observations on their structures. Hodgson, H. H., and Hathway, D. E. *Trans. Faraday Soc.*, 41, *pp.* 115–121, *March*, 1945.—A study of the absorption spectra of α- and β-amino- and nitronaphthalenes and of certain selected mononitronaphthylamines has enabled the following tentative conclusions to be made: yellow mononitronaphthylamines exhibit 2 absorption bands within λ 2 310–4 500 Å whereas their red isomers have a third band within λ 3 380–3 500 Å; the middle band is characteristic of the β-compounds only; in the mononitronaphthylamines all the bands are shifted towards the longer wavelengths and so indicate relief of electronic strain in the molecule; all three bands are characteristic of heteronuclear nitro-naphthylamines and of those homonuclear isomers in which the amino-group is in the β-position. These compounds are all red and it is assumed that their structures possess a single central bond, in contrast to the more strained yellow forms which are assumed to owe their strain to the presence of a central double bond. The red colour of β-naphthaquinone is at once explicable if its formula be written with a central single bond: this substance exhibits 3 bands within λ 2 310–4 500 Å.

535.343.3 : 541.651 : 541.182.5 1423

Amphipathic character of proteins and certain lyophile colloids as indicated by absorption spectra of dyes. Sheppard, S. E., and Geddes, A. L. *J. Chem. Phys.*, 13, *pp.* 63–65, *Feb.*, 1945.—A characteristic change of spectral absorption of certain dyes as between water and organic solvents appears in aq. solutions of gelatin or of the colloidal detergent, cetyl pyridinium chloride. This is attributed to a bilateral character of lamellar micelles, the elementary lamellae being polar and hydrophile on one side, non-polar and organophile on the reverse side. The possibility is indicated of diagnosing such amphipathic characteristics by comparative spectrophotometric measurements with suitable dyes.

535.343.32 1424

Solvents for use in the infra-red. Torkington, P., and Thompson, H. W. *Trans. Faraday Soc.*, 41, *pp.* 184–186, *April-May*, 1945.—Emphasizes the desirability of using solvents which have no appreciable absorption over the spectral range being studied and the necessity for careful choice of solvent. A diagram and table are given by means of which the most suitable solvent for a particular region may be chosen. The range covered is from 500 to 3 200 cm.$^{-1}$ A. H.

535.343.32 : 541.651 *see Abstr.* 1578

535.343.4 : 537.531 = 3 *see Abstr.* 1513, 1514

535.372 : 541.65 1425

Phosphorescence and the triplet state. Lewis, G. N., and Kasha, M. *J. Amer. Chem. Soc.*, 66, *pp.* 2100–2116, *Dec.*, 1944.—The phosphorescence of organic substances in transparent, usually rigid, solvents is discussed. Each substance has a unique phosphorescent state, contrary observations being due to impurities, to pseudo-isomers (in the case of some dyes), or to photochemical reaction, which becomes apparent as a change in the phosphorescence with continued illumination. These photochemical reactions, usually first-order with respect to photons, are second-order when the photons react with the phosphorescent state. The phosphorescent state shows sharp and characteristic bands suitable for identifying substances. The difference between fluorescence and phosphorescence is discussed and the non-appearance of phosphorescence in certain substances is interpreted. The band systems originate in the fall from the phosphorescent state to the different vibrational levels of the ground state. The energies of the phosphorescent state of 89 substances were calculated. In the phosphorescent state the molecule may exhibit frequencies coincidental to those recorded in infra-red and Raman spectra, but may also prominently exhibit frequencies forbidden in the infra-red and Raman spectra. β-Chloronaphthalene and C_6H_6 are discussed in this connection. Preliminary results on "unsaturated" inorganic substances reveal similar effects. The effects of auxochromes on the energy, and of certain substituents on the life-time of the phosphorescent state, are considered. The proposal that the phosphorescent state is identical with the triplet or biradical state is supported by consideration of the energy of the triplet state for which an equation is derived involving the energy of rupture of the double bond, the repulsive energy, and the difference in the resonance energy between the normal and triplet states. Data for anthracene, Ph_2 and its *o*-derivatives, and $CSPh_2$ are adduced in support of the theory.

W. R. A.

535.375.5 1426

Raman spectrum of dimethyldiacetylene. Meister, A. G., and Cleveland, F. F. *Proc. Amer. Phys. Soc., Chicago, Dec.* 1 *and* 2, 1944. *Abstr. in Phys. Rev.*, 67, *p.* 63, *Jan.* 1 *and* 15, 1945.—Raman frequencies, relative intensities, and depolarization factors were obtained for dimethyldiacetylene. A tentative assignment was made of all the observed Raman frequencies assuming that the molecule has the symmetry D'_{sh}. Three cases of Fermi resonance were observed, but there were also two cases where only a single line was observed in spite of the fact that the frequency and symmetry conditions for resonance were satisfied. The C—C triple-bond frequency which appears at 2 183 cm.$^{-1}$ for diacetylene is shifted considerably, appearing at 2 264 cm.$^{-1}$ for dimethyldiacetylene.

535.375.5 : 549.211 1427

Raman spectrum of diamond. Krishnan, R. S. *Nature, Lond.*, 155, *p.* 171, *Feb.* 10, 1945.

535.375.51 1428

Raman effect in aqueous solutions of some inorganic gases. Rao, B. P. *Proc. Indian Acad. Sci. A*, 20, *pp.* 292–297, *Nov*, 1944.—The Raman spectra of the solutions of SO_2 and NH_3 in water at different conc. are recorded, using a Hartmann diaphragm; there is no shift in the frequency of the strong Raman line in both the solutions with changing conc. No new lines attributable to SO_3^{--} or HSO_3^- or NH_4^- ions could be recorded. The ratios of the conc. of the solutions in both the cases are equal to the ratios of the intensities of the lines. The intensities of the l.f. components of the water-band in the solution of SO_2 tend to increase in comparison with that of the h.f. component with increasing conc.

535.39 1429

On the measurement of the spectral apparent reflectance of low-reflecting materials. Keegan, H. J. *J. Opt. Soc. Amer.*, 34, *pp.* 770–771, *Dec.*, 1944.—Describes methods by which very low values of reflectance (such as that of the reflection-reducing films on glass) may be measured to a fair degree of accuracy by artificially bringing the reflectance up, by an accurately known amount, into the region at which the spectrophotometer can be used without considerable error. J. W. T. W.

535.391.2 : 537.311.33 : 539.132 1430

Optical properties and electronic structure of solid silicon. MULLANEY, J. F. *Phys. Rev.*, 66, *pp.* 326–339, *Dec.*, 1944.—The existence of an empty (conduction) band 1·5 or 2·0 V above the highest filled band in Si and certain sulphides is inferred from their optical properties. Reflectivity data of silicon are examined using the expression for the complex index of refraction as given by classical electromagnetic theory. An oscillator strength of 1·6 electrons for the absorption, and a permittivity at l.f. of 12·5 are computed. The Wigner–Seitz–Slater method of computing electronic energy bands in crystals is used to determine the band structure of Si, which is found to resemble closely that obtained by Kimball for the diamond, except that Si is more nearly metallic than is the diamond. The form of the optical absorption as expected from band-structure considerations is proposed. The width of the filled bands as observed in soft X-ray emission spectra is about equal to the width of the computed bands.

535.4 : 548.0 : 537.531 = 4 *see Abstr.* 1515, 1516

535.4 : 548.55 : 537.531 *see Abstr.* 1517

535.417 : 535.325 1431

Rayleigh interferometers for gas analysis. O'BRYAN, H. M. *J. Opt. Soc. Amer.*, 34, *p.* 774, *Dec.*, 1944.—Describes modifications of the Rayleigh interferometer for measuring refractive indices of gases. One is the use of a four-compartment cell, giving twice the sensitivity without increase in overall length. Another is the use of auto-collimation, in combination with a four-compartment cell, in a portable instrument for measuring concentration of toxic gases in industrial atmospheres. J. W. T. W.

535.417 : 535.87 *see Abstr.* 1463

535.42 : 621.396.616 : 538.56 *see Abstr.* 1530

535.43 : 535.12 *see Abstr.* 1349

535.433 : 541.24 1432

Molecular weights of proteins as determined by light-scattering. HELLER, W., AND KLEVENS, H. B. *Proc. Amer. Phys. Soc.*, *Chicago*, *Dec.* 1 *and* 2, 1944. *Phys. Rev.*, 67, *p.* 61, *Jan.* 1 *and* 15, 1945.—Debye's equation [Abstr. 2425 (1944)] was verified on suspensions of polymers and on protein solutions by using a spectrophotometric-interferometric method (18-cm. layer). The symmetry of radiation was tested by means of Tyndall spectra. Aq. solutions of egg albumin gave the following data (*p*H 4·65–4·68) at 4°C.: Immediately after preparation, 47 000 ± 1 500; 24 hr. later, 64 000 ± 2 000; 72 hr. later, 81 000 ± 3 000. The ultra-centrifugal and osmotic-pressure data are 40 500–44 000 and 42 000–45 100, respectively. Similar agreement between light-scattering and ultracentrifugal data was found for serum-albumin. The method is extremely sensitive towards aggregation (denaturation) of proteins.

535.514.2 : 531.717.1 : 539.23 1433

The ellipsometer, an apparatus to measure thicknesses of thin surface films. ROTHEN, A. *Rev. Sci. Instrum.*, 16, *pp.* 26–30, *Feb.*, 1945.—Describes apparatus suitable for measuring the thickness of extremely thin protein films deposited on metal slides. Plane polarized light reflected from a metal surface becomes elliptically polarized and a thin transparent film alters the parameters of the ellipse. Measurement of the changes enables film thicknesses to be determined within ±0·3 Å. A. H.

535.515 : 537.228.3 : 541.182 1434

Electro-optical effect in colloids. SAKMANN, B. W. *J. Opt. Soc. Amer.*, 34, *pp.* 774–775, *Dec.*, 1944.—An account of work carried out by the photo-electric method, previously described [Abstr. 2924 (1942)], for studying the birefringence of colloidal solutions in a.c. fields. The results obtained with monodisperse bentonite sols are interpreted by means of a relaxation theory. J. W. T. W.

535.516 1435

Reflection in a non-isotropic medium. WEST, G. D. *Nature, Lond.*, 155, *p.* 546, *May* 5, 1945.—A photograph shows the trace of a ray of unpolarized light incident upon the totally reflecting face of a prism of calcite, cut so that the optic axis is parallel to the incident beam. The ray reflected normally is the ordinary ray, the one reflected at an obtuse angle is the extraordinary ray.

535.55 : 620.171.5 : 531.225 *see Abstr.* 1248

535.563 : 541.653 1436

Optical rotatory power and structure in triterpenoid compounds. Application of the method of molecular rotation differences. BARTON, D. H. R., AND JONES, E. R. H. *J. Chem. Soc.*, *pp.* 659–665, *Dec.*, 1944.—Data on the optical rotatory properties of all known compounds of the triterpenoid class are collected and analysed by the method of molecular rotation differences. The molecular rotations of triterpenoid carboxylic acids and their esters are identical. The majority of the well-characterized triterpenoid compounds can be separated, according to their molecular rotation difference values, into 2 groups, related to either the α- and β-amyrins or else to lupeol and betulin; the existence of a third and hitherto unsuspected group, embracing a number of the less well studied triterpenoids, is suggested. Very marked anomalies point distinctly to the existence of H bonding in the α- and β-boswellic acids and in echinocystic acid, and to its absence in siaresinolic acid. Hydrogenation of the easily reducible ethenoid linkage present in certain triterpenes produces characteristic molecular rotation differences.

535.6 1437

Quantitative data and methods for colorimetry. *J. Opt. Soc. Amer.*, 34, *pp.* 633–688, *Nov.*, 1944.—A further chapter (No. 7) of the Report on Colorimetry of the Opt. Soc. Amer. [Abstr. 387 (1944), 190 (1945)], giving the numerical data required for colorimetric calculations. These include (*a*) energy distribution of the 3 C.I.E. illuminants, of different phases of daylight and sunlight and of certain sources of light, (*b*) standard luminosity data and light flux distribution from standard illuminants, (*c*) tristimulus computation data for std. illuminants, for Planckian radiators at various temperatures, for daylight and certain light sources, (*d*) selected ordinates for evaluation of radiant energy, (*e*) selected ordinates for calculation of the tristimulus values with Planckian illuminants, daylight and various light sources, (*f*) trichromatic co-ordinates of the spectrum, of a number of light sources and of Planckian radiators, (*g*) coefficients for converting excitation to colorimetric purity for the three standard illuminants, (*h*) certain scotopic luminosity data, (*k*) sensitivity to brightness difference at different brightness levels.

J. W. T. W.

535.64 1438

Colorimeters and colour standards. *J. Opt. Soc. Amer.*, 35, *pp.* 1–25, *Jan.*, 1945.—Forms chapter VIII of the Report on Colorimetry [see Abstr. 1437 (1945)], dealing with colorimeters (i.e. instruments used for measuring colour, not those employed in chemical analysis, for which the name "colour comparator" is suggested) and other methods of specifying colours. The latter include empirical colorimeters such as the tintometer, sets of colour samples such as the Munsell or Ostwald, which are described in considerable detail, and colour dictionaries. The colorimeters described are those of W. D. Wright, J. Guild, R. Donaldson and P. G. Nutting.

J. W. T. W.

535.642 1439

The geometrical solutions of some colour mixture problems. GOUREVICH, M. M. *J. Opt. Soc. Amer.*, 35, *pp.* 196–198, *March*, 1945.—After a résumé of the mathematical treatment of colour mixture problems, the author describes a geometrical method of determining (*a*) the luminance of a mixture and (*b*) the chromaticity of a mixture when the luminance ratios of the components are known.

J. W. T. W.

535.65 1440

Notes on the problem of colour harmony and the geometry of colour space. POPE, A. *J. Opt. Soc. Amer.*, 34, *pp.* 759–765, *Dec.*, 1944.—Criticism of recent papers by Moon and Spencer [Abstr. 2022 (1944)] on the mathematical treatment of colour harmony. The paper is followed by a reply by these authors.

J. W. T. W.

535.653 1441

The distribution of colour matchings around a colour centre. SILBERSTEIN, L., AND MACADAM, D. L. *J. Opt. Soc. Amer.*, 35, *pp.* 32–39, *Jan.*, 1945.—Experimental data concerning the accuracy of visual chromaticity matching (automatically constant luminance) are compared with predictions based on the assumption of a normal frequency distribution in two dimensions. The standard deviations and correlation coefficient of the two conventional coordinates vary from point to point in the chromaticity diagram and values computed from the experimental data are presented. The major and minor axes, and the angle of inclination of the major axis of the ellipse representing the standard deviation of matchings in any specified direction from any central colour, are computed from the parameters of the distribution function, as are the coefficients of the quadratic differential form representing noticeability of chromaticity difference. The conclusions [Abstr. 1434, 1435 (1943)] are confirmed and strengthened.

535.653.8 1442

Modified chromatic value colour space. SAUNDERSON, J. L., AND MILNER, B. I. *J. Opt. Soc. Amer.*, 34, *p.* 770, *Dec.*, 1944.—Describes a modification of the "chromatic value" diagram of Adams [Abstr. 1547 (1942)] and compares the results with various colour difference formulae that have been proposed.

J. W. T. W.

535.668.1 : 532.692 1443

Polypentaerythritol drying oils. BURRELL, H. *Industr. Engng Chem.*, 37, *pp.* 86–89, *Jan.*, 1945.—Esterification rates and bodying rates are given. The polypentaerythritol drying oils are compared with other synthetic and natural oils as to drying time, hardness, durability, and increase in yellowness.

535.7 1444

The physical and photochemical basis of visual resolving power. II. Visual acuity and the photochemistry of the retina. BYRAM, G. M. *J. Opt. Soc. Amer.*, 34, *pp.* 718–738, *Dec.*, 1944.—A continuation of a previous paper [see Abstr. 930 (1945)], describing the results of measurements of visual acuity at different brightness levels. These are discussed in the light of S. Hecht's photochemical theory of perception. By assuming that visual resolving power is determined by energy-rate discrimination rather than by retinal-illumination discrimination, most of the data on visual acuity, except area-threshold phenomena, can be explained.

J. W. T. W.

535.7 : 535.82 1445

Visual factors in microscopy. DEMPSTER, W. T. *J. Opt. Soc. Amer.*, 34, *pp.* 711–717, *Dec.*, 1944.—The problem of vision through a microscope is discussed and the literature relative to visual acuity is reviewed. Conditions for high visual acuity and visual comfort are outlined.

535.7 : 541.141 1446

A modified photochemical theory of vision. MOON, P., AND SPENCER, D. E. *J. Opt. Soc. Amer.*, 35, *pp.* 43–65, *Jan.*, 1945.—A theory based on certain assumptions for the forms of the equations representing (*a*) the chemical and photochemical reactions between rhodopsin and retinene and (*b*) the action of light in producing electrical impulses in the nerve fibre. Curves of light or dark adaptation, values of absolute thresholds, etc., obtained by means of this theory, are compared with experimentally obtained data and the agreement is found to be satisfactory.

J. W. T. W.

535.7 : 612.84 1447

Absolute scotopic sensitivity of the eye in the ultraviolet and in the visible spectrum. PINEGIN, N. I. *Nature, Lond.*, 155, *pp.* 20–21, *Jan.* 6, 1945.

535.73 : 612.84 1448

The delineation of retinal zones with dark tube vision. ALLEN, F. *Canad. J. Res. A*, 23, *pp.* 21–31, *Jan.*, 1945.—The effect of increasing the stimulated area of the central or foveal part of the retina upon the critical frequency of flicker is described. The vision of one eye—the right—was directed through a long black tube at a screen of constant brightness, the different areas stimulated being obtained and measured by using holes of various dia. in black paper placed over the far end of the tube. Between this end of the tube and the screen was a rotating sectored disc with which the fusion frequency was obtained and measured. The graph obtained by plotting the measurements has 3 breaks in it, which correspond to the 5 central retinal zones delineated by histologists. The fusion frequencies are $\propto$ the log. of the diameters (or areas) of the retinal zones. A similar set of measurements was made on the periphery of the retina which showed both similarities to and differences from the central or foveal effects.

535.733 1449

The relation of protanopic to normal vision. JUDD, D. B. *J. Opt. Soc. Amer.*, 34, *pp.* 768–769, *Dec.*, 1944.—For the protanope it can be shown that $x = y(Q - 1{\cdot}224)/(-0{\cdot}546) + 0{\cdot}180$ and this family of straight lines (for different values of Q) on the chromaticity diagram, together with the lines indicating the chromaticity confusions of the normal protanope, gives a complete summary of the relation between protanopic and normal vision [see Abstr, 2343 (1943)]. J. W. T. W.

535.733 1450

Spectral sensitivity of the human eye. I. A spectral adaptometer. WALD, G. *J. Opt. Soc. Amer.*, 35, *pp.* 187–196, *March*, 1945.—Describes apparatus with which the eye can be adapted to radiation in ten spectral regions centred at wavelengths well distributed through the visible spectrum. The source is a h.p. Hg arc. Full details are given of the filter combinations used and of the special precautions taken to avoid even very small leaks of unwanted wavelengths. J. W. T. W.

535.733.1 1451

The transient Stiles–Crawford effect. MOON, P., AND SPENCER, D. E. *J. Opt. Soc. Amer.*, 34, *pp.* 744–750, *Dec.*, 1944.—A continuation of previous work [Abstr. 2427 (1944)] on the relation between pupil size and retinal illumination. The present paper deals with the transient conditions when the pupil is opening or closing as a result of change of the adaptation level, using empirical equations to represent the size of the pupil at any given time from the instant of change. Some applications of the results are given.

J. W. T. W.

535.733.1 1452

Standard response functions for protanopic and deuteranopic vision. JUDD, D. B. *J. Res. Nat. Bur. Stand., Wash.*, 33, *pp.* 407–438, *Dec.*, 1944. *J. Opt. Soc. Amer.*, 35, *pp.* 199–221, *March*, 1945.—The colour matches set up by the normal observer can be predicted satisfactorily by 3 functions of wavelength defining the ICI standard observer. It has been found possible by a transformation of co-ordinate system to express these functions in a form such that 2 of the 3 pairs also represent the colour matches of the 2 recognized types of red-green-blind observer, the protanope and the deuteranope, within the small uncertainties to which they are known. The remaining pair of functions represents, within the uncertainties to which they are known, the colour matches of the tritanope, a more rare type of observer who confuses reddish blue with greenish yellow. These 3 functions, therefore, serve to relate the colour matches made by dichromats to those made by normal trichromats, and so make conveniently accessible the colour confusions of average dichromatic observers. The use of the functions in the solution of problems arising in the design of tests for colourblindness is illustrated by solution of 3 such problems, and their connection to theories of colour vision is discussed.

535.736 1453

Spectral sensitivity of the dark-adapted human eye. WALD, G. *J. Opt. Soc. Amer.*, 34, *p.* 769, *Dec.*, 1944.—The threshold sensitivity of the retina has been determined for the fully dark-adapted eye, using nine narrowly restricted regions of the spectrum and an exposure time of $^1/_{25}$ sec. At 8° above the fovea the max. sensitivity is at 505 mμ, at 365 mμ it is 4·2 log units lower and at 750 mμ 6·4 log units lower, For foveal vision, the max. is at 565 mμ, and at both 365 and 750 mμ, it is 4·2–4·4 log units lower. The absolute sensitivity of the fovea is much lower than that of the periphery below about 670 mμ, where the curves cross. J. W. T. W.

535.736 1454

Dark adaptation following light adaptation to red and white lights. HECHT, S., AND HSIA, Y. *J. Opt. Soc. Amer.*, 34, *p.* 769, *Dec.*, 1944.—Describes an investigation of the value of red light or red goggles for preliminary dark adaptation. It is found that to achieve the same subsequent dark adaptation in the same time, one may remain light-adapted to about 10 times as high a photopic brightness of red light (beyond 650 mμ) as of white light. J. W. T. W.

535.736 : 612.84 1455

Visual resolution as a function of intensity and exposure time in the human fovea. NIVEN, J. I., AND BROWN, R. H. *J. Opt. Soc. Amer.*, 34, *pp.* 738–743, *Dec.*, 1944.—Describes the results of experiments on the relation between the brightness of a visual test object (an illuminated slit), its size and the time of exposure required for detection. The results are discussed in terms of Hecht's theory of visual intensity discrimination. J. W. T. W.

535.81 1456

On the use of working standards of didymium and vitrolite glasses for spectrophotometric measurements. KEEGAN, J., AND GIBSON, K. S. *J. Opt. Soc. Amer.*, 34, *p.* 770, *Dec.*, 1944.—Gives the wavelengths of max. absorption for Corning 512 and Jena BG 11 didymium glasses. Typical spectral reflectance curves for different melts and thicknesses of vitrolite and of Corning thermometer white glasses are also given.

J. W. T. W.

535.81 1457

A proposed method of specifying appearance defects of optical parts. MCLEOD, J. H., AND SHERWOOD, W. T. *J. Opt. Soc. Amer.*, 34, *p.* 774, *Dec.*, 1944.—Limits are set to the permissible amount of imperfection of optical glass parts, due to accidental scratches and digs, by making comparison with standard samples carrying these imperfections to different degrees. J. W. T. W.

535.82 : 535.7 *see Abstr.* 1445

535.824 1458

Preliminary experiments in phase-difference microscopy. JUPNIK, H. *J. Opt. Soc. Amer.*, 34, *p.* 773, *Dec.*, 1944.—Contrast in the images of highly transparent objects can be improved, and negative contrast can be produced, by suitably altering the phase of part of the light that has passed through the object. The effect on contrast when both amplitude and phase changes are made in portions of the light passing through the objective has been studied. It is found that (*a*) the introduction of absorption is important and (*b*) the regions most enhanced in the image are the regions of rapid change of refractive index in the object. J. W. T. W.

535.824 1459

Phase-difference microscopy as a problem in diffraction. Osterberg, H. *J. Opt. Soc. Amer.*, 34, *pp.* 773–774, *Dec.*, 1944.—A theoretical treatment of the problem considered by Jupnik [see Abstr. 1458 (1945)]. A series of interchangeable objectives, or of plates for use with a given objective, is required to give the different distributions of absorption and phase difference needed to produce the desired contrast variations with a given object specimen. The effect of this method on the resolution of a 16 mm. microscope objective has been found to be negligible for most of the distributions of absorption and phase which give excellent contrast differences with biological particles. J. W. T. W.

535.824 : 535.326 *see Abstr.* 1374

535.824.3 1460

Principles of microscope illumination and the problem of glare. Dempster, W. T. *J. Opt. Soc. Amer.*, 34, *pp.* 695–710, *Dec.*, 1944.—The adjustments for glare-free illumination are discussed and aspects of the lighting requirements of the microscope are analysed; regulation of the apertures of the field and condenser stops are the basic requirements for controlled illumination.

535.826.7 1461

Fluorescent staining of insect tissues. Brues, C. T. *Science*, 100, *pp.* 554–555, *Dec.* 15, 1944.

535.87 1462

Coma-free high-aperture twin ellipsoid mirror. Woodson, R. A. *J. Opt. Soc. Amer.*, 34, *p.* 774, *Dec.*, 1944.—A device for giving a coma-free real image of a real object at unit magnification for a large numerical aperture. It consists of a pair of identical prolate ellipsoids of revolution placed with major axes in line and with one focus in common, so that the distance of one extreme focus (position of object) from the other (position of image) is twice the distance between the foci of a single mirror. The useful field is considerable even for high numerical apertures. J. W. T. W.

535.87 : 535.417 1463

Silvered mirrors for interferometric measurement. Grodzinski, P. *Nature, Lond.*, 154, *pp.* 799–800, *Dec.* 23, 1944.

535.89 1464

Schlieren and shadowgraph equipment for air-flow analysis. Barnes, N. F., and Bellinger, S. L. *J. Opt. Soc. Amer.*, 34, *p.* 775, *Dec.*, 1944. *See also Gen. Elect. Rev.*, 47, *pp.* 27–36, *Dec.*, 1944.—Discusses the merits of different types of light sources for schlieren and for shadowgraph equipment. For the former, the high-pressure 1 000 W Hg lamp with air cooling is recommended, for the latter a h.v. spark discharge is considered best for photographic recording. J. W. T. W.

536 : 541.127.4 1465

Properties of vanadium tetrachloride. Simons, J. H., and Powell, M. G. *J. Amer. Chem. Soc.*, 67, *pp.* 75–77, *Jan.*, 1945.—K_p in mm. for the reaction $2VCl_3$ (*s*) + Cl_2 (g) = $2VCl_4$ (g) is 1 480 at 160°, 2 070 at 170°, 3 000 at 180°, with a calculated ΔH of 13·8 k.cal. The f.p. is −25·7°. The v.p. followed the equation $\log_{10} P_{mm.} = -1\,998/T + 7{\cdot}581$ between 29·5° and 80·2°. This extrapolates to give a normal b.p. of 152° ± 2° and a Trouton-rule constant of 21·3. F.p. measurements of VCl_4 dissolved in CCl_4 were made. From these the equilibrium constant at approximately −25° is $18{\cdot}2 \times 10^{-3}$ for the assumed equilibrium $V_2Cl_8 = 2VCl_4$, and the concentrations expressed in moles per 1 000 g. of CCl_4.

536.2 : 518.4 1466

Graphical methods for temperature distribution with unsteady heat flow. Patton, T. C. *Industr. Engng Chem.*, 36, *pp.* 990–996, *Nov.*, 1944.—Contains 22 references to publications dealing with heat-flow calculations, and gives details of simplified graphical methods for determining the temperature distribution across the boundary of a composite wall, through a cylinder and through a sphere. Examples for each case are given. The modifications necessary to allow for changes in the constants with temperature are indicated. R. W. P.

536.2 : 532.13 *see Abstr.* 1275

536.2 : 532.72 : 533.15 *see Abstr.* 1311

536.212 1467

Thermal conductivity of carbon blacks. Smith, W. R., and Wilkes, G. B. *Industr. Engng Chem.*, 36, *pp.* 1111–1112, *Dec.*, 1944.—The conductivity of 3 samples of commercial carbon black was measured. The conductivity appears to be independent of the ultimate particle size and, in 2 samples, is lower than that of still air. Agglomeration of carbon black into free-flowing pellets increases the conductivity to a value slightly higher than that of still air.

536.23 1468

An apparatus to measure the specific thermal conductivity of gases at low temperatures. Ubbink, J. B., and De Haas, W. J. *Physica, 's Grav.*, 10, *pp.* 451–464, *July*, 1943.—The hot-wire method and the plate method for measuring the specific thermal conductivity (*k*) are discussed. The former is unsuitable for use at low temperatures, but the latter may be adapted for such use (convection, for example, which is more probable at low temperatures because of the relatively high gas densities, is suppressed by mounting the hot plate above the other one). The constructional details of the apparatus are given and the theory of the method for measuring *k* is developed. Control measurements on hydrogen at 19°K. and on hydrogen and air at 0°C. show that the theory agrees with experimental results. The values of *k* found for hydrogen and for dry air (free from CO_2) at 0°C. are $42{\cdot}1 \times 10^{-5}$cal.cm.$^{-1}$sec.$^{-1}$deg.$^{-1}$ and $5{\cdot}85 \times 10^{-5}$ cal.cm.$^{-1}$sec.$^{-1}$deg.$^{-1}$ respectively and these are compared with values previously obtained by other authors. L. S. G.

536.23 1469

Thermal conductivity of gaseous helium. Ubbink, J. B., and De Haas, W. J. *Physica, 's Grav.*, 10, *pp.* 465–470, *July*, 1943.—Using the apparatus previously described [Abstr. 1468 (1945)] measurements of the conductivity (*k*) were made in the liquid

O_2–N_2 region, in the liquid-H_2 and in the liquid-He region down to 1·62°K. In the first two regions k is independent of the pressure, which was varied from 76 cm. to 1 cm. Hg. A graph is given of the variation of k with temperature, and there is a note on the comparison of the values of k with theoretical values. The quantum-mechanical calculations of Uehling [Abstr. 4455 (1939)] are not in agreement with the present experimental values and for reasons which are given it is not suitable to make a comparison with theoretical results based on the classical expression for k. Recent calculations of De Boer (using a potential field with a repulsive component $\propto r^{-12}$ and an attractive component $\propto r^{-6}$) are in reasonable agreement with the experimental results. L. S. G.

536.24 : 533.6.011 *see Abstr.* 1315

536.41 1470

The effect of temperature on the density of polythene. Hunter, E., and Oakes, W. G. *Trans. Faraday Soc.*, 41, *pp.* 49–56, *Feb.*, 1945.—The densities of specimens between 0° and 170°C. and the thermal expansion between −178°C. and 30°C. were measured. The results are consistent with the theory that the long molecules of the solid are partly in a crystalline and partly in an amorphous condition in proportions dependent on temperature. Rough values of the crystalline fraction at different temperatures were calculated. They show an amount of crystalline mater (55% at room temperature) which is unchanged up to 70°C. but thereafter falls more and more rapidly until the substance becomes wholly amorphous at a temperature (in the range 100°–120°) dependent on the nature of the specimen. Densities of molten polythene show little dependence on average mol. wt., but the temperature at which crystalline material first appears on cooling is raised by increase in mol. wt. Specimens of different composition differ markedly in density at 100°C. The specimen examined at sub-normal temperatures showed signs of a minor transition at −45°C. In the liquid, the density rapidly becomes const. after change of temperature. By shock-cooling of the liquid rather than slow cooling, a solid of slightly lower density is obtained which partially reverts to the density of the slowly cooled form on annealing at 100°.

536.42 : 536.655 1471

Vapour pressure, latent heat of vaporization, and triple-point temperature N_2O. Hoge, H. J. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 281–295, *March*, 1945.—The v.p. of N_2O was measured from the triple point ($T = 182{\cdot}351$°K., $p = 658{\cdot}9$ mm. Hg) to 236°K. ($p = 10{\cdot}25$ atm.). The data are compared with previous work in a graph that includes the entire liquid range. The lat. ht. of vaporization was measured from the triple point to 205°K. At the b.p. (184·695°K.) the lat. ht. is 16·55 kJ mole^{-1}. The consistency of the data was tested with Clapeyron's equation, which was also used to compute lat. hts. above the range of the direct measurements.

536.421 : 541.66 1472

The melting of polythene. Richards, R. B. *Trans. Faraday Soc.*, 41, *pp.* 127–137, *March*, 1945.—By an extension of the statistical thermodynamic treatment [Abstr. 2032 (1944)], an equation is derived for the variation, with temperature, of the degree of crystallinity of a long-chain linear paraffin containing various proportions of short-chain paraffinic liquids which are concentrated in the amorphous regions of the solid. From this equation a further equation is derived for the change of m.p. with the proportion and mol. wts. of the added liquid. The theoretical results agree with observed data for the depression of m.p. by paraffins of various mol. wts. The theoretical results suggest that there should be a connection between the crystallinity, and hence density, of the solid at ordinary temperatures and the m.p. of the sample; this is in accord with observed data. The presence of side groups will have an effect similar to that of short molecules, and by increasing the entropy of the amorphous regions will lead to a more amorphous polymer. Part of the variability in m.p. and crystallinity in polythene is due to variation in the degree of chain branching.

536.422.1 1473

Equipment and techniques for evaporation of metals. Olsen, L. O., Smith, C. S., and Crittenden, E. C., Jr. *Proc. Amer. Phys. Soc., Cleveland, Ohio, Sept.* 11–12, 1944. *Abstr. in Phys. Rev.*, 66, *p.* 357, *Dec.* 1 *and* 15, 1944.—In an 18 in. evaporation system, a number of evaporations have been carried out using close-wound conical baskets and/or helical coils of N, Fe, chromel, and W, as well as crucibles, as the heating elements. The evaporation behaviour of 40 metals has been observed.

536.422.1 1474

The evaporation of metals from crucibles. Smith, C. S., Olsen, L. O., and Crittenden, E. C., Jr. *Proc. Amer. Phys. Soc., Cleveland, Ohio, Sept.* 11–12, 1944. *Abstr. in Phys. Rev.*, 66, *p.* 357, *Dec.* 1 *and* 15, 1944.—BeO-coated tungsten-wire crucibles have been made with a 1 cm.^{3} capacity and used at 1 750°C. for short periods, and at 1 550°C. for long periods. Aluminia-coated crucibles are excellent below 1 200°C., and have been given repeated use with different metals.

536.422.15 : 523.11 1475

Vapour pressure of solids at low temperatures (and the origin of the planets). Parson, A. L. *Nature, Lond.*, 154, *pp.* 707–708, *Dec.* 2, 1944.

536.423 1476

Evaporation indices of hydrocarbon thinners. McArdle, E. H., and Robertson, A. E. *Industr. Engng Chem.* (*Analyt. Edit.*), 16, *pp.* 690–693, *Nov.*, 1944.—Pending the development of a standardized test for determining evaporation rates of solvent naphthas and hydrocarbon thinners, equations are suggested by which evaporation indices can be estimated from the normal routine determinations of their specific gravities and volatilities. R. W. P.

536.423.15 1477

The vapour pressure of water in the neighbourhood of 100°C. Michels, A., Blaisse, B., ten Seldam, C. A., and Wouters, H. M. *Physica, 's Grav.*, 10, *pp.* 613–620, *Oct.*, 1943.—The apparatus for measuring the v.p. (by the dynamic principle) is described. The disturbing effects of the radiation from the heating elements to the thermometer and from the thermometer to the walls of the apparatus are avoided. Measurements are made between 98·0°C. and 102·6°C., using an artificial atmosphere from 706–

833 mm. Hg, respectively. The v.p. may be represented by the formula

$$t = 100 + a(p - 760) - b(p - 760)^2$$

where a and b are numerical constants, or more accurately by a cubic formula. A comparison is made with v.p. curves published since 1927 and the criticism of Moser [Abstr. 5103 (1932)] is discussed.

L. S. G.

536.423.15 : 541.123.2 1478

Carbon tetrachloride–tetrachloroethylene system. McDonald, H. J., and McMillan, W. R. *Industr. Engng Chem.*, 36, *pp.* 1175–1176, *Dec.*, 1944.—The liquid-vapour composition was determined. The v.p. data are obtained by determining the b.p. at 4 different pressures of 9 samples covering the binary diagram. The b.p. of the system at 1 atm. pressure and the v.p. at 60°C. are given.

536.44 : 541.265 1479

Correlations of critical constants with parachors. Herzog, R. *Industr. Engng Chem.*, 36, *pp.* 997–1001, *Nov.*, 1944.—Various correlations are examined. Four relations involving the parachor are developed, from which relatively accurate critical constants can be estimated, using the normal b.p. and calculated parachors as auxiliary data. Statistical measures of the reliability of the estimated constants are presented.

536.445 : 532.739 1480

Critical solution temperatures with cyclic hydrocarbons. Francis, A. W. *Industr. Engng Chem.*, 36, *pp.* 1096–1104, *Dec.*, 1944.—Critical solution temperatures are reported for 60 organic solvents, each with one or several of 35 aromatic hydrocarbons and 3 naphthenes. For each solvent the points agree approximately with a smooth function of the total number of paraffinic C atoms in the side chains of the hydrocarbons. In the case of alkyl-benzenes, the temperatures are nearly parallel with the b.p. of the hydrocarbons. For most aliphatic solvents the critical solution temperatures are nearly the same for corresponding derivatives of benzene and naphthalene. The effects of substituent groups in the solvents upon miscibility are estimated. The hydroxyl, amino, and carboxyl radicals raise the temperatures roughly 200°C. or more, and the nitro group about 150°. Selectivities of solvents for aromatic hydrocarbons with respect to paraffins are 6 times as great as those for naphthenes. A composite arrangement of solvents and hydrocarbons is devised, showing qualitatively the mutual solubility of any pair of included substances as liquids.

536.46 1481

The abnormality of flame gases. David, W. T. *Proc. Instn Mech. Engrs, Lond.*, 151, 3, *pp.* 236–247, 1944.—Experiments are described which show that flame gases hold within them a long-lived latent energy. The latent energy may amount to 15% of the heat of combustion; but it varies greatly with the conditions under which combustion takes place. These conditions have been investigated by means of explosion-pressure and heat-loss measurements, flame-gas temperature measurements, and flame photography. Experiments are described which show that, in virtue of the latent energy, an abnormally large amount of dissociation may obtain in flame gases. On account of this, a Pt wire immersed in flame gases may attain a far higher temperature than a similar wire coated with quartz, and this cannot be accounted for in terms of the different emissivities of the surfaces. There seems little doubt that this phenomenon may have an important bearing upon such problems as the transmission of heat from flame gases and the selection of gas-fire radiants. Flame gases resulting from the combustion of weak hydrogen-air mixtures behave in a quite exceptional manner and a short account of some experiments with these gases is given.

536.49 : 667.64 1482

Infra-red radiant-heat baking of enamels. Ernst, R. C., and Schumacher, E. F. *Industr. Engng Chem.*, 36, *pp.* 1132–1137, *Dec.*, 1944.—Comparison between the drying behaviour of enamels baked in radiant heat and convection ovens at equal panel temperatures showed no significant differences. Absorptivities were determined for black, green, red, yellow, and white gloss enamels. An analysis was made of the distribution of energy in heating these enamels with radiant heat. The influence of convection currents and thermal conduction on radiant-heat baking is discussed. The influence of the percentage of polymerizing material in a series of film-forming compositions upon the rate of hardening when baked with radiant heat was determined.

536.5.081 : 621.326.791 : 535.233 *see Abstr.* 1355

536.532 1483

A thermocouple-bolometer detector. Conn, G. K. T. *Trans. Faraday Soc.*, 41, *pp.* 192–197, *April–May*, 1945.—It is pointed out that the sensitivity of thermocouple detectors may be enhanced and controlled by use of the fact that the electrical resistance of the wires changes with temperature. This application of the principle of the bolometer is got by placing the thermojunction in a Wheatstone bridge circuit. Improvement by factors varying from 2 to 4 in the sensitivity of the thermocouples already in use can be obtained. Precautions to be observed are considered. A. H.

536.6 : 536.7 : 541.127.4 1484

Heats, free energies, and equilibrium constants of some reactions involving O_2, H_2, H_2O, C, CO, CO_2, and CH_4. Wagman, D. D., Kilpatrick, J. E., Taylor, W. J., Pitzer, K. S., and Rossini, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 143–162, *Feb.*, 1945.—Values are presented for the following thermodynamic properties: The heat-content function, $(H° - H_0^°)/T$, the free-energy function, $(F° - H_0^°)/T$, the entropy, $S°$, the heat content, $H° - H_0^°$, and the heat capacity, $C_p^°$, for O_2(gas) to 5 000°K., H_2 (gas) to 5 000°K., H_2O (gas) to 3 000°K., N_2 (gas) to 5 000°K., C (solid, graphite) to 1 500°K., C (solid, diamond) to 1 200°K., CO (gas) to 5 000°K., CO_2 (gas) to 3 500°K., and CH_4 (gas) to 1 500°K., the standard entropy, $S°$, for H_2O (liq.) at 25°C., the heat of formation, $\Delta Hf°$, the free energy of formation, $\Delta Ff°$, and the equilibrium constant of formation, Kf, from the elements, for H_2O (liq.) at 25°C., and for H_2O (gas), CO (gas), CO_2 (gas), and CH_4 (gas), to 1 500°K.; the increment in heat content, $\Delta H°$, and the increment in free energy, $\Delta F°$, for the transition of graphite into diamond, to 1 200°K. and to 20 000 atm. From the foregoing, values were calculated for the increment in heat content, $\Delta H°$, the increment in free energy, ΔF°, and the equilibrium constant, K, for the following reactions.

536.6/.7 1485

Thermal data. XVIII. The heat capacity, heat of fusion, entropy, and free energy of ethylbenzene. Guthrie, G. B., Jr., Spitzer, R. W., and Huffman, H. M. *J. Amer. Chem. Soc.*, 66, *pp.* 2120–2121, *Dec.*, 1944.—Values of C_p from 13° to 305·4°K. were measured with an adiabatic calorimeter, the m.p, is 178·169 ± 0·03°K. Heat of fusion is 2 190·3 g.cal./mol., entropy for liquid PhEt is 60·95 ± 0·10 g. cal./deg./mol. at 298·16°K., and the molal free energy of formation of liquid PhEt at 298·16°K. is 28·65 Kg. cal. W. R. A.

536.6/.7 1486

High-temperature heat contents of aluminium oxide, aluminium sulphate, potassium sulphate, ammonium sulphate and ammonium bisulphate. Shomate, C. H., and Naylor, B. F. *J. Amer. Chem. Soc.*, 67, *pp.* 72–75, *Jan.*, 1945.—High temperature heat contents were determined from 473° to (in one case) 1 773°K. for Al_2O_3 (sapphire), $Al_2(SO_4)_3$, K_2SO_4, $(NH_4)_2SO_4$, and NH_4HSO_4. The heats of fusion of K_2SO_4 and NH_4HSO_4 are 8 760 (1 342°K.) and 3 420 (417°K.) g.cal. The heat of transition of K_2SO_4 at 856°K. is 1 940 g.cal. Equations are given for $H_0 - H_{298\cdot16}$ and C_p, and heat content, entropy, and free energy increments at 50° intervals from 350° to 600°K. for NH_4HSO_4 and $(NH_4)_2SO_4$ and at 100° intervals from 400° to 1 800° for the others are tabulated. W. R. A.

536.6/.7 1487

Heat contents at high temperatures of magnesium and calcium fluorides. Naylor, B. F. *J. Amer. Chem. Soc.*, 67, *pp.* 150–152, *Jan.*, 1945.—Heat contents above 298·16°K. were determined from room temperature to 1 773°K. for MgF_2 and CaF_2 (fluorite). The following values are given: heats of fusion, 13 900 and 7 100 g.cal./mol; m.p. 1 536° and 1 691°K.; equations for $H_0 - H_{298\cdot16}$ and for C_p for solid and liquid forms; heat content and entropy increments at 100° intervals above 298·16°K. W. R. A.

536.62 1488

Specific heats of gaseous 1,3-butadiene, isobutene, styrene, and ethylbenzene. Scott, R. B., and Mellors, J. W. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 243–254, *March*, 1945.—Describes a flow calorimeter and measurements of the specific heats of 4 hydrocarbons. The measurements on gaseous 1,3-butadiene and isobutene cover the range −35° to +80°C. The specific heats of styrene vapour and ethylbenzene vapour were determined at 100°C. The calorimeter was tested by measuring the sp. ht. of normal hydrogen. The results on the hydrocarbons are correct to ±0·5%.

536.621 : 536.653 : 536.7 : 541.124.7 1489

Heats of dilution and heat capacities of aqueous solutions of mono-, di-, and tri-methylamine hydrochlorides. Whitlow, E. P., with Felsing, W. A. *J. Amer. Chem. Soc.*, 66, *pp.* 2028–2033, *Dec.*, 1944.—Differential heats of dilution for aq. MeNH . HCl, Me_2NH . HCl, and Me_3N . HCl have been determined at 25° in conc. 0·05 to 1·0 *M*. From these data, measured heat capacities at 25°, and recorded activity coefficients near the f.p., the activity coefficients at 25° have been computed. A silvered 3-litre Dewar flask was used as calorimeter vessel, the temperature being measured by a thermopile consisting 1 300 Cu-constantan coupler. W. R. A.

536.63 : 536.653 1490

The heat capacity, heat of solution, and crystallinity of polythene. Raine, H. C., Richards, R. B., and Ryder, H. *Trans. Faraday Soc.*, 41, *pp.* 56–64, *Feb.*, 1945.—The sp. ht. of solid polythene at 20°C. is about 0·55, and is greater than the sp. ht. of entirely crystalline short-chain paraffins. As the temperature is raised, the sp. ht. increases, reaching a value of about 1·0 at 90°C. and 2·0 at 110°C. These results indicate a disordering of the structure of the solid beginning below 50°C. and becoming increasingly marked as the temperature is raised, culminating in a relatively sharp change to a liquid structure at about 115°C. The changes are similar to those shown by density measurements and are believed to be due to a decrease in the proportion of the long molecules which pass through crystallites. The difference between the heat capacity of solid polythene and the extrapolated heat capacity of liquid polythene at the same temperature (the heat of fusion), is 43·4 cal./g. at 20°C., decreasing to 28·7 at 90°C. and 9·6 at 110°C. Values for the heat of solution in xylene are similar to the heat of fusion at the same temperature. A comparison with the heat of fusion of entirely crystalline paraffins indicates that at room temperature the polythene sample was approx. 75% crystalline. Lack of complete reversibility of heat-capacity measurement shows that thermodynamic equilibrium between crystalline and amorphous regions is not attained instantaneously.

536.63 : 536.77 : 539.132 *see Abstr.* 1534

536.633 : 534.321.9 1491

The heat capacity of gaseous butadiene-1,3. Aston, J. G., Moessen, G. W., Hardy, H. C., and Szasz, G. J. *J. Chem. Phys.*, 12, *pp.* 458–463, *Nov.*, 1944.—The heat capacity at 300°K. and at 363°K. was determined by the measurement of the velocity of h.f. sound over the pressure range from $^1/_3$ to 1 atm. The heat capacity at zero pressure, evaluated by extrapolation, agrees with the value calculated from experimental state data. There is a marked disagreement between the experimental results and values calculated from spectroscopic and molecular data.

536.633.1 1492

The heat capacity of gaseous 1,3-butadiene from 0° to 100°. Templeton, D. H., Davies, D. D., with Felsing, W. A. *J. Amer. Chem. Soc.*, 66, *pp.* 2033–2035, *Dec.*, 1944.—Values of C_p for n-C_4H_{10} and air at 25° were measured to calibrate a constant-flow apparatus. Values of C_p of 1 : 3-butadiene at 6 temperatures between 5° and 105° are reported and compared with those deduced from spectroscopy, thermodynamic properties, direct calorimetry, and measurements of velocity of sound. W. R. A.

536.653 : 536.63 *see Abstr.* 1490

536.653 : 536.7 : 541.124.7 : 536.621 *see Abstr.* 1489

536.655 : 536.42 *see Abstr.* 1471

536.655 : 536.71 1493

A calculation of the latent heat of vaporization based on a revised equation of state. MacLeod, D. B. *Trans. Faraday Soc.*, 41, *pp.* 122–126, *March*, 1945.—

In a recent paper the author examined the consequences that followed from assuming the volume of the molecules, as represented by b in Van der Waals' equation, to be a function of $P + a/v^2$, the total pressure. The latent heats of vaporization, from the b.p. to the critical temperatures, are calculated for several typical substances [see Abstr. 148 (1945)]. In the equation of state, evidence was adduced that molecules contract in passing from the vaporous to the liquid condition. Allowance has been made for the work required to overcome this contraction. The calculated values accord closely with those obtained from the Clausius–Clapeyron equation.

536.658 : 541.183.56 : 532.62 *see Abstr.* 1303

536.66 1494

Heat of formation of carbon dioxide and of the transition of graphite into diamond. Prosen, E. J., Jessup, R. S., and Rossini, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 33, *pp.* 447–450, *Dec.*, 1944.—A recalculation of data previously reported [Abstr. 4987 (1938)], together with consideration of some new data on graphite, yielded the following selected best values:

$$\text{C (c, graphite)} + \text{O}_2\ \text{(gas)} = \text{CO}_2\ \text{(gas)};$$
$$\Delta H^{\circ}_{298\cdot 16} = -\ 393\ 447 \pm 45\ \text{int. J/mole} = -\ 94\ 051\cdot 8 \pm 10\cdot 8\ \text{cal/mole.}$$

$$\text{C (c, diamond)} + \text{O}_2\ \text{(gas)} = \text{CO}_2\ \text{(gas)};$$
$$\Delta H^{\circ}_{298\cdot 16} = -\ 395\ 343 \pm 96\ \text{int. J/mole} = -\ 94\ 505\cdot 1 \pm 22\cdot 9\ \text{cal/mole.}$$

$$\text{C (c, graphite)} = \text{C (c, diamond)};$$
$$\Delta H^{\circ}_{298\cdot 16} = 1\ 896 \pm 85\ \text{int. J/mole} = 453\cdot 2 \pm 22\cdot 9\ \text{cal/mole.}$$

536.66 1495

Heats of formation and combustion of 1,3-butadiene and styrene. Prosen, E. J., and Rossini, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 59–64, *Jan.*, 1945.

536.662 1496

Some experimental data on the heats of combustion of benzoic acid and carbon (graphite). Prosen, E. J., and Rossini, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 33, *pp.* 439–446, *Dec.*, 1944.—The data on benzoic acid support the change in the value for its heat of combustion recently reported. The data on carbon (graphite) yield a slightly higher value for the heat of formation of CO_2 than that previously reported.

536.662 1497

Heats of combustion of benzene, toluene, ethylbenzene, *o*-xylene, *m*-xylene, *p*-xylene, *n*-propylbenzene, and styrene. Prosen, E. J., Gilmont, R., and Rossini, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 65–72, *Jan.*, 1945.—The heats of combustion were measured with a bomb calorimeter. The following values were obtained, at 25°C. and const. pressure, for the liquid hydrocarbon in gaseous oxygen to form gaseous CO_2 and liquid H_2O, with all the reactants and products in their thermodynamic standard reference states, in international J/mole: Benzene, 3 267·09 ± 0·43; toluene, 3 909·31 ± 0·49; ethylbenzene, 4 564·09 ± 0·72; *o*-xylene, 4 552·10 ± 1·02; *m*-xylene, 4 551·10 ± 0·62; *p*-xylene, 4 552·09 ± 0·91; *n*-propylbenzene, 5 217·37 ± 0·68; styrene, 4 394·14 ± 0·82.

536.662 1498

Heats of combustion and formation of the paraffin hydrocarbons at 25°C. Prosen, E. J., and Rossini, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 263–270, *March*, 1945.—Selected "best" values are given for the heats of combustion (in oxygen to form gaseous CO_2 and liquid H_2O) and the heats of formation (from the elements solid carbon, graphite, and gaseous hydrogen) for methane and ethane in the gaseous state, and for all the paraffin hydrocarbons from propane through the octanes and the normal paraffins through eicosane, in both the liquid (except for one octane which is solid) and gaseous states, all at 25°C. Equations are given for calculating values for all the normal paraffins above eicosane.

536.666 : 541.62 1499

Heats of isomerization of the 18 octanes. Prosen, E. J., and Rossini, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 163–174, *Feb.*, 1945.—The heats of isomerization of all of the 18 octanes were determined by measurement of the ratios of their heats of combustion, in the liquid state for 17 and the solid state for 1, using the procedure previously described for the hexanes and the heptanes. Values of the heats of isomerization are reported for the condensed (liquid or solid) state at 25°C. and for the gaseous state at 25°C. and 0°K.

536.7 : 532.62 *see Abstr.* 1304

536.7 : 541.123.61 *see Abstr.* 1564

536.7 : 541.124.7 : 536.653 : 536.621 *see Abstr.* 1489

536.7 : 541.127.4 : 536.6 *see Abstr.* 1484

536.71 : 536.655 *see Abstr.* 1493

536.75 1500

Thermal transpiration and reversible process for a degenerate gas. Gogate, D. V., and Upadhyaya, V. N. *Phil. Mag.*, 35, *pp.* 760–764, *Nov.*, 1944.—The gas considered is degenerate in the sense of Fermi–Dirac statistics and the total change in entropy arising from a certain reversible process is calculated. It is found that there is a decrease in entropy in conformity with an earlier observation [Abstr. 2923 (1932)] that a basic theorem of thermodynamics that "the entropy change of a universe during a reversible process is zero" is not always applicable. L. S. G.

536.753 : 536.77 : 532.771 : 541.64 1501

Thermodynamics of heterogeneous polymers and their solutions. Flory, P. J. *J. Chem. Phys.*, 12, *pp.* 425–438, *Nov.*, 1944.—The statistical mechanical treatment is extended to heterogeneous polymers composed of numerous molecular species differing in chain length. Entropies of mixing with solvent are derived for the oriented pure components, the disoriented pure components, and the disoriented mixture of species. The entropy in the last-mentioned state is identical with that previously derived neglecting polymer heterogeneity. On introducing a van Laar heat-of-mixing term, expressions for the partial molal free energies are derived. The thermodynamic equations are applied to the problem of equilibrium in the range of partial miscibility for solvent-heterogeneous polymer systems. The requisites for efficient fractionation of high polymers are discussed. The efficiency of separation depends on the ratio of the volumes of the supernatant and the precipitated phases; to attain a high ratio, very dilute solutions must be employed. The higher the mol. wt. at which separation occurs, the greater the dilution required for the same sharpness of separation. The free-energy expressions are applied to the formulation of equilibrium constants to be employed in reversible polymerization-degradation processes. The equilibrium state for a poly-functional condensation, considered as a reaction between functional groups, is not affected by the polymeric nature of the reacting species.

536.77 : 519.1 1502

The number of arrangements on a lattice of molecules each occupying several sites. Guggenheim, E. A. *Trans. Faraday Soc.*, 41, *pp.* 107–114, *March*, 1945.—The statistical treatment by Chang [Abstr. 1516, 1882 (1939)] of molecules each occupying 2 sites (dimers) and by Miller [Abstr. 351 (1942), 1037 (1943)] of molecules each occupying 3 sites (trimers) is simplified and extended to a mixture of dimers and trimers and to molecules each occupying 4 sites (tetramers). The resulting formulae are in agreement with those obtained in a previous paper by a more powerful method [Abstr. 967 (1945)]. An essential condition of this treatment is zero energy of interaction between molecules.

536.77 : 532.771 : 541.64 : 536.753 *see Abstr.* 1501

536.77 : 536.63 : 539.132 *see Abstr.* 1534

536.77 : 541.127.4 : 541.621 1503

Free energies and equilibria of isomerization of the 18 octanes. Prosen, E. J., Pitzer, K. S., and Rossini, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 255–263, *March*, 1945.—Values of the following thermodynamic properties are presented in tabular and graphical form for the 18 octanes in the ideal gaseous state, for the range 298° to 1 000°K.; the standard free energy of isomerization divided by the abs. temperature, $\Delta F°/T$; and the relative amounts of the several isomers present in equilibrium with each other.

536.8 = 6 1504

Internal-combustion-engine cycles. Mesny, M. *Publ. Fac. Cienc. Fis.-Mat. La Plata, No.* 179, *pp.* 311–332, *Dec.*, 1944.—Based on the standard ideal cycle of the so-called perfect mixture, a study is made of the actual efficiency of the cycle in the case of constant-temperature, constant-pressure, constant-volume and mixed cycles. A tabulated comparison is made of the characteristics of the ideal cycles for constant volume, constant pressure, and constant pressure with complete expansion. R. M.

537 : 612.0 = 3 1505

Fundamental problems of modern electrophysiology. Schaefer, H. *Elektrotech. Z.* [*ETZ*], 55, *pp.* 87–91, *March* 23, 1944.—[Abstr. 1000 B (1945)].

537.221 : 532.613.2 *see Abstr.* 1298

537.226.2 : 621.317.335 1506

The absolute value of the dielectric constant of liquids. Clay, J., Dekker, A. J., and Hemelrijk, J. *Physica, 's Grav.*, 10, *pp.* 768–776, *Nov.*, 1943.—[Abstr. 1195 B (1945)].

537.226.3 : 621.317.374 = 3 1507

On the temperature variation of the dielectric losses of different types of glass in the short-wave region. Strutt, M. J. O., and van der Ziel, A. *Physica, 's Grav.*, 10, *pp.* 445–450, *July*, 1943.—[Abstr. 1198 B (1945)].

537.228.3 : 541.182 : 535.515 *see Abstr.* 1434

537.228.5 : 530.145.61 1508

On the theory of the Stark effect. Zeilon, N. *K. Fysiogr. Sällsk. Lund, Förh.*, 14, 11, 20 *pp.*, 1944.—The Schrödinger equation for the Stark effect in H_2 does not lend itself readily to mathematical treatment, particularly for fields of high intensity. The equation is replaced by another approx. identical equation for small values of x, and possessing proper functions which may be expressed in finite terms. This is developed as a general procedure. Expansion in power series is shown to be mathematically unsatisfactory. The possibility of deducing an exact solution for the Stark-effect problem as the direct consequence of the Schrödinger equation is discussed, and the problem is treated on the basis of the fundamental difference equation. Calculated results agree within the limits of experimental error with those obtained by experiment for the π_{18} component of Hγ. A. J. M.

537.29 : 532.13 *see Abstr.* 1276

537.311.33 : 539.132 : 535.391.2 *see Abstr.* 1430

537.312.62 1509

On the transition of a sphere from the supraconducting to the normal state. Casimir, H. B. G. *Physica, 's Grav.*, 10, *pp.* 757–767, *Nov.*, 1943.—The theory of the transition is discussed and a discrepancy is pointed out between the theoretical and experimental values of the external magnetic field at which the transition process begins. The problem solved (mathematically) is whether a situation in which a cylindrical core of a sphere is in the supraconducting state and an outer ring in the transition state can be thermodynamically stable with respect to a small shift of the boundary. The conclusion reached is that such a situation is impossible on the assumption that in the transition state there can be no circulating current. It is also shown that the fact that during the beginning of the transition process the induction is distributed homogeneously, can only be accounted for by assuming the existence of persisting currents in the intermediate state. L. S. G.

537.523.5 : 535.338 *see Abstr.* 1391

537.523.5 : 621.325.1 1510

The energy balance at the positive crater of the carbon arc. MacPherson, H. G. *Proc. Amer. Phys. Soc., Cleveland, Ohio, Sept.* 11–12, 1944. *Abstr. in Phys. Rev.*, 66, *p.* 357, *Dec.* 1 *and* 15, 1944.—[Abstr. 1222 B (1945)].

537.531 : 535.338.1 = 3 1511

***K*-emission lines in argon.** Lindh, A. E. *Ark. Mat. Astr. Fys.*, 29*B*, 2, *No.* 5, 4 *pp.*, 1943.—An X-ray tube with a concave Al cathode and a Cu anticathode cooled with liquid air is used to obtain the *K*-emission lines of A, the gas being adsorbed by the surface of the anticathode. A Siegbahn vacuum spectrograph with a calcite crystal gave the following wavelengths in X.U.: $K\alpha_1$, 4 183·13; $K\alpha_2$, 4 186·07; $K\beta_1$, 3 877·97. The critical condition for the appearance of the lines is found to be not so much the cooling of the anticathode as the occurrence of sputtering. Cleaning-up of the A during running of the tube is attributed to adsorption by the Al cathode. The gas can be liberated in an evacuated tube by using metal from an old cathode as anticathode. A. HU.

537.531 : 535.343 1512

Further notes on the *K*-absorption spectrum of magnesium. SANDSTRÖM, A. E. *Ark. Mat. Astr. Fys.*, 29*B*, 2, *No.* 3, 7 *pp.*, 1943.—The comparison between the hexagonal lattice of Mg and the face-centred cube of Al drawn in a previous paper [Abstr. 1358 (1944)] is extended. Using this comparison, the observed absorption maxima in Mg are identified with atomic planes in the corresponding face-centred cubic lattice, and the identifications are checked against the distances in eV from the *K*-edge. Fair agreement is found if a relative displacement betw. the 2 sets of lines is allowed. Poor agreement betw. the observed intensities and those predicted, assuming that the reflecting power of the atomic planes is the same for electrons as for X-rays, is attributed to the simplified lattice used. The distance of the edge from the zero level is about 11·6 eV, in agreement with the value found from an extrapolated photo-electric threshold. The widths of the Brillouin zones seems to be <4 eV, an unexpectedly low figure which emphasizes the necessity for high resolving power in the spectrograph used. A. HU.

537.531 : 535.343.4 = 3 1513

***K*-absorption spectrum of free chlorine and of chlorine in hydrogen chloride.** LINDH, A. E., AND NILSSON, A. *Ark. Mat. Astr. Fys.*, 29*A*, 4, *No.* 27, 17 *pp.*, 1943.—X-ray absorption spectrograms near the *K*-absorption edge of Cl are obtained with a Siegbahn vacuum spectrograph employing Cl_2 in an absorption tube 11 cm. long. The gas is prepared both from $MnO_2 + HCl$ and from decomposition of $AuCl_3$. The major feature of the fine structure revealed is a broad (8·7 X.U.) absorption min. α at 5·1 eV from the main *K*-edge. Similar spectrograms using HCl give a more compressed fine structure in which α is only 3·1 X.U. wide and is 3·1 eV from the main edge, which is itself 2·6 eV on the short-wave side of the *K*-edge in Cl_2. Asymmetry in the α min. from Cl_2 may be due to a superposed min. due to HCl impurity in the Cl_2 gas used, since a 10 : 1 mixture of Cl_2 : HCl gives a more marked asymmetry of the same type. A. HU.

537.531 : 535.343.4 = 3 1514

***K*-absorption spectrum of chlorine in the gaseous chloromethanes.** NILSSON, A. *Ark. Mat. Astr. Fys.*, 29*A*, 4, *No.* 28, 9 *pp.*, 1943.—Fine structures of the *K*-absorption edge of Cl using absorbing columns of CCl_4, $CHCl_3$, CH_2Cl_2 and CH_3Cl are compared with each other and with those in Cl_2 and HCl [see Abstr. 1513 (1945)]. In the organic compounds the breadth of the α min. decreases from 4·7 X.U. in CCl_4 to 2·8 X.U. in CH_3Cl. The width of the fine structure is inversely correlated with the Cl-Cl separation in the various tetrahedral molecules. A. HU.

537.531 : 535.4 : 548.0 = 4 1515

Remarks on the diffraction of X-rays by thermal waves. BLEULER, K., AND WEIGLE, J. *Arch. Sci. Phys. Nat.*, 24, *Nov.-Dec.* (*Suppl. No.* 3, *C.R. Soc. Phys. Hist. Nat., Genève*, 59, *pp.* 210–212), 1942.—Further remarks are made relative to previous papers [Abstr. 1577, 3074 (1942)] and it is shown that for a crystal composed of similar atoms it is not possible to obtain, by means of thermal waves, reflection from a plane whose structure factor is zero. L. S. G.

537.531 : 535.4 : 548.0 = 4 1516

Higher order terms in the diffraction of X-rays by crystals. BONNELANCE, L., AND BLEULER, K. *Arch. Sci. Phys. Nat.*, 24, *Nov.-Dec.* (*Suppl. No.* 3, *C.R. Soc. Phys. Hist. Nat., Genève*, 59, *pp.* 213–216), 1942.—Using results of a previous paper [Abstr. 879 (1943)] a calculation is made of the effect of thermal vibrations on the Fourier lattice (and the electron density) of a crystal. An application is made to the NaCl crystal. L. S. G.

537.531 : 535.4 : 548.55 1517

Double Bragg reflections of X-rays in a single crystal. DAVISSON, C. J., AND HAWORTH, F. E. *Phys. Rev.*, 66, *pp.* 351–352, *Dec.* 1 *and* 15, 1944.—Double Bragg reflections, arising from the interchange of energy between the primary beam, reflected beam and associated reflections when the Bragg condition is satisfied for a permitted reflection and a forbidden reflection at the same time, are demonstrated in the case of quartz. Details of the apparatus are given. J. T.

537.533.72 1518

Limiting stable current in electron beams in the presence of ions. PIERCE, J. R. *J. Appl. Phys.*, 15, *pp.* 721–726, *Oct.*, 1944.—The analysis given is based on the plasma oscillation equations of Tonks and Langmuir [Abstr. 3635 (1929)], the boundary conditions being carefully considered. The one-dimensional case of a uniform electron current injected perpendicular to 2 parallel grids connected by a zero impedance is treated in detail. A limiting current, beyond which homogeneous flow is unstable, is evaluated. The case of axially symmetric flow with no radial motion is studied and the limiting current is deduced. These limiting currents are about 6 times as great as in the absence of ions. L. S. G.

537.533.72 : 539.216.1 = 3 *see Abstr.* 1544

537.533.72 : 621.385.833 1519

Historical background of electron optics. CALBICK, C. J. *J. Appl. Phys.*, 15, *pp.* 685–690, *Oct.*, 1944.—[Abstr. 1262 B (1945)].

537.533.8 : 535.14 *see Abstr.* 1350

537.56 : 539.153.4 : 535.338.3 *see Abstr.* 1399

537.56 : 621.791.75 1520

Use of high-frequency ionizing devices for arc welding. ZADE, H. P. *Welding*, *pp.* 50–53, *March*, 1945.—[Abstr. 1336 B (1945)].

537.561 : 539.153 1521

Energy imparted by active nitrogen. MITRA, S. K. *Nature, Lond.*, 154, *p.* 831, *Dec.* 30, 1944.

537.591 1522

Cosmic radiation bursts and extensive showers. CLAY, J., AND HOOFT, C. G'T. *Physica, 's Grav.*, 10, *pp.* 185–195, *April*, 1943.—A description is given of experiments designed to study the connection between the bursts and extensive showers. It is supposed that the bursts are part of the same phenomenon as the extensive showers which are assumed to be meson showers, each meson being accompanied by a cluster of electrons. The frequency and size of the bursts in an ionization vessel are in agreement with the number and extension of the showers and the increase in frequency with height in the atmosphere is the same for bursts and showers. L. S. G.

537.591 : 539.16.08 1523

Probability fluctuations of discharges in a Geiger-Müller counter produced by cosmic radiation. LEVERT, C., AND SCHEEN, W. L. *Physica, 's Grav.*, 10, *pp.* 225-238, *April*, 1943.—A lengthy mathematical analysis leads to an accurate formula for the chance of counting N pulses in an interval t of time. This is an improvement on a previous formula [Abstr. 3700 (1934)]. The resolving time of the counter appears explicitly in the new formula which is transformed into one more suitable for experimental tests; these are reported for 2 counters. L. S. G.

537.591 : 539.16.08 *see Abstr.* 1539

537.591.5 : 525.24 : 538.691 *see Abstr.* 1531

537.591.5 = 3 1524

Barometric effect on cosmic rays. LINDHOLM, F. *Ark. Mat. Astr. Fys.*, 30*A*, 2, *No.* 13, 16 *pp.*, 1944.—Results obtained with the coincidence counters previously described [Abstr 629 (1945)] are analysed statistically. Correlation coefficients betw. daily means of the hourly coincidences and of 4-hourly barometric readings are derived for N. and S. readings at different elevations; at about $-0{\cdot}85$ they are higher than those for sea-level measurements with cloud chambers, and approach Alpine values obtained at altitudes of 3 000 m. Mean values are also derived for the regression coefficient (pressure effect) which lie around $-0{\cdot}25\%$ per mm. Hg, a figure which is also high compared with cloud-chamber results. It is suggested that differential screening effects on the hard and soft components may account for the differences found. An atmospheric mass-absorption coefficient of $2{\cdot}5 \times 10^{-3}$ g.$^{-1}$ cm.^{2} is calculated on the assumption that the pressure effect is due to pure ionization-absorption of a geometrically and physically simple radiation. The discrepancy betw. this value and that found for dense media is explained on the spontaneous disintegration theory, and mean meson energies are derived from observational and theoretical estimates of the absorption coefficient of the penetrating component. A. HU.

537.591.8 1525

The production of soft electronic radiation by mesonic collisions. CLAY, J., AND VENEMA, A. *Physica, 's Grav.*, 10, *pp.* 735-748, *Nov.*, 1943.—A continuation of previous work [Abstr. 141 (1940)]. A method is described for measuring quantitatively the ratio of the produced secondary electrons to the number of primary electrons in various materials, and measurements are carried out for different layers of Pb, Fe, Al, H_2O and C. Results are given in tabular and graphical form, and an application is made to the theory of the composition of cosmic radiation. L. S. G.

538.214 1526

Magnetic susceptibilities of calcium and strontium ions. PRASAD, M., DHARMATTI, S. S., AND GOKHALE, S. V. *Proc. Indian Acad. Sci. A*, 20, *pp.* 224-244, *Nov.*, 1944.—Magnetic susceptibilities were measured on a Gouy balance for $CaBr_2$, $3H_2O$; $CaCO_3$; $CaCl_2$; $CaCrO_4$, $2H_2O$; CaF_2; $Ca(OH)_2$; $Ca(NO_3)_2$; CaO; $CaSO_4$, $2H_2O$; $Ca(OAc)_2$; and Ca formate, lactate, oxalate, tartrate, and salicylate; $SrBr_2$; $SrCO_3$; $SrCl_2$; $SrCrO_4$; $SrSO_4$; $Sr(OH)_2$; $Sr(NO_3)_2$, $4H_2O$; SrO; and Sr acetate, oxalate, formate, salicylate, and tartrate. The ionic susceptibilities of $Ca^{\cdot\cdot}$ and $Sr^{\cdot\cdot}$ ions are deduced by assuming additivity and using all the values of the various anions given by previous workers; calculated values are compared with values derived theoretically using the methods of Pauling, Slater, and Angus. The ionic susceptibility of a cation evaluated by using the anion values deduced from solution data is $<$ that obtained when anion values for solid salts are used. Also, cation values deduced from salts of organic acids are $>$ those from salts of inorganic acids. No steady increase in the cation susceptibility with increasing at. no. or with the no. of C atoms was revealed. Values of the susceptibilities of electronic isomers of certain of the compounds investigated are compared and discussed. Ionic radii of $Ca^{\cdot\cdot}$ and $Sr^{\cdot\cdot}$ ions have been deduced from the mean ionic susceptibilities. W. R. A.

538.214 : 541.67 1527

The magnetic susceptibility of certain organic compounds. I. The constitution of the *p*-benzoquinone, quinol, and quinhydrone system. MIKHAIL, H., AND BADDAR, F. G. *J. Chem. Soc.*, *pp.* 590-592, *Nov.*, 1944.—The law of additivity holds. Three resonance formulae are suggested for quinone.

538.3 : 530.145.6 *see Abstr.* 1237

538.3 : 530.145.63 *see Abstr.* 1243

538.3 : 621.3.01 1528

Electromotive force and potential difference. HOWE, G. W. O. *Wireless Engr*, 22, *pp.* 53-55, *Feb.*, 1945.—[Abstr. 1056 B (1945)].

538.56 1529

On multipole radiation. KRAMERS, H. A. *Physica, 's Grav.*, 10, *pp.* 261-272, *April*, 1943.—A mathematical theory (classical and quantum theoretical) somewhat different from that previously given. The fundamental point of view taken is the irreducibility of the sets of multiple fields, and emphasis is placed upon the advantage of introducing right-hand and left-hand circular multipole radiations. The irreducible multipole fields are expressed in terms of derivatives of

$$G = \frac{e^{\pm ikr}}{kr} \quad \text{(travelling waves)}$$

or

$$G = \frac{\sin kr}{kr} \quad \text{(standing waves)}$$

Quantization in terms of multipole wave-quanta is discussed and an expression is deduced for the angular momentum of the radiation field. L. S. G.

538.56 : 535.42 : 621.396.616 1530

Comments on Bethe's theory of diffraction of electromagnetic waves by small holes. PEKERIS, C. L. *Phys. Rev.*, 66, *p.* 351, *Dec.* 1 *and* 15, 1944.

538.615 : 535.338 *see Abstr.* 1392

538.691 : 525.24 : 537.591.5 1531

Experimental determination of asymptotic orbits in the Earth's magnetic field. MALMFORS, K. G. *Ark. Mat. Astr. Fys.*, 30*A*, 2, *No.* 12, 10 *pp.*, 1944.—The author represents the paths of charged particles in the Earth's field by projecting electrons from a small "gun" in an evacuated vessel and 11 cm. from the

centre of a magnetized sphere 5 cm. in radius. Provision is made for varying the geometrical conditions of projection of the electrons from the (imaginary) surface of the model Earth by giving the sphere, which is external to the evacuated vessel, suitable translations and rotations. With a sphere of magnetic moment 45 500 gauss cm.^{3} and an accelerating potential of 180 V., the conditions simulate those for protons coming in to the Earth's field with an energy of $6 \cdot 3 \times 10^9$ eV. Measurements of the asymptotic directions are made for magnetic latitudes 65°, 60°, 55° and 50°N., the electron beam being directed N., S., E. and W. at each latitude and at all zenith angles allowed by the apparatus. Sources of error and their magnitudes are discussed, and comparisons made with calculated orbits. The results are applied to a discussion of the diurnal variation of cosmic radiation.
A. HU.

539.13 1532

The tetrahedral X_2YZ_2 molecular model. I. Classical vibration problem. II. Rotation-vibration energies. SHAFFER, W. H., AND HERMAN, R. C. *J. Chem. Phys.*, 12, *pp.* 494–503, *Dec.*, 1944, *and* 13, *pp.* 83–88, *Feb.*, 1945.—Appropriate co-ordinates are set up from the standpoint of group theory for describing the normal modes of oscillation in such a manner that max. factorization of the secular determinant is accomplished. The cubic and quartic portions of the anharmonic potential function are derived. The components of vibrational angular momentum are set down. The complete valence-type potential function is discussed; explicit relations are derived between the generalized force constants occurring in the secular determinant and the valence force constants for CH_2D_2. The quantum-mechanical Hamiltonian is set up for investigating rotation-vibration energies to second-order approximation. The vibrational term G is derived explicitly as a function of the anharmonic constants, Coriolis parameters, etc. The elements are given for the secular determinant required for evaluation of the rotational term F including dependence on Coriolis interactions, centrifugal stretching, effective moments of inertia, etc. Selection rules are discussed.

539.13 : 535.338.42 *see Abstr.* 1407

539.132 : 533.7 1533

The intermolecular field of hydrogen and deuterium and the quantum mechanical theory of the equation of state. DE BOER, J. *Physica, 's Grav.*, 10, *pp.* 357–364, *May*, 1943.—The small difference between the second virial coefficient of hydrogen and deuterium gas is partly due to the correction terms on the classical expression for this coefficient (resulting from the application of quantum mechanics) and partly to small differences in the intermolecular potential field. The calculation of the quantum effect is here extended to include the deviations from spherical symmetry. The difference between the intermolecular field is calculated. There is a comparison with experimental data.
L. S. G.

539.132 : 536.63 : 536.77 1534

The occurrence and properties of molecular vibrations with $V(x) = ax^4$. BELL, R. P. *Proc. Roy. Soc. A*, 183, *pp.* 328–337, *Feb.*, 1945.—In certain modes of vibration of plane rings, the potential energy for small displacements is $\propto$ (displacement)^4, provided there is free rotation about the bonds of the ring. The energies and wave functions of the first 4 levels of a 1-dimensional oscillator with $V(x) = ax^4$ are derived by successive approximations, and asymptotic formulae are given for the higher levels. The wave functions are qualitatively similar to those of a harmonic oscillator, but the energy levels differ considerably. A comparison is made between energy levels for oscillators with $V(x) = a_q|x^q|$ and different values of q. The selection rule for dipole radiation from a fourth-power vibration is discussed. Estimates are made of the spectrum frequencies of fourth-power vibrations in actual molecules, with special reference to cyclobutane and diborane. The contribution of a fourth-power vibration to any thermodynamic function will differ from that of a harmonic vibration with the same fundamental spectrum frequency. Figures are given for the specific heat, where the difference should be detectable experimentally. In the general case $V(x) = a_q|x^q|$, the energy levels derived from the quantum theory lead to expressions for the thermodynamic functions which agree with the predictions of classical theory at high temperatures. [Abstr. 1193 (1945)].

539.132 : 537.311.33 : 535.391.2 *see Abstr.* 1430

539.133 1535

Electric moments of some γ-substituted pyridines. LEIS, D. G., AND CURRAN, B. C. *J. Amer. Chem. Soc.*, 67, *pp.* 79–81, *Jan.*, 1945.—Electric moments of C_5H_5N in C_6H_6 and in dioxane and of 9 γ-substituted pyridines in C_6H_6 or in dioxane were determined, and and discussed in relation to the structure and electron distribution of the compounds.
W. R. A.

539.133 : 533.7 *see Abstr.* 1324

539.133 : 661.713 : 532.133 *see Abstr.* 1280

539.152.1 1536

Non-conservative fundamental particles. PROCA, A. *Nature, Lond.*, 154, *p.* 674, *Nov.* 25, 1944.—An equation is set up defining a fundamental particle which, in the restricted relativity approx., does not obey the law of conservation of energy. The particle has some properties close to those of Dirac's electron. It has a constant charge but its main feature is the spontaneous change of energy and momentum. The total amount of energy varies, even when the particle is at rest or in no field. The change of energy is connected with a new term in the defining equation and is proportional to the age of the particle. The quantum mechanical treatment of the particle is briefly discussed.
L. S. G.

539.153 : 530.12 *see Abstr.* 1234

539.153 : 537.561 *see Abstr.* 1521

539.153.4 : 537.56 : 535.338.3 *see Abstr.* 1399

539.16.08 1537

A counter arrangement with constant resolving time. GILTAY, J. *Physica, 's Grav.*, 10, *pp.* 725–734, *Nov.*, 1943.—The definition of resolving time, h, given by Levert and Scheen [Abstr. 1523 (1945)] is criticized and it is pointed out that a really constant resolving time may be obtained by protecting the counter from pulses that occur before the counter has come to rest after excitation. An experimental arrangement for achieving this is described. It consists of a valve amplifier (receiving pulses from the counter) coupled to a thyratron which energizes the electro-mechanical counter. The main result of the paper is the calculation (essentially by Levert and Scheen's method) of the probability of counting a given number of pulses in a given time when those pulses are not counted which arrive less than a time *h* after the occurrence of a pulse which has been counted. This problem is analogous to a well-known problem in telephone traffic [Abstr. 1215 B (1939)]. L. S. G.

539.16.08 1538

On the frequency distribution of the number of discharges counted by a Geiger–Müller counter in a constant interval. Kosten, L. *Physica, 's Grav.*, 10, *pp.* 749–756, *Nov.*, 1943.—The problem of Levert and Scheen [Abstr. 1523 (1945)] concerning the frequency distribution is solved by a method applied previously [Abstr. 1275 B (1937)] to a similar distribution problem. It is now used in conjunction with the operational calculus and mainly consists in setting up a set of "balance-equations" and solving these by the theory of "generating functions." L. S. G.

539.16.08 : 537.591 1539

Application of a randomly-operated large Wilson cloud chamber for the determination of the mass of the meson. Sen Gupta, R. L. *Nature, Lond.*, 154, *pp.* 706–707, *Dec.* 2, 1944.

539.16.08 : 537.591 *see Abstr.* 1523

539.165.2 1540

Potential nuclear monokinetic electron sources. Pool, M. L. *J. Appl. Phys.*, 15, *pp.* 716–717, *Oct.*, 1944.—A table of 68 sources (obtained by producing artificial radioactive elements) is given, the voltage of the electrons emitted in the lowest energy group being 17 ekV and that in the highest being 578 ekV. L. S. G.

539.185 1541

The resonance levels for neutron capture. II. Coster, D., De Vries, H., and Diemer, G. *Physica, 's Grav.*, 10, *pp.* 281–298, *May*, 1943.—Experimental arrangements are described for measuring absorption of neutrons by various elements. The self-absorption curves for Cu (5 min. period), Ag (2·3 min.), Ag (22 sec.) and Al are given. Boron absorption measurements are given from which resonance energies could be calculated. Measurements are also made of the Doppler effect for Ag (22 sec.) and Cu (5 min.). The different methods of calculating the effective cross-section are discussed and it is shown that this cross-section does not increase at higher resonance energy. The average distance between resonance level for neutron capture is about 15 eV for Ag and 150 eV for Cu. L. S. G.

539.185 1542

The resonance levels for neutron capture. III. Scattering of resonance neutrons. Coster, D., De Vries, H., and Diemer, G. *Physica, 's Grav.*, 10, *pp.* 299–311, *May.*, 1943.—A continuation of a previous paper [Abstr. 1541 (1945)]. A new method is given for determining the cross-section for neutron scattering, and a theoretical method is proposed for calculating the level width by relating it to the energy loss in elastic collisions. Results of measurements and calculations are given. Attention is drawn to a new effect: if a group of neutrons is absorbed by a resonance absorber, a "hole" is present in the neutron distribution, and this hole may be refilled by interposing a second (scattering) absorber. L. S. G.

539.185 1543

The resonance levels for neutron capture. IV. Overlapping of levels. Coster, D., De Vries, H., and Diemer, G. *Physica, 's Grav.*, 10, *pp.* 312–323, *May*, 1943.—A continuation of an earlier paper [Abstr. 1542 (1945)]. The Cu 5 min. resonance neutrons are strongly absorbed in Ag and Cd and further investigations of this fact are reported. It is shown that the large absorption coefficients must be ascribed to the overlapping of a resonance level of Cu with one of Cd and, at the same time, one of Ag. The Cu 5 min. resonance activity is ascribed to the contributions of at least 3 groups of neutrons and the isotopes responsible for the overlapping are ^{65}Cu (5 min.); ^{109}Ag (22 sec.); that of Cd is as yet unknown. A quantitative calculation of the overlapping is made. L. S. G.

539.214 : 517.946.9 *see Abstr.* 1203

539.216.1 : 537.533.72 = 3 1544

Discussion on electron microscopy of cellulose fibres. Wergin, W. *Kolloid Z.*, 100, *pp.* 436–437, *Sept.*, 1942.—A reply to Frey–Wyssling's criticisms [Abstr. 1637 (1944)]. R. N.

539.216.1 : 591.478 = 3 1545

Nature of animal fibres. III. Chemical and histological studies of the action of ammonia on human hair. Lehmann, E. *Melliand Textilber.*, 24, *pp.* 1–6, *Jan.*, 1943.—After 1 week in 25% aq. NH_3 human hairs showed no microscopical differences, and the stretching and swelling capacities were little altered; the liquid contained yellow decomposition products of the melanine colours present, sulphides and protein split-products. After more than 1 week, alkaline hydrolysis occurred, and this action was used to study fibre structure, since the least mechanical action then sufficed to break the fibre up into its fusiform cells. It is established that these are the ultimate units of which the fibre is built, and their structure is illustrated by photomicrographs. The cells have a slight tendency to twist, they fibrillate readily and they are bound together in the fibre by an amorphous protein substance of as yet unknown composition. Pieces of the epidermal membrane are also found in the liquid and have a net-like surface structure. After 10 months the fibre has swollen to 200 times its original thickness, and if it is then dried it shrinks to 50% of the latter and gives an X-ray diagram similar to that of α-keratin. J. G.

539.217.1 1546

Permeability of adsorbing substances. Glückauf, E. *Nature, Lond.*, 154, *pp.* 831–832, *Dec.* 30, 1944.

539.217.5 1547

Water vapour permeability of organic films. Doty, P. M., Aiken, W. H., and Mark, H. *Industr. Engng Chem.* (*Analyt. Edit.*), 16, *pp.* 686–690, *Nov.*, 1944.—Apparatus for a rapid, precise, and reproducible determination is described. Diffusion velocity and solubility together determine the vapour permeability of a film. Equations based on the validity of Fick's law are tested with commercial films of low permeability. The dependence of permeability on thickness, and temperature, is studied. A discussion of the process is given.

539.23 : 531.717.1 : 535.514.2 *see Abstr.* 1433

539.231 : 532.692 : 621.793.72 1548

The formation of metal-sprayed deposits. Ballard, W. E. *Proc. Phys. Soc., Lond.*, 57, *pp.* 67–83, *March,* 1945.—[Abstr. 1346 B (1945)].

539.24 : 669.14 1549

A further note on the microstructure of high-silicon acid-resisting iron. Hurst, J. E., and Riley, R. V. *J. Iron Steel Inst.*, 3 *pp.*, *Dec.*, 1944. *Advance copy.*—Further observations on the nature of the "barley-shell" structure [Abstr. 253 (1944)] are recorded. The well-defined barley-shell structure observed by W. Wrażej [Abstr. 1461 (1944)] on pure (electrolytic) iron and steel, was found to be produced only when the etchants containing hydrofluoric acid were contaminated with silica or silicon-bearing compounds. The dissolved silica in the etchant could be derived from a number of sources, as, for example, the glass vessel in which the reagent had been stored or from a specimen of high-silicon iron alloy previously etched in the same etchant. The barley-shell structure was invariably produced on high-silicon iron alloys even when the etchant was free from silica. The fact that silicon or its compounds, either in the etching reagent or in the specimen, are essential to the formation of the barley-shell structure will have to be taken into consideration in any explanation of its exact nature.

539.26 : 532.74 = 3 *see Abstr.* 1307

539.374 1550

Non-homogeneous stresses in visco-elastic media. Alfrey, T. *Quart. Appl. Math.*, 2, *pp.* 113–119, *July,* 1944.—The theory of elasticity is extended to include visco-elastic media, the materials considered being isotropic and incompressible and characterized by near relations between the components of stress, strain and their time derivatives. Only small strains are considered; body forces (e.g. inertia forces) are neglected. In the first boundary value problem, the surface forces are given as functions of the position and the time, and the stress distribution is determined. In the second problem, the surface displacements are given as functions of the position and the time, and the displacements in the interior of the body are found. In each case the solution is reduced to that of an equivalent boundary-value problem of elasticity and the determination of the response of the visco-elastic material under consideration is reduced to that of a simple shearing stress or strain. L. S. G.

539.382 : 620.172.22.05 1551

The yielding phenomenon of metals. I–III. Welter, G. *Metallurgia, Manchr, pp.* 144–150, *Jan.;* 207–212, *Feb., and pp.* 263–268, *March,* 1945.—[Abstr. 1014 B (1945)].

539.4 : 676.6 1552

Stock preparation in paperboard mills. Yraola, F. V. A. *Pulp Pap. Mag. Can.*, 46, 3, *pp.* 212–220, 1945.—Curves show the relationships between the strength properties, stretch, bulk, porosity, freeness and shrinkage of bleached sulphite pulp, and the power consumptions of a jordan, plug type refiner, and a pulper consisting of a circular tube with impeller. Photomicrographs demonstrate the considerable degree of progressive fibrillation which occurs on refiner and jordan treatment, and the absence of visible change in the pulp. J. G.

539.4.01 : 620.172 1553

Effect of length on tensile strength. Gurney, C. *Nature, Lond.*, 155, *pp.* 273–274, *March* 3, 1945.

539.4.016 : 539.433 : 669.14 1554

The influence of the heat treatment of steel on the damping capacity at low stresses. Frommer, L., and Murray, A. *J. Iron Steel Inst.*, 9 *pp.*, *Dec.*, 1944. *Advance copy.*—An electromagnetic method of inducing torsional oscillations in freely-suspended cylindrical steel bars was used for measurements of the damping capacity up to a max. stress of 100 lb./in.^{2} Measurements were made in the normalized, 830°C. oil-quenched, and the fully tempered conditions; by successive heat treatment these conditions were repeated. The damping value varies for each condition and is reproduced through 2 heat-treatment cycles. The torsional damping capacity is independent of oscillation frequency up to 7 000 c/s and of stresses up to 100 lb./in.^{2} The damping values as expressed by the logarithmic decrement are $0{\cdot}5\times10^{-4}$ for the tempered condition, and $0{\cdot}7\times10^{-4}$ for the oil-quenched condition.

539.4.016 : 621.791 : 620.17.05 1555

Experiments on the effect of residual stress on the strength of welded constructions. Orr, J. *Trans. Instn Engrs Shipb. Scot.*, 88, *pp.* 139–156, *Feb.*, 1945.—[Abstr. 1008 B (1945)].

539.42 : 676.1.04 1556

Melamine resins for the development of wet and dry strengths of paper. Fromm, G. E. *Pulp Pap. Mag. Can.*, 46, 3, *pp.* 157–160 *and* 164, 1945.—Treatment of paper with melamine resin increases the tensile and bursting strengths (by up to 50%), folding endurance, and wet and dry rub resistances, and it produces wet tensile and bursting strengths of up to 60% of the dry strength. It does not affect the absorbency of unsized paper, though it improves the water resistance of rosin-sized sheets. Factors influencing the efficiency of melamine treatment, and possible uses for the resulting products, are discussed. J. G.

539.433 : 669.14 : 539.4.016 *see Abstr.* 1554

539.501 : 541.24 = 3 1557

Structural mechanics of highly elastic continua. VII. Viscosity and chemical constitution of macromolecular systems. Umstätter, H. *Kolloid Z.*, 103, *pp.* 7–18, *April,* 1943—The results of the previous investigations on micromolecular systems [Abstr. 375 (1945)] are not applicable to macromolecular systems. For these a viscosity/concentration function is derived by connecting Fick's law of diffusion with Maxwell's viscosity equation. The lower the mol. wt. of the solvent the more does the shearing elasticity change with concentration proportional to the characteristic viscosity of the dissolved substance. The calculation of the mol. wt. of the macromolecular substance from kinetic considerations is rendered difficult by the flexibility of the macromolecules. The size of the particles may be determined from the flow curve and the viscosity/temperature function. A lower limit exists for the mechanical stability of the molecules. Macromolecules may be parted if the molar cohesion is greater than the weakest valency force in the molecular union. The mol. wt. of natural substances is therefore accidental. R. N.

539.501 : 625.85 = 3 1558

Mineral-powder suspensions in bitumen and related substances. I. WALTHER, H. *Kolloid Z.*, 103, *pp.* 54–60, *April*, 1943.—The stabilizing effect of mineral powders suspended in coal tar or bitumen is investigated. This effect consists in raising the softening point, lowering the breaking point, increasing the viscosity at high temperatures, and lowering the brittleness at low temperatures. It is the greater the more anisodimensional the powder particles; thus fibrillous "Microasbest," slate flour and lime flour, are in order of diminishing effect. Bitumen films stabilized in this way are more weatherproof and tear less easily. R. N.

539.53 : 620.178.152 1559

An analysis of hardness. VIVIAN, A. C. *Phil. Mag.*, 35, *pp.* 765–777, *Nov.*, 1944.—[Abstr. 1017 B (1945)].

539.536 : 679.5 : 620.178.13 1560

Abrasion resistance of paper base plastics and associated materials. HOFFMAN, E. R. *Paper Tr. J.*, 120, *TAPPI Sect.*, *pp.* 31–34, *Jan.* 25, 1945.—Abstr. 1016 B (1945)].

54 : 535.338–1 *see Abstr.* 1394, 1395

541.123.1 1561

Correlation of vapour-liquid equilibria data for hydrocarbons. MILLER, C. O., AND BARLEY, R. C. *Industr. Engng Chem.*, 36, *pp.* 1018–1021, *Nov.*, 1944.—Empirically it has been found that, for the *n*-paraffin hydrocarbons from propane through *n*-octane, the vapour fugacity f_y is a single function of total pressure at conditions of const. liquid fugacity. It was known previously that, for a given substance, liquid fugacity f_z is a single function of temperature. By employing these two relations, values derived from experimental vapour-liquid equilibria data have been correlated. The correlation is presented in the form of an alignment chart with scales for temperature, pressure, and equilibrium constants ($K = y/x$), and points representing various light hydrocarbons.

541.123.1 : 541.182.6 *see Abstr.* 1571

541.123.2 : 536.423.15 *see Abstr.* 1478

541.123.3 1562

Ternary systems involving water and aluminium fluoride with aluminium nitrate, sulphate, or chloride. EHRET, W. F., AND FRERE, F. J. *J. Amer. Chem. Soc.*, 67, *pp.* 68–71, *Jan.*, 1945.—Isotherms for (*a*) $Al_2(SO_4)_3$–AlF_3–H_2O, (*b*) $AlCl_3$–AlF_3–H_2O, and (*c*) $Al(NO_3)_3$–AlF_3–H_2O were determined at 25°. No double salt or solid solution was found with (*c*); both (*a*) and (*b*) gave congruently soluble double salts having the formulae $Al_2(SO_4)_3 . AlF_3 . 15H_2O$ and $AlF_3 . 5AlCl_3 . 38H_2O$. Attention is drawn to the influence which the more soluble, metastable α-AlF_3 has upon the solubility determinations in these ternary systems. W. R. A.

541.123.38 1563

Equilibria between hydrogen sulphide and aqueous solutions of monoethanolamine at 25°, 45°, and 60°. RIEGGER, E., TARTAR, H. V., AND LINGAFELTER, E. C. *J. Amer. Chem. Soc.*, 66, *pp.* 2024–2027, *Dec.*, 1944.—Equilibria between H_2S (partial pressures 25–700 mm.) and aq. monoethanolamine (0·5–4·0 *N*) have been determined at 25°, 45°, and 60°. Two types of apparatus are described, one for use at 25°, and the other, for use at the higher temperatures, is designed to eliminate H_2O vapour loss. Henry's law is obeyed by H_2S in 0·6 *M* monoethanolamine solution at 25°, but the calculation in respect of higher temperatures and higher concentrations was not carried out. W. R. A.

541.123.61 : 536.7 1564

Phase behaviour in systems of hydrocarbon-furfural-water. HOLLOWAY, C., JR., AND THURBER, S. H. *Industr. Engng Chem.*, 36, *pp.* 980–985, *Nov.*, 1944.—Systems of 3 hydrocarbons with a furfural-water solution are studied with respect to cloud point and to density of cloud-point liquid. Isobutane is the least soluble in the 4% water–96% (by weight) furfural mixture, followed by *n*-butane and 1-butene. Isothermal v.p. and density data for the same 3 systems and for the corresponding butadiene system are taken at 250°, 200°, 150° and 100°F. These v.p. data permit the calculation of activity co-efficients which are presented as plots of γ against x for each system at the 4 temperatures.

541.124 : 541.64 *see Abstr.* 1577

541.124.7 : 536.653 : 536.7 : 536.621 *see Abstr.* 1489

541.124.7 : 541.64 1565

The effects of temperature on the polymerization of styrene. COHEN, S. G. *J. Amer. Chem. Soc.*, 67, *pp.* 17–20, *Jan.*, 1945.—The rates of decomposition of $(C_6H_5CO)_2O_2$ in 3·46 *M* solutions of styrene in C_6H_6 were determined at 53·98°, 64·02°, and 74·02°, and the polymerization of styrene at these temperatures was studied at equal rates of peroxide decomposition. Rise in temperature causes increase in the rates of polymerization and in the mol. wt. of the products, the rates rising more rapidly than the mol. wt. A calculation, based on the approximation that equal rates of peroxide decomposition at different temperatures imply equal rates of chain initiation, gave an activation energy of 11 k.cal. for the chain growth reaction. In the peroxide-catalysed polymerization, the mol. wt. is determined largely in a reaction of lower activation energy than that of chain growth, and chain transfer reactions are of minor importance. W. R. A.

541.127 1566

Effects of temperature, contact time, and water vapour on the olefine-aromatic ratio in the dehydrogenation of *n*-heptane with chromia-alumina. MATTOX, W. J. *J. Amer. Chem. Soc.*, 66, *pp.* 2059–2063, *Dec.*, 1944.—Increase in contact time at fixed temperature, and increase in temperature at fixed contact time result in a decrease in the proportion of *n*-heptene to PhMe, whereas addition of H_2O vapour increases the ratio. W. R. A.

541.127.1 1567

Chemical processes in continuous-flow systems. Reaction kinetics. HULBURT, H. M. *Industr. Engng Chem.*, 36, *pp.* 1012–1017, *Nov.*, 1944.—General equations governing reacting, flowing mixtures are presented and applied to the discussion of homogeneous reactions. Dimensional analysis based on these equations gives a simple and direct means of correlating empirical rate data and of determining activation energies and specific reaction rates. Equations and charts showing dependence of yield on process variables are given for simple reaction mechanisms.

541.127.1 1568

The reduction of peroxydisulphate by cerous ion, catalysed by silver nitrate. Cone, W. H. *J. Amer. Chem. Soc.*, 67, *p.* 78, *Jan.*, 1945.—The rate of the $AgNO_3$-catalysed reduction of S_2O_8'' ions by $Ce^{\cdot\cdot\cdot}$ is $\propto [S_2O_8'']$ and $[Ag^{\cdot}]$ but does not depend on $[Ce^{\cdot\cdot\cdot}]$. The specific reaction rate has approximately the same value as for $Cr^{\cdot\cdot\cdot}$, $Mn^{\cdot\cdot}$, and vanadyl ions, and hydrazine. W. R. A.

541.127.1 : 532.785 *see Abstr.* 1310

541.127.4 : 536 *see Abstr.* 1465

541.127.4 : 536.7 : 536.6 *see Abstr.* 1484

541.127.4 : 541.621 : 536.77 *see Abstr.* 1503

541.132.3 1569

Interaction between sodium triphosphate and salts of polyvalent cations as shown by *p*H measurements. Frankenthal, L. *J. Amer. Chem. Soc.*, 66, *pp.* 2124–2126, *Dec.*, 1944.—The variation in the *p*H of 0·277 *M* Na triphosphate with different conc. of $MgCl_2$ was investigated potentiometrically using a bubbling hydrogen electrode. As the conc. of $MgCl_2$ is increased, the *p*H diminishes and at high $[MgCl_2]$ the *p*H is $<$ that of $MgCl_2$ alone at the same concn. W. R. A.

541.141 : 535.7 *see Abstr.* 1446

541.18 : 532.133 = 3 1570

The effect of aggregation (micelle formation) on viscosity. Philipoff, W. *Kolloid Z.*, 100, *pp.* 320–327, *Sept.*, 1942.—By distinguishing between lateral and linear aggregations and an aggregation in which the aggregates are geometrically similar to the primary particles, it is shown that aggregation may alter the viscosity in the ratio 2·5 : 1 owing to the change in the form factor [Abstr. 1240 (1942)]. Only the theoretically simplest case in which aggregation is independent of concentration is discussed. R. N.

541.182 : 537.228.3 : 535.515 *see Abstr.* 1434

541.182.025 : 532.137 = 3 *see Abstr.* 1283

541.182.5 : 541.651 : 535.343.3 *see Abstr.* 1423

541.182.6 : 541.123.1 1571

Soap-boiling equilibria for sodium stearate. The new phase, kettle wax. McBain, J. W., Gardner, K., and Vold, R. D. *Industr. Engng Chem.*, 36, *pp.* 808–810, *Sept.*, 1944.

541.182.6 : 545.37 1572

Differentiation of hydrogen clays and identification of their mineral constituents by electrochemical and viscous methods. Mukherjee, J. N., and Mitra, R. P. *Nature, Lond.*, 154, *p.* 824, *Dec.* 30, 1944.

541.183.56 : 536.658 : 532.62 *see Abstr.* 1303

541.24 : 535.433 *see Abstr.* 1432

541.24 : 539.501 = 3 *see Abstr.* 1557

541.265 : 536.44 *see Abstr.* 1479

541.41 1573

On the nature of the starch-iodine complex. Rundle, R. E., Foster, J. F., and Baldwin, R. R. *J. Amer. Chem. Soc.*, 66, *pp.* 2116–2120, *Dec.*, 1944.—From results of potentiometric and spectrometric titrations of starch components with I a means of interaction of amylose with I is proposed. Effects of changes in the amylose chain length on the stability and colour of the complex is discussed. W. R. A.

541.45 1574

The acidity of buffered and unbuffered sulphuric acid solutions in nitromethane. Smith, L. C., and Hammett, L. P. *J. Amer. Chem. Soc.*, 67, *pp.* 23–30, *Jan.*, 1945.—The acidities of buffered and unbuffered solutions of H_2SO_4 in $MeNO_2$ were determined colorimetrically. The *o*-$NO_2C_6H_4NH_2$ and 2-nitro-4-chloro-aniline indicators used were found by distribution experiments to be unassociated in $MeNO_2$, and *o*-$NO_2C_6H_4NH_2$ was unassociated in C_6H_6. In buffered solutions of H_2SO_4 and $C_5H_5NH \,.\, HSO_4$, the indicator activity is approx. $\propto [H_2SO_4]^4$ and inversely $\propto [HSO_4']^2$, whilst in unbuffered acid solution it is $\propto [H_2SO_4]^2$. Preliminary data for HCl and methanesulphonic acids indicate similar effects. The results point to unexpected behaviour of acids when in solvents of low basicity even when these solvents have relatively high permittivities. W. R. A.

541.57 1575

The C–C valency vibrations of organic molecules. Kellner, L. *Trans. Faraday Soc.*, 41, *pp.* 217–223, *April–May*, 1945.—An attempt is made to calculate the C–C valency vibrations of aliphatic hydrocarbons. General formulae are developed for the valency vibrations of normal chains of CH_2 groups, isomers and cyclic molecules. Comparison is made with the observed spectra and from the agreement it is concluded that the interaction between bending and stretching vibrations is only a 2nd-order effect. It follows that it is possible to identify the C–C valency vibrations of any hydrocarbon by applying the formulae obtained. A. H.

541.57 1576

The force constants of some CH, NH and related bonds. Linnett, J. W. *Trans. Faraday Soc.*, 41, *pp.* 223–236, *April–May*, 1945.—The force constants of C–H and N–H bonds in a variety of molecules, together with a few O–H, S–H and similar bonds, are calculated. It is found possible to give a normal value for a given bond force constant and to account, in most cases, for deviations from the normal value. A. H.

541.62 : 536.666 *see Abstr.* 1499

541.621 : 541.127.4 : 536.77 *see Abstr.* 1503

541.64 : 536.77 : 532.771 : 536.753 *see Abstr.* 1501

541.64 : 541.124 1577

The structure of copolymers. II. Wall, F. T. *J. Amer. Chem. Soc.*, 66, *pp.* 2050–2057, *Dec.*, 1944.—A general theory of copolymerization is developed involving relative polymerization velocities as functions of monomer composition. Ideal systems are suggested as starting concepts from which deviations might be observed. Non-ideal copolymerization systems can lead to "azeotropic copolymers," the nature and intramolecular distributions of which are considered. The theory accounts for the behaviour of certain polymerization systems, particularly those leading to heteropolymers. W. R. A.

541.64 : 541.124.7 *see Abstr.* 1565

541.65 : 535.372 *see Abstr.* 1425

541.651 : 535.343-1 *see Abstr.* 1415, 1416

541.651 : 535.343-31 *see Abstr.* 1420

541.651 : 535.343.3 *see Abstr.* 1422

541.651 : 535.343.32 1578

Effect of solvents upon the absorption spectra of dyes. IV. Water as solvent: a common pattern. V. Water as solvent: quantitative examination of the dimerization hypothesis. Sheppard, S. E., and Geddes, A. L. *J. Amer. Chem. Soc.*, 66, *pp.* 1995–2009, *Dec.*, 1944.—[See Abstr. 1796 (1944)]. IV. Many dyes (e.g. azo to disazo, Ph_3CH, fluorescein, azine and polymethines, and azoporphyrine dyes) show marked deviations from Beer's Law in aq. solution, although certain members of each class conform to the law. The deviations are attributed to the formation of optically coupled pairs of ions, or dimers, such dimerization being impossible for dyes conforming to the law because of intermolecular steric hindrance. The absorption spectra of 1 : 1′-diethylcarbocyanine chloride, phenosafranine, benzopurpurine B, metabenzopurpurine 4Bl, and zinc phthalocyanine sodium sulphonate are recorded. Apparent exceptions to the proposed hypothesis are discussed and it is concluded that the available data on them do not cover a sufficient range of *p*H. V. Several cyanine and two azo- dyes have been examined quantitatively and support the dimerization hypothesis. The simple mass law is inadequate and activity factors have to be taken into account. There are indications of the possible incorporation of a molecule of "H_2O of dimerization."

W. R. A.

541.651 : 541.182.5 : 535.343.3 *see Abstr.* 1423

541.653 : 535.563 *see Abstr.* 1436

541.653.3 1579

The reactivity of the monothioacetals of glucose and galactose in relation to furanoside synthesis. Wolfrom, M. L., Weisblat, D. I., and Hanze, A. R. *J. Amer. Chem. Soc.*, 66, *pp.* 2065–2068, *Dec.*, 1944.—D-Glucose S-ethyl O-methyl monothioacetal exhibited a simple mutarotation at 25° in methanol containing 0·05% HCl and a complex mutarotation in 0·05% aq. HCl. Ethyl α-thio-D-glucofuranoside was isolated as a final product in both cases. Similar mutarotation phenomena were exhibited by D-galactose diethyl monothioacetal.

541.66 : 536.421 *see Abstr.* 1472

541.67 : 538.214 *see Abstr.* 1527

542.6 1580

Removal of gas nuclei from liquids and surfaces. Harvey, E. N., Barnes, D. K., McElroy, W. D., Whiteley, A. H., and Pease, D. C. *J. Amer. Chem. Soc.*, 67, *pp.* 156–157, *Jan.*, 1945.—Two new methods of removing gas nuclei are described. Strong centrifuging of the liquid and container will remove all gas nuclei which grow to bubbles at the v.p. of H_2O at 22° (called gas macronuclei). If the tube of centrifuged liquid is now tapped or is subjected to h.f. sound waves, bubbles appear owing to the formation of gas micronuclei that have not been removed by the centrifuging. In the other method, the tube and liquid are subjected to high hydrostatic pressures (~ 1 000 atm.) when gas micronuclei are removed by dissolution. Water treated in this way can be heated to $>200°$ without bursting into vapour, does not give rise to bubbles when subjected to h.f. sound waves, and if exhausted to the v.p. of H_2O will form bubbles only when dealt a severe blow. The severe blow appears to develop a sufficiently negative pressure locally to tear cavities in H_2O free of gas nuclei.

W. R. A.

543 : 535.343-1 *see Abstr.* 1417, 1418

544.62 : 535.33 *see Abstr.* 1377

545.37 : 541.182.6 *see Abstr.* 1572

545.82 : 535.243 : 535.33 *see Abstr.* 1375, 1376

548.0 : 535.4 : 537.531 = 4 *see Abstr.* 1515, 1516

548.33 : 548.73 *see Abstr.* 1582

548.55 : 535.4 : 537.531 *see Abstr.* 1517

548.73 1581

The crystal structure of biphenylene. Waser, J., and Lu, C. S. *J. Amer. Chem. Soc.*, 66, *pp.* 2035–2042, *Dec.*, 1944.—The structure is determined from rotation and Weissenberg photographs, using Fourier projection. It is deduced that the probable space group is $C_{2h}^5 - P2_1/a$. The unit cell, which contains 6 molecules, has dimension $a = 19{\cdot}60$ Å ± 0·03. $b = 10{\cdot}50$ Å ± 0·02, $c = 5{\cdot}84$ Å ± 0·02 and $= 91° 20' \pm 20'$ Approximate values of the 54 parameters for the *C* atoms are evaluated for planar molecules of dimensions suggested by a previous investigation. The packing of the molecules is discussed.

J. T.

548.73 : 548.33 1582

Dimorphism in aluminium fluoride trihydrate. Ehret, W. F., and Frere, F. J. *J. Amer. Chem. Soc.*, 67, *pp.* 64–68, *Jan.*, 1945.—The existence of metastable (α) and stable (β) forms of $AlF_3 . 3H_2O$ is indicated by solubility determinations and confirmed by X-ray analysis. The α–β conversion is irreversible and the time taken to effect the transition varies from a few hours to 2 years at 25°C., according to conditions. The solubility of AlF_3 in H_2O at 25°C. is found to be 0·41% by wt.

J. T.

548.73 : 591.823 1583

X-ray diffraction studies on protein fibres. 2. Feather rachis, porcupine quill tip and clam muscle. Bear, R. S. *J. Amer. Chem. Soc.*, 66, *pp.* 2043–2050, *Dec.*, 1944.—The spacings along the fibre-axes in the cases of feather rachis, porcupine quill tip and clam muscle are 95 Å, 198 Å and 725 Å, respectively, with transverse spacings of 34 Å, 85 Å and 325 Å. It is suggested, on the basis of X-ray diffraction photographs, that the complex fibrous proteins possess local regions of two or more kinds differing in the degree of crystalline or quasi-crystalline order. Only a fraction of the better ordered regions contribute predominantly to the wide-angle diffraction, while larger structural patterns, embracing a number of the smaller regions of all kinds, contribute to the small-angle diffraction. There is evidence for the location of dense layers of matter every 145 Å along the fibrils of clam muscle.

J. T.

549.211 : 535.343-1 *see Abstr.* 1419

549.211 : 535.375.5 *see Abstr.* 1427

551.501.7 : 551.571.7 1584

A slide rule for upper-air hygrometric calculations. Bartrum, P. C. *Quart. J. Roy. Met. Soc.*, 70, *pp.* 97–102, *April*, 1944.—A modification of the Bilham humidity slide rule is described in which wet-bulb calculations are discarded, the additional space being used for calculations of mixing rates and specific humidity. All the scales are based on a logarithmic scale of vapour pressure and are interrelated in such a way that for most calculations only one movement of the slide is necessary. The rule is illustrated and the scales and arrows specified, and a worked example is given. A. HU.

551.506.3 : 551.524.3 1585

A comparison between winter temperatures at Lerwick and Kew Observatory over the period 1858–1943. Bruce, W. J. *Quart. J. Roy. Met. Soc.*, 70, *pp.* 147–151, *April*, 1944.—Lerwick temperature records for the months of Dec., Jan. and Feb. in the period 1858–1943 are compared with those for Kew [Abstr. 1267 (1943)]. The secular winter trend in the latter does not appear in the Shetland records, though the means agree to 0·1°F. Daily ranges of temperature and mean monthly differences are tabulated, and a detailed comparison made betw. the records for the severe winters 1939–1942. A. HU.

551.511 : 551.54 1586

Some properties of geostrophic motion. Westwater, F. L. *Quart. J. Roy. Met. Soc.*, 70, *pp.* 145–147, *April*, 1944.—The properties of a pressure field permitting persistent geostrophic motion are discussed. Starting with the equations of motion in Eulerian and in Lagrangian form, the condition that the motion is non-accelerated leads to the restriction that the pressure field shall be a developable surface. If this condition is not satisfied it is impossible to find an isallobaric system to balance the advection terms. Thus the problem of separating the translation from the isallobaric effect when considering the development of the pressure field is insoluble. A. HU.

551.515.4 + 551.577.31 1587

The diurnal variation of warm-frontal precipitation and thunderstorms. Dexter, R. V. *Quart. J. Roy. Met. Soc.*, 70, *pp.* 129–137, *April*, 1944.—The observed enlargement of warm-front precipitation areas at night and the tendency of frontal thunderstorms to occur at night are explained in terms of the diurnal variation in potential instability. Max. potential instability is developed in the late afternoon but is realized only after lifting at the frontal surface, so that max. rainfall is reached 6–10 hr. later. This max. reaches the edge of the precipitation area later by a corresponding interval and thus increases the width of the area at night. A similar mechanism affects the frequency of thunderstorms, since latent instability may develop through lifting a potentially unstable air-mass. Two series of synoptic charts illustrate the theory. A. HU.

551.524.3 : 551.506.3 *see Abstr.* 1585

551.54 : 551.511 *see Abstr.* 1586

551.571.7 : 551.501.7 *see Abstr.* 1584

551.577.21 : 551.577.37 1588

The water resources of Loch Quoich. McClean, W. N. *Quart. J. Roy. Met. Soc.*, 70, *pp.* 138–140, *April*, 1944.—Comparative rainfall figures are given for several stations in the Loch Quoich watershed for the years 1936–43 inclusive. An analysis is given of 3 periods during this time when the rainfall was excessively heavy. Run-off figures for the loch area at different times show very different losses, indicating the difficulty of basing water resources on the records of a few rain-gauges, and the necessity of using flow-gauges and level recorders. A. HU.

551.577.31 + 551.515.4 *see Abstr.* 1587

551.577.37 : 551.577.21 *see Abstr.* 1588

551.579.4 : 624.13 1589

Report on tests for soil stabilization. *J. Inst. Petrol.*, 30, *pp.* 327–348, *Nov.*, 1944.—The report is based on discussions by the soil stabilization sub-committee of the Inst. Petrol. Standardization Committee and has been confined to stabilization by bituminous materials. Soil stabilization is defined as treating the soil so that it will remain in its initial compacted state without detrimental change in shape or volume when subjected to the stresses imposed by traffic or other agency and to the disintegrating effect of weather and subsoil water. The tests described are (1) methods of mixing so that the specimen has a desired water content and stabilizer content for use in subsequent tests, separate details being given for using oil or asphaltic bitumen stabilizers, or emulsified oil or emulsified asphaltic bitumen stabilizers; (2) determination of moisture content; (3) determination of the load-bearing capacity of a compacted stabilized soil mix by resting a loaded cone on its surface and then, after permitting it to penetrate for 1 min., increasing the load on the cone and noting the penetration readings 2 mins. later—a formula being employed for determining the cone penetration resistance from these readings; (4) determination of load-bearing capacity by a compression test in a testing machine; (5) measurement of the capillary water absorption after cylindrical specimens of standardized size have been stood with their lower face immersed to a depth of 2 mm. for one day, and then the test repeated at regular intervals as convenient; (6) measurement of the bulk density; and (7) measurement of the water absorbed by completely immersed specimens. A. C. W.

551.594.221 : 621.316.93 : 621.311.1 : 621.3.014.3 : 621.3.015.3 1590

Lightning investigation on 132 kV system of American Gas and Electric Company. Gross, I. W., and Lippert, G. D. *Trans. Amer. Inst. Elect. Engrs*, 64, *pp.* 76–84, *Feb.*, 1945.—[Abstr. 1068 B (1945)].

581.44 : 634.97 1591

On the form and strength of trees. II. The primary branches. Opatowski, I. *Bull. Math. Biophys.*, 6, *pp.* 153–156, *Dec.*, 1944.—The relation of the shape of the branch to its strength is studied, a primary branch being regarded as a horizontal level of conical shape. A theory is given which explains why the cross-section of the branch decreases towards the free end and why a tree has many branches. [See Abstr. 734 (1945)]. L. S. G.

581.44 : 634.97 1592

On the form and strength of trees. III. The secondary branches and their relation to the primary branches. Opatowski, I. *Bull. Math. Biophys.*, 7, *pp.* 1–4, *March*, 1945.—A continuation of previous work [Abstr. 1591 (1945)]. The secondary branches are considered for the purpose of applying the principle of maximum strength to the primary branches. A numerical example is given. L. S. G.

591.112.3 : 532.57 *see Abstr.* 1295

591.478 : 539.216.1 = 3 *see Abstr.* 1545

591.823 : 548.73 *see Abstr.* 1583

612.84 1593

Contributions to the mathematical biophysics of visual aesthetics. RASHEVSKY, N., AND BROWN, V. *Bull. Math. Biophys.*, 6, *pp.* 163–168, *Dec.*, 1944.—A general expression is given for the aesthetic value of some types of polygonal patterns and the values are compared with those obtained by experiment, using the rank order method. There are 77 polygons, each of 16 sides, obtained by permuting the sides of a given member. Theory and experiment are found to agree to within about 10%. [See Abstr. 740 (1945)]. L. S. G.

612.84 1594

A contribution to the mathematical biophysics of visual aesthetics. RASHEVSKY, N. *Bull. Math. Biophys.*, 7, *pp.* 41–45, *March*, 1945.—A continuation of previous studies [Abstr. 1593 (1945)]. Inequalities are set up between various parameters of the brain and these determine whether an individual prefers, in general, visual patterns consisting of a small number of strongly excited elements, e.g. artificial human-made designs, or patterns consisting of a very large number of weakly excited elements, e.g. natural landscapes. L. S. G.

612.84 : 535.14 *see Abstr.* 1351

612.84 : 535.7 *see Abstr.* 1447

612.84 : 535.73 *see Abstr.* 1448

612.84 : 535.736 *see Abstr.* 1455

612.85 : 534.773 *see Abstr.* 1346

624.13 : 551.579.4 *see Abstr.* 1589

624.18 : 517.949 = 3 *see Abstr.* 1212

625.85 : 539.501 = 3 *see Abstr.* 1558

634.97 : 581.44 *see Abstr.* 1591, 1592

661.713 : 539.133 : 532.133 *see Abstr.* 1280

666.1 : 532.612 = 3 *see Abstr.* 1297

667.64 : 536.49 *see Abstr.* 1482

669.1 : 535.331 *see Abstr.* 1389

669.14 : 539.24 *see Abstr.* 1549

669.14 : 539.433 : 539.4.016 *see Abstr.* 1554

669.18 : 535.331 *see Abstr.* 1390

674.049 : 679.5 1595

Compreg as a laminated wood and as a plastic. DREYER, J. F. *Mech. Engng*, 66, *pp.* 710–712, *Nov.*, 1944.

676 1596

Recovery of wood and fibre wastes. NEWMAN, C. A. *Pulp. Pap. Mag. Can.*, 45, *pp.* 603–604, *July*, 1944.—A lay-out for the recovery of all wood and fibre wastes (25·3 tons per day) from the groundwood and sulphite pulping processes of the Quebec North Shore Paper Co. is described. The inclusion of the recovered material in the ordinary groundwood does not reduce the quality appreciably, but it is necessary to compensate for the tendency towards coarseness by grinding rather more finely. J. G.

676.1.02 1597

Development of high sulphidity in kraft cooking liquors. KRESS, O. *Paper Tr. J.*, 119, *TAPPI Sect.*, *pp.* 165–169, *Oct.* 26, 1944.—Possible methods of producing high sulphidities are discussed, viz. use of waste liquors from the sulphite process pulping of Southern woods, addition of Na_2SO_3 to the NaOH used, addition of S to the white liquor or to the smelt produced in the kraft recovery process, and addition of SO_2 to the smelter. J. G.

676.15 1598

Bleached groundwood pulp. Properties of sodium peroxide bleached pulp and its application in paper manufacture. BEEMAN, L. A., GOODWILL, F. C., AND SHEARER, R. *Pulp Pap. Mag. Can.*, 45, *pp.* 610–614, *July*, 1944.—Groundwood pulp which has been bleached by the peroxide process must be regarded as a new type of pulp and not as a substitute for ordinary groundwood or semi-chemical pulps. In addition to having the ordinary good printing characteristics, high bulk and opacity of the latter, it is much cleaner and more comparable with ordinary bleached sulphite pulps in colour, brightness, stability and light-fastness. It runs well on the machine at high speeds, producing a paper with a more velvety feel than many unbleached pulps. It may be used with 20–80% of longer-fibred pulp, but should be beaten separately. Beating, dyeing and sizing techniques are described. An extensive future for better-grade book papers, duplicators and papers for converting is forecast. J. G.

676.16 1599

Introduction of additional sulphur into alkaline cooking liquors by means of sodium sulphite. WELLS, S. D. *Paper Tr. J.*, 119, *TAPPI Sect.*, *pp.* 137–140, *Oct.* 5, 1944.—Typical kraft pulps can be obtained from scrub pine wood by replacing approx. 50% of the Na_2S in a typical kraft liquor by slightly more than the equiv. wt. of Na_2SO_3, and increasing slightly the cooking time or temperature. The additional cost of make-up chemical is small, and heat recovery is increased (elimination of the heat demand normally required for the reduction of the Na_2SO_4). The odour nuisance is also reduced. A system is described enabling a small amount of S to be introduced conveniently into the cooking and recovery systems. J. G.

676.2 1600

Economical air-handling in paper mills. METCALFE, W. K. *Pulp Pap. Mag. Can.*, 45, *pp.* 821–823, *Oct.*, 1944.—About 60–80 tons of air are handled per ton of paper produced. Economic usage of this air depends largely on the recovery of heat from exhaust vapours. This is done by (1) recirculation of a porton of the exhaust; (2) utilizing the exhaust, in a Ross–Briner heat interchanger, to heat incoming air; or (3) using it to heat water. The use of psychrometric charts in these connections is described. J. G.

678 : 535.338–1 *see Abstr.* 1396

678.7 1601

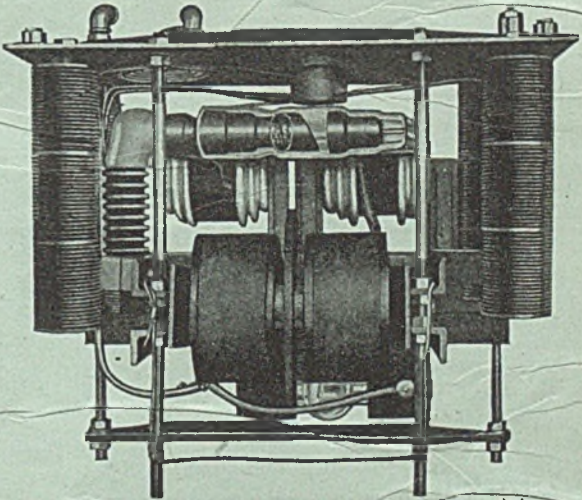
Vinyl butyrals in the rubber industry. PLUMB, D. S. *Industr. Engng Chem.*, 36, *pp.* 1035–1038, *Nov.*, 1944.

679.5 : 674.049 *see Abstr.* 1595

771.35 : 526.918.523 : 535.317.1 *see Abstr.* 1370

771.351 : 535.241.41 : 535.317 *see Abstr.* 1369

788.6 : 534.3 *see Abstr.* 1337



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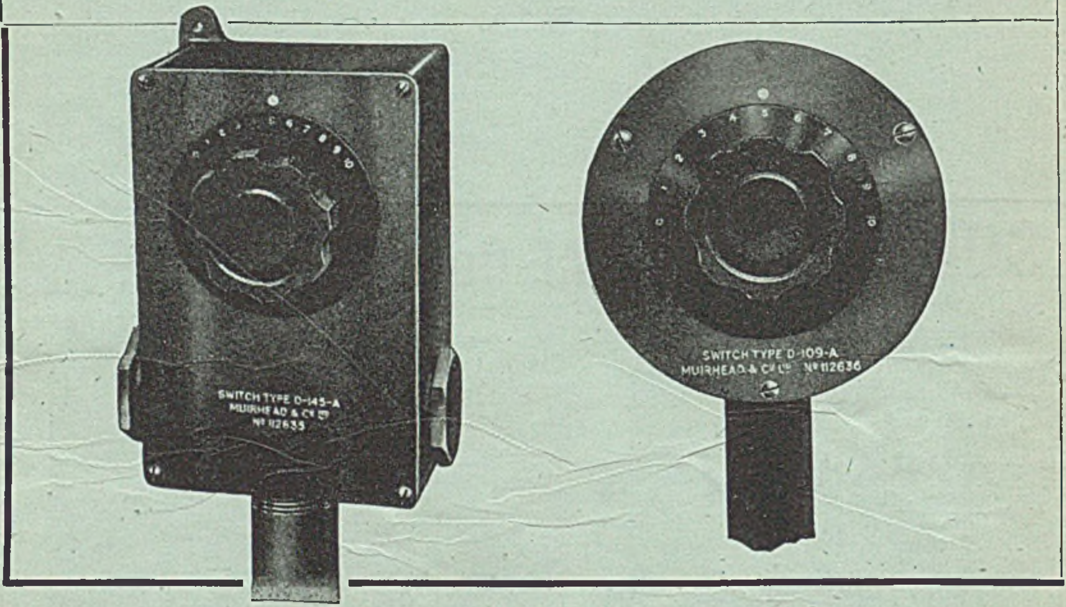

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