I.—SUB-ATOMICS.

Photometry of stars by emission spectra; application to Nova Herculis 1934—35. P. Rossier (*Arch. Sci. phys. nat.*, 1941, [v], **23**, 217—230).—From the sensitivity curve of the photographic plate the photographic intensity of each line can be deduced by means of a photomicrogram and the visual intensity calc. The method is applied to 13 stellar spectrograms; intensities in the green and violet are compared and results for lines due to H, He, O^{++}, Ne, and Sr are tabulated and discussed. N. M. B.

Cosmical abundance of the elements. H. N. Russell (*Nature*, 1941, **148**, 647—649).—An address. L. S. T.

Superposition fringes in the internally reflected light from a Fabry-Perot etalon. S. Mrozowski (*J. Opt. Soc. Amer.*, 1941, **31**, 209—212).—A system of very sharp dark fringes is observed in the spectra formed by both of the first-order reflexions occurring in the quartz plates of a Fabry-Perot etalon. These fringes are complementary to those observed in the light passing through the two non-parallel etalons of equal thickness. They are produced by the passage of the light through the etalon and subsequent reflexion from it in the reverse direction. Two intersecting systems of fringes also appear in the second-order reflexions. The fringe separation is half that of the first-order fringes. A. J. M.

Strongest lines of singly ionised atoms. W. F. Meggers (*J. Opt. Soc. Amer.*, 1941, **31**, 605—611).—$\lambda\lambda$ of the strongest lines in the first spark spectra of the elements are tabulated. O. D. S.

Values of R and of e/m from the spectra of H, D, and He^+. R. T. Birge (*Physical Rev.*, 1941, [ii], **60**, 766—785).—Data of Drinkwater *et al.* (cf. A., 1940, I, 191) on the α lines of H and D are recalc. to obtain R for H and D and, from these, for He and for infinite mass. Explicit equations (some new) are derived for all calculations. The work of Houston (cf. A., 1928, 3) and of Chu (cf. A., 1939, I, 165) is recalc. The change in the revised val. of R_∞ is due mainly to new vals. of n for air, and recent work on this is summarised. The three sets of data lead to vals. of E (at. wt. of the electron) and e/m. All recent precision work on e/m is recalc. Finally 12 different precision vals. of e/m, obtained by 7 different experimental methods, are obtained. There are no serious discrepancies, but almost complete consistency could be obtained by the expedient (without experimental justification) of raising the adopted val. of the Faraday by $\sim$30 coulombs. Recommended vals. are: $R_H = 109,677.581_6 \pm 0.007_5$, $R_D = 109,707.419_3 \pm 0.007_5$, $R_{He} = 109,722.263 \pm 0.012$, $R_\infty = 109,737.303 \pm 0.017$ cm.$^{-1}$ (I.A. scale); $e/m = 1.7592 \pm 0.0005 \times 10^7$; $E = 5.4862_4 \pm 0.0017 \times 10^{-4}$. N. M. B.

Self-consistent field, with exchange, for Si IV and Si V. W. Hartree, D. R. Hartree, and M. F. Manning (*Physical Rev.*, 1941, [ii], **60**, 857—865).—Mathematical. Results of solutions of Fock's equations for the normal state of Si V and for $3s$, $4s$, $5s$, $3p$, $4p$, $5p$, $3d$, $4d$, $5d$, $4f$, and $5g$ states of Si IV are reported. Calc. term vals. for the series electron are in satisfactory agreement with experiment (cf. McDougall, A., 1932, 789). Spin-orbit separations are calc. from the wave functions; they agree satisfactorily with observed vals. for the p but not for the d and f states. N. M. B.

Spectra of Au I and Au II. J. R. Platt and R. A. Sawyer (*Physical Rev.*, 1941, [ii], **60**, 866—876).—The Au spectrum excited in a hollow-cathode discharge in He was photographed with four different spectrographs for the range 600—10,000 A. Full data and classifications for $\sim$500 lines are tabulated, including 237 newly classified in Au I and 83 newly classified in Au II, which involve respectively 32 and 12 new terms. In the Au I spectrum the ns and nd series are extended to $n = 14$, and new vals. of the $5f^2F$ levels are suggested. The series limit $5d^{10}\,{}^1S_0$ of Au II is calc. as 74,410 cm.$^{-1}$ above the ground state $5d^{10}6s^2S_{\frac{1}{2}}$ of Au I. Several new terms above the series limit have been located. In Au II a resonance triplet (cf. A., 1933, 440) has been confirmed. The lowest six members of the $5d^9\,7p$ group have been found, and the $5d^86s^2$ configuration has been completed. N. M. B.

Zeeman effect data and preliminary classification of the spark spectrum of praseodymium, Pr II. N. Rosen, G. R. Harrison, and J. R. McNally, jun. (*Physical Rev.*, 1941, [ii], **60**, 722—730).—Studies at fields up to 95,000 oersteds over 2400—7100 A. are reported. g and J vals. for 74 Pr II levels from resolved Zeeman patterns of

141 lines were determined. With these data and new $\lambda\lambda$ data a quadratic term array accounting for 312 lines is set up. Results are consistent with available data. The lowest term of Pr II is $f^3(4I^\circ).s-{}^5I'_4$. Most of the strong lines showing hyperfine structure arise from the f^3s configuration. N. M. B.

Quenching and depolarisation of mercury resonance radiation by the rare gases. L. O. Olsen (*Physical Rev.*, 1941, [ii], **60**, 739—742).—Results of experiments on quenching and depolarisation of Hg resonance radiation 2537 A. by He, Ne, A, and Kr are tabulated and plotted. Probabilities and cross-sections calc. from formulæ and theory previously reported (cf. A., 1941, I, 398) are given. N. M. B.

Absorption spectrum as a quantitative test for mercury vapour in air.—See A., I, 114.

Principles of quantitative spectrochemical analysis.—See A., 1942, I, 111.

Lundegårdh apparatus [for spectrographic analysis].—See A., 1942, I, 116.

Photometry in spectrochemical analysis.—See A., 1942, I, 117.

Fe $K\beta'$ and $K\beta_5$ lines of FeS_2 and Fe_2O_3. J. C. McDonald (*Physical Rev.*, 1941, [ii], **60**, 912).—A comparison of previous results (cf. A., 1937, I, 3) with those of Yoshida (cf. A., 1941, I, 312). N. M. B.

Scattering of positive alkali ions at an angle of 90° in mercury vapour. J. B. Macelwane (*Physical Rev.*, 1941, [ii], **60**, 762—765).—K, Rb, and Cs ions emitted from a block of Kunsman catalyst were collected, after scattering, on a stationary cylinder, and incident and scattered currents were measured simultaneously. Curves are given and show that scattering increases linearly with the pressure of the Hg vapour, decreases with increasing energy of the incident ions, and decreases with the mass of the incident ions. N. M. B.

Pulses in negative point-to-plane corona. L. B. Loeb, A. F. Kip, G. G. Hudson, and W. H. Bennett (*Physical Rev.*, 1941, [ii], **60**, 714—722).—The pulses reported by Trichel (cf. *ibid.*, 1938, [ii], **54**, 1078) in room air are not found with very fine or polished negative points in dust-free air, but appear to require the presence of a source of triggering electrons. These can be furnished from fine points, or by roughness on larger points through field emission, or by very fine dust specks, and probably by adequate photo-electric or thermionic emission from the point. Trichel's theory is applicable except as modified by the influence of the negative ion space charge and the necessity of triggering electrons. N. M. B.

Fundamental limit of performance of an electron microscope. J. Hillier (*Physical Rev.*, 1941, [ii], **60**, 743—745).—Mathematical. The contrast obtainable in the image of a single atom is limited by diffusion arising from the diffraction defect. If a photographic emulsion can detect a min. of 10% change in intensity, it is shown that a single atom can produce a discernible image only if its at. no. is >25. With the optimum objective aperture the addition of the at. electrons appears to produce only a slight change in this lower limit of at. no. Its val. is increased by the effects of neighbouring atoms, non-parallel illumination, and lens aberrations. N. M. B.

Average energy required to produce an ion pair in xenon with 0·16 A. X-rays. N. L. Walbridge (*Physical Rev.*, 1941, [ii], **60**, 852—856).—Measurements of X-ray energy for λ 0·12—0·24 A. were made with a Pb-disc thermopile absorbing 97% of the incident radiation, and with a thin Ag-disc thermopile absorbing 8·9%. Ionisation was measured in Xe at 2·22 atm. The energy found was 21.3 ± 0.8 e.v. N. M. B.

Photo-electric properties of bismuth. H. Jupnik (*Physical Rev.*, 1941, [ii], **60**, 884—889; cf. Weber, A., 1938, I, 378; 1942, I, 29).—Threshold determinations with Fowler plots were made for six Bi surfaces evaporated on glass under high vac. The work function vals. were 4·22—4·25 e.v. There was no significant temp. variation in the range $-70°$ to 200° for λ 2537 A. Vals. of the parameter α, the no. of electrons that strike unit surface area per sec. and absorb a quantum of energy when the light intensity is 1, were 0·03—1 as great as those of Na surfaces. Like those for Na, the vals. of α are $\sim 10^{-2}$ as great as the upper limit set by Du Bridge if the no. of free electrons per Bi atom is assumed to be 5. N. M. B.

Theory of the cyclotron.—See A., 1942, I, 158.

Effects of heat-treatment on field emission from metals. J. H. Daniel (*J. Appl. Physics*, 1941, **12**, 645—652).—The effects of heat-treatment on field emission from metals may be investigated by means of a cylindrical electron projector tube. Large unstable field currents (anomalous emission) are due to the presence of surface electropositive impurities. It is possible to remove these impurities from W, Ta, or Mo by heating to >2200° κ., but they could not be removed from Ni below the m.p. The effect of gas adsorption is small, but even pressures of 10^{-7} mm. increase the frequency of breakdown. This is probably due to a rearrangement or breaking up of impurity layers, or of the metal itself by positive-ion bombardment. The magnitude of anomalous emission is greatly reduced by making the surface microscopically smooth, but such emission cannot be entirely removed by this means. An expression is given for the calculation of the voltage necessary to cause vibration of the filament in a cylindrical electron projector tube when there is a definite voltage between filament and screen. A. J. M.

Production of proton beams. E. S. Lamar, W. W. Buechner, and R. J. van de Graaff (*J. Appl. Physics*, 1941, **12**, 132—140).—Metal and glass capillary ion sources of the diffusion type have been investigated. The average proton yield of a metal source is ~10%, but this is not reproducible, and is probably affected by surface conditions difficult to control. By coating the walls of the discharge tube with a syrupy mixture of P_2O_5 and H_2O, and mixing sufficient H_2O vapour with the H_2 to prevent the coating from drying, the proton yield may be increased to 80%. The coating prevents loss of at. H by diffusion into the cathode and anode regions where recombination takes place on the electrodes. Pyrex sources are more reliable than metal ones, and can be made to give a yield of ~60%. The variation of output with the shape and dimensions of the source and with the arc current is considered. A. J. M.

Sparking of oxide-coated cathodes in mercury vapour. D. D. Knowles and J. W. McNall (*J. Appl. Physics*, 1941, **12**, 149—154).—When an oxide-coated cathode tube of the gas or vapour type passes > a certain current, a spark or cathode spot occurs on the cathode and the tube is damaged. A procedure has been devised for finding how the sparking current is affected by cathode temp. and gas pressure, the duration of the spark being so reduced that the tube is not greatly damaged, and a no. of observations can be made with the tube. At a const. cathode temp. and Hg v.p., the tube drop is a linear function of anode current. Increase in cathode temp. causes a decrease in the slope of the tube-voltage-drop–current curve, and a larger sparking current. The effect of pressure of Hg vapour on the sparking curve was also investigated. The mechanism of sparking is discussed on the basis of the experimental results. A. J. M.

Final measurements of velocity of light. W. C. Anderson (*J. Opt. Soc. Amer.*, 1941, **31**, 187—197).—An earlier method of determining the velocity of light, using a photo-electric cell (cf. A., 1938, I, 550), has been improved. Group velocity is discussed as a correction factor. Electron transit time is a limiting factor for the method. The final result is 299,776±14 km. per sec. The velocity of light is a const. as nearly as can be measured at present. A. J. M.

Mass differences of the fundamental doublets used in the determination of the isotopic weights ^{12}C and ^{14}N. E. B. Jordan (*Physical Rev.*, 1941, [ii], **60**, 710—713; cf. A., 1941, I, 67; Mattauch, A., 1940, I, 337).—In view of discrepancies in available data for the mass val. of ^{12}C, to the determination of which the mass difference $^{12}CH_4$—^{16}O is fundamental, the latter was redetermined by means of a new large spectrograph, giving the val. $363 \cdot 2 \pm 0 \cdot 35 \times 10^{-4}$. Other doublet measurements and vals. ($\times 10^{-4}$) are: $^{12}CH_3$—$^{14}N^1H$ $125 \cdot 63 \pm 0 \cdot 13$, $^{12}CH_4$—$^{14}NH_2$ $125 \cdot 50 \pm 0 \cdot 13$, checking the mass difference $^{12}CH_2$—^{14}N $125 \cdot 60 \pm 0 \cdot 15$. N. M. B.

Determination of radium in some igneous rocks.—See A., 1942, I, 113.

Slowing down of low-energy neutrons in water. M. Goldhaber and R. D. O'Neal (*Physical Rev.*, 1941, [ii], **60**, 834).—The experiments of Amaldi (cf. A., 1937, I, 58) on fast neutrons show that the intensities of resonance and C neutrons decrease in a similar manner. Experiments are reported showing that for low-energy primary neutrons there is much less similarity in the curves for resonance and C neutrons. The neutron source was the photo-neutrons (220± 20 ke.v.) produced in Be by the hard γ-rays of radio-Y. At a large distance from the source the intensity of the resonance neutrons decreases much faster than that of the C neutrons. Hence C neutrons practically free from resonance neutrons can be obtained. N. M. B.

Scattering of fast neutrons by lead. H. F. Dunlap and R. N. Little (*Physical Rev.*, 1941, [ii], **60**, 693—701).—Cloud-chamber investigations of the scattering of D–D neutrons by Pb show that the energy distribution of the inelastically scattered neutrons, determined for 0·6—2·0 Me.v., does not agree with the theoretical predictions of Weisskopf (cf. A., 1940, I, 187). The cross-section for inelastic scattering is $1 \cdot 31 \pm 0 \cdot 53 \times 10^{-24}$ sq. cm. The elastic scattering is not spherically symmetric, and is very small for angles >~50°. N. M. B.

Interaction of slow neutrons with nuclei. H. Carroll (*Physical Rev.*, 1941, [ii], **60**, 702—709; cf. A., 1938, I, 593).—The influence of the mol. binding of the proton was investigated by measuring the total cross-section per proton, for neutrons absorbed by Cd (C neutrons), of a gaseous hydrocarbon series C_nH_{2n+2} and of H_2, H_2O, and solid paraffin. Results show that the cross-section per proton increases rapidly from the val. for the free proton, varying approx. as the square of the reduced mass of the system. The bound proton cross-section for paraffin approaches a limiting val. 2·4 times that for the free proton. The dependence of neutron scattering on structure was investigated for liquid and solid $C_{16}H_{34}$. The marked increase in the cross-section of the liquid over the solid state indicates the presence of much coherent scattering. Total cross-sections of the deuteron in D_2O, and of He, Ne, A, Kr, O, and N were also measured. N. M. B.

Scattering of neutrons by deuterons and the nature of nuclear forces. R. A. Buckingham and H. S. W. Massey (*Proc. Roy. Soc.*, 1941, **A**, **179**, 123—151).—Calculations are made of the angular distributions and effective cross-sections of elastic collisions between neutrons of 2·2 Mv. energy and deuterons at rest. Theoretical vals. have been obtained using fundamental interactions of ordinary and of exchange types, so that the possibility of distinguishing between these types by experiment can be examined. The method and a large no. of the numerical tables can be used in the closely similar problem of the collisions between protons and deuterons. It is concluded that the available experimental results are consistent with the assumption of the existence of exchange forces. G. D. P.

Auto-radiography of ores.—See A., 1942, I, 115.

Recent advances in atomic physics. T. Alty (*Proc. Roy. Phil. Soc. Glasgow*, 1940—41, **65**, 17—27).—A lecture.

Energies of γ-rays from ^{63}Ni, ^{56}Mn, ^{69}Zn, ^{67}Ga. A. Guthrie (*Physical Rev.*, 1941, [ii], **60**, 746—747).—With a focussing magnetic spectrograph the values obtained are ^{63}Ni (2·6 hr.) $0 \cdot 280 \pm 0 \cdot 007$, $0 \cdot 65 \pm 0 \cdot 01$ (both not previously reported), $0 \cdot 93 \pm 0 \cdot 04$; ^{69}Zn (13·6 hr.) $0 \cdot 440 \pm 0 \cdot 006$; ^{67}Ga (83 hr.) $0 \cdot 292 \pm 0 \cdot 006$; ^{56}Mn (2·59 hr.) $0 \cdot 800 \pm 0 \cdot 015$ Me.v. Fair agreement is shown with vals. reported elsewhere (cf. Helmholz, A., 1942, I, 34; Deutsch, A., 1941, I, 441). N. M. B.

Radioactive isotopes of mercury. C. S. Wu and G. Friedlander (*Physical Rev.*, 1941, [ii], **60**, 747—748; cf. Sherr *et al.*, A., 1942, I, 35).—Slow and fast neutron bombardment of Hg give 25-hr. and 64-hr. activities (the latter new) identical with the Hg fraction from the bombardment of Au with 16-Me.v. deuterons. Absorption in Al showed that both activities emit conversion electrons of max. energy ~200 ke.v. and <90 ke.v., respectively. Crit. absorption measurements of the emitted X-rays indicate that both activities are due to ^{197}Hg and that both decay to ^{197}Au by K electron capture. Associated with both periods are complex groups of soft γ-rays. A 43-min. period is induced strongly in Hg by fast neutrons, and associated with it is a line of ~460-ke.v. electrons, a group of several γ-rays, and X-rays shown to be Hg K radiation. The activity is probably associated with an isomeric transition in Hg, and may be ^{199}Hg or $^{201}*Hg$. Slow- and fast-neutron bombardment of Hg gives a 54-day period, probably ^{203}Hg; it emits negative β-particles of 300—350 ke.v. upper energy limit, and γ-rays of ~300 ke.v., but no X-rays. N. M. B.

Range–velocity relation for fission fragments in helium. J. K. Bøggild (*Physical Rev.*, 1941, [ii], **60**, 827—830; cf. A., 1941, I, 189).—Curves obtained from individual close collisions and from statistical considerations of the branch frequency are investigated. Comparison with data for tracks in A indicates that the shape of the range–velocity curves for A and He differs appreciably in the last part of the range as expected from theoretical considerations on the relative contributions to the stopping power by electron encounters and nuclear collisions in light and heavy gases. N. M. B.

Preparation and properties of long-lived radio-chlorine. D. C. Grahame and H. J. Walke (*Physical Rev.*, 1941, [ii], **60**, 909).—Intensive slow-neutron irradiation of $NaClO_3$ or $NaClO_4$ kept for ~6 months near a cyclotron target holder gave, after purification and separation as NaCl, an activity of half-life <2 years, with indirect evidence pointing to ~10^3 years. Observable emitted radiations are of very small intensity; cloud-chamber tracks indicate negative electrons, low-energy positrons, and an indication of photo-electrons from soft X-rays. The new isotope is probably ^{36}Cl formed by the reaction $^{35}Cl (n,γ) ^{36}Cl$. The suggested disintegration along three parallel paths is → $^{36}A + β^-$; → $^{36}S + β^+$; →$^{36}S + K$ radiation (?). Absorption measurements give an end-point corresponding with an energy of 0·64 Me.v. Production of the isotope by deuteron irradiation of NaCl was unsatisfactory because there was no way to concentrate the active substance. N. M. B.

Nuclear photo-effect on sulphur, aluminium, and magnesium. O. Huber, O. Lienhard, P. Scherrer, and H. Wäffler (*Physical Rev.*, 1941, [ii], **60**, 910).—From the energetic viewpoint, disintegration of all nuclei should be possible by means of 17-Me.v. γ-rays

produced in resonance capture of protons by Li. In order to detect possible short-lived activities, S, Al, Mg, and Si were irradiated with these γ-rays, and then, in <2 sec., were submitted to Geiger–Müller counter examination. The reactions and half-lives obtained were : ^{32}S (γ,n) ^{31}S $(2\cdot9\pm0\cdot2$ sec.) ; ^{27}Al (γ,n) ^{26}Al $(7\cdot2\pm0\cdot5$ sec.) ; Mg, a weak activity obscured by other reactions ; Si, no effect. The respective yields relative to ^{63}Cu (γ,n) ^{62}Cu $(10\cdot5$ mm.) were 14, 11, ~5, and 0%.   N. M. B.

Radioactive isotopes of cobalt. J. J. Livingood and G. T. Seaborg (*Physical Rev.*, 1941, [ii], **60**, 913 ; cf. A., 1941, I, 439).—From available data the following complete assignments and interpretations are made : ^{60}Co (5·3 years) is produced by ^{59}Co (n,γ) ^{60}Co, ^{59}Co (d,p) ^{60}Co, and ^{62}Ni (d,a) ^{60}Co ; negative β-particles and γ-rays are emitted ; the activity is due to β-particle decay from the lower level in ^{60}Co to stable ^{60}Ni. ^{60}Co (10·7 min.) is produced by ^{59}Co (n,γ) ^{60}Co and ^{60}Ni (n,p) ^{60}Co ; the radiation is mainly conversion electrons, and the activity is an isomeric transition from an upper to a lower level in ^{60}Co. ^{58}Co (72 days) is produced by ^{55}Mn (a,n) ^{58}Co, ^{58}Ni (n,p) ^{58}Co, ^{57}Fe (d,n) ^{58}Fe (p,γ) ^{58}Co, and probably ^{56}Fe (a,np) ^{58}Co ; the particles are mainly or entirely positive β-particles with upper energy limit 0·4 Me.v. ; the γ-ray absorption corresponds with 0·6 Me.v. energy. ^{57}Co (270 days) is produced by ^{56}Fe (d,n) ^{57}Co and ^{56}Fe (p,γ) ^{57}Co ; the positron energy is 0·26 Me.v., and conversion electrons are also present in the radiation. ^{56}Co (72 days) results from ^{56}Fe $(d,2n)$ ^{56}Co, ^{58}Ni (d,a) ^{56}Co, and ^{54}Fe (a,np) ^{56}Co, emits positrons of upper energy limit 1·2 Me.v. ; the γ-ray absorption corresponds with 1·05 Me.v. energy. ^{55}Co (18·0 hr.) is produced by ^{54}Fe (d,n) ^{55}Co and ^{54}Fe (p,γ) ^{55}Co, and is the parent of ^{55}Fe. There is no evidence of ^{54}Co from the possible reaction ^{54}Fe $(d,2n)$ ^{54}Co.   N. M. B.

Range and ionisation measurements on high-speed protons. R. R. Wilson (*Physical Rev.*, 1941, [ii], **60**, 749—753).—The relative sp. ionisation along an initially mono-energetic 4-Me.v. proton beam was measured. The stopping power of Al relative to air is 1·48 mg. per sq. cm. per cm. of air at 15° and 76 cm. Hg, and independent of the energy for 1·5—4·0 Me.v. This is interpreted theoretically. Measurements of stopping powers of Cu, Fe, Mo, Ni, Pt, Ta, and Zn foils are tabulated. The calc. val. of the mean excitation energy of atoms with many electrons (I in Bethe's formula for the rate of loss of energy of heavy particles by ionisation) is $0\cdot85Z(me^4/2\hbar)$ or $Z \times 11\cdot5$ e.v.   N. M. B.

Mass of the meson by the method of momentum loss. J. A. Wheeler and R. Ladenburg (*Physical Rev.*, 1941, [ii], **60**, 754—761).—Measurement of particle mass by observations on track curvature before and after traversal of a known amount of matter is discussed with reference to the meson. The stopping power for fast particles is calc. from Wilson's experiments (cf. preceding abstract), and curves are given for the dependence of range on energy and momentum for fast H and He nuclei and for mesons. Results from the momentum-loss method and by various other methods based on available data are examined. It is concluded that these do not yet establish a uniqueness of meson mass.   N. M. B.

Cosmic rays and the magnetic disturbance of September 18, 1941. V. F. Hess and E. B. Berry, jun. (*Physical Rev.*, 1941, [ii], **60**, 746). —An analysis of data from several instruments and comparison with reports on former aurora displays.   N. M. B.

Differential measurements of the meson's lifetime at different elevations. G. Bernardini, B. N. Cacciapuoti, E. Pancini, O. Piccioni, and G. C. Wick (*Physical Rev.*, 1941, [ii], **60**, 910—911).—In view of discrepancies in available data, independent of energy distribution assumptions, on meson lifetime, coincidence-counter measurements were made at three different localities of different altitude. Calc. vals. of the proper lifetime r of the meson are $3\cdot4\pm0\cdot3$, $2\cdot55\pm0\cdot4$, and $1\cdot65\pm0\cdot3$ μ-sec. There is evidence that $\mu c^2/r$ increases with altitude and average meson energy.   N. M. B.

Electric fields in interstellar space. F. Evans (*Physical Rev.*, 1941, [ii], **60**, 911 ; cf. A., 1941, I, 95).—A recalculation of previous results on the basis of a formula suggested by Mohler (cf. *ibid.*, 358) for the collision cross-section for at. scattering of electrons.   N. M. B.

Penetrating non-ionising cosmic-ray particles. L. Jánossy and G. D. Rochester (*Nature*, 1941, **148**, 531—532).—Experiments showing the existence of penetrating neutral particles at sea-level are described (cf. A., 1941, I, 145). The mean free path of the particles is ~10 cm. of Pb, and the estimated intensity of the beam is 0·03% of the total cosmic-ray beam at sea-level. A possible interpretation of the observations is given.   L. S. T.

Cloud chamber investigation of penetrating showers. L. Jánossy, C. B. McCusker, and G. D. Rochester (*Nature*, 1941, **148**, 660).—Results of an investigation of the nature of penetrating showers by means of a deep cloud chamber controlled by a counter system selective for these showers are described. The photographs obtained indicate that all penetrating showers contain associated penetrating particles, and that they do not consist simply of simultaneous mesons, but are complex.   L. S. T.

Physical concepts of the meson theory of the atomic nucleus. W. Heitler (*Nature*, 1941, **148**, 680—683).—A review.   L. S. T.

Origin of cosmic rays : a hypothesis and the experimental testing of it in India and elsewhere. R. A. Millikan, H. V. Neher, and W. H. Pickering (*Current Sci.*, 1941, **10**, 393—394).—Vertically-incoming cosmic rays are distributed among five energy bands ; rays in each band should reach the earth at a crit. latitude and at all higher latitudes, and four "plateaux" of const. cosmic-ray intensity should exist between the successive crit. latitudes. These latitudes are determined by interaction of the particles with the earth's magnetic field. The bands have energies 1·9, 5·6, 6·6, 7·5, and $13\cdot2 \times 10^9$ e.v., and correspond with production of rays by annihilation of the rest-mass energies of He, C, N, O, and Si atoms, respectively, in interstellar space. Evidence in favour of the hypothesis is reviewed.   A. J. E. W.

Internal diamagnetic fields. W. E. Lamb, jun. (*Physical Rev.*, 1941, [ii], **60**, 817—819).—Mathematical. The val., at the nucleus, of the magnetic field produced by the diamagnetism of the at. electrons is calc. on the Fermi–Thomas model and checked for a no. of atoms by available Hartree calculations. The statistical treatment gives for the ratio of induced to external field $0\cdot319 \times 10^{-4}Z^{4/3}$, while the numerical coeff. on the Hartree model is lower by 19% at $Z = 19$ and by 12% at $Z = 80$. The effect is equiv. to a reduction of the nuclear g val. by a factor $(1 - 0\cdot319 \times 10^{-4}Z^{4/3})$, and in this form the correction may be applied in the calculation of hyperfine structure of heavy atoms. The influence of the diamagnetic fields on an orbital electron is shown to be equiv. to a reduction in the g val. of an outer s electron of the same order of magnitude as the relativistic correction (cf. Margenau, A., 1937, I, 191).   N. M. B.

Pseudoscalar mesotron theory of β-decay. E. C. Nelson (*Physical Rev.*, 1941, [ii], **60**, 830—833).—Mathematical. Sakata's calculations (*Proc. Phys. Math. Soc. Japan*, 1941, **23**, 291) which indicate that the theory can account for both mesotron decay and β-decay are shown to be in error. The theory gives the correct spin and parity selection rules for β-decay, but also gives β-decay lifetimes too long by a factor 10^6 and having an inverse-seventh-power dependence on the upper limit of the β-spectrum. These conclusions can be made when the mesotron field is strongly coupled to nuclear particles, and show that pseudoscalar mesotrons are not responsible for β-decay.   N. M. B.

Meson theory and nuclear forces. H. Wergeland (*Physical Rev.*, 1941, [ii], **60**, 835—836).—Mathematical. The possibility that the diverging terms in the nuclear interaction predicted by meson theory may have a significance analogous to the magnetic interaction between electrons was discussed and discarded by Bethe (cf. A., 1940, I, 190), but such terms cannot be considered simply as part of an energy operator in configuration space (cf. Breit, A., 1932, 441) and it is suggested that the meson interaction and Breit's operator have a similar origin. To demonstrate this a modified derivation of nuclear forces from field theory is presented.   N. M. B.

a-Model of nuclear structure, and nuclear moments. D. R. Inglis (*Physical Rev.*, 1941, [ii], **60**, 837—851).—Criticism of the a-model (cf. Grönblum, A., 1939, I, 176 ; Margenau, A., 1941, I, 94) based on the conventional assumption of nuclear forces with several exchange terms and a single-range parameter is controverted by a calculation based on a more satisfactory assumption of nuclear forces with fewer terms and two-range parameters ; this leads to an adequate first-order attraction between the a-particles. Observed regularities among nuclear moments are qualitatively explained, and other consequences of the model are discussed. The occurrence of large positive electric quadrupole moments only in the neighbourhood of the rare earths is related to the shape of an a-framework and to the participation of only one or very few particles in the orbital motion.   N. M. B.

Collision relations. L. A. Pars (*Phil. Mag.*, 1942, [vii], **33**, 96—101).—A geometrical method is given of proving and exhibiting directional and velocity relations resulting from collisions of the first and second kind between, e.g., a-particles and at. nuclei.   L. J. J.

Forces on an electron according to Dirac's wave equation. A. Lees (*Phil. Mag.*, 1942, [vii], **33**, 131—137).—Mathematical. The forces on an electron are proved to consist of a purely internal system of stresses together with classical external electromagnetic field forces.   L. J. J.

II.—MOLECULAR STRUCTURE.

Relation between potential energy and interatomic distance in diatomic molecules. II. J. W. Linnett (*Trans. Faraday Soc.*, 1942, **38**, 1—9).—The extension of the function $V = a/r^m - be^{-nr}$ (cf. A., 1941, I 25) from the first short period to mols. involving atoms in other periods is discussed. When suitable expressions are used to obtain the vals. of the consts. this function gives a relation by which r_e can be derived from observed vals. of the vibration frequency. The results are less satisfactory for mols. in which one atom is in group 2 or 3 and the other in groups 4—7 than for those in which

both atoms are in groups 4—7, owing to the less exact data available for the former. F. L. U.

Isotope effect in the predissociation phenomena of CH and CD. L. Gerö and R. F. Schmid (*Physical Rev.*, 1941, [ii], **60**, 911—912). —The locating of the positions of several limiting curves of predissociation has extended and improved results previously reported (cf. A., 1941, I, 237). A comparison of predissociation effects in the CH and CD spectra shows that the graphs of corresponding limiting curves of predissociation can be brought into coincidence for both mols. only by lowering the equilibrium position of the CD ground state by ~350 cm.$^{-1}$ units relative to that of the CH mol. As the electronic isotope effect is very small, the energies in the equilibrium positions of all CD states must be lowered by approx. the same val. Increases in dissociation energy are also found for AlD and CaD. A group of lines in the CH spectrum at ~4324 A. was identified as the (2,2) band of the $^2\Delta \rightarrow {}^2\Pi$ system. The corresponding CD band is discussed. N. M. B.

Isotope effect in OH and OD bands. M. G. Sastry (*Current Sci.*, 1941, **10**, 362—363).—Vibrational and rotational isotope shifts calc. from the mass factor are compared with observed total shifts for 10 band heads. The poor agreement is attributed to spin coupling and electronic interaction with rotation and vibration. A. J. E. W.

Rotational structure of the Birge–Hopfield bands of nitrogen. J. W. T. Spinks (*Canad. J. Res.*, 1942, **20, A**, 1—5).—The bands were photographed in the third order of a 3-m. grating. Wave nos. and assignments of the $2 \rightarrow 10$, $3 \rightarrow 11$, $4 \rightarrow 12$, $5 \rightarrow 13$, $5 \rightarrow 14$, and $6 \rightarrow 14$ bands of the $a\,{}^1\Pi_u \rightarrow X\,{}^1\Sigma_g^+$ system of N_2 are tabulated, and rotational consts. are given. The occurrence of P, Q, and R branches confirms the transition as $^1\Pi \rightarrow {}^1\Sigma$. N. M. B.

$^2\Pi_u \rightarrow {}^2\Pi_g$ bands of CO_2^+. I. S. Mrozowski (*Physical Rev.*, 1941, [ii], **60**, 730—738).—A study of the emission band spectrum in the region $\lambda\lambda$ 2900—4300 is reported. Excitation conditions agree with former results (cf. Duffendack, A., 1929, 969). The bands, obtained with great intensity, were photographed in the second order of a 30-ft. grating. A preliminary rotational and vibrational analysis is given, with wave nos., and origins of the bands, analyses of 5 double bands of the $v_1{}'' = v_2{}'' = v_3{}'' = 0$ progression of the symmetrical vibration ($v_1{}'$ varying, $v_2{}' = v_3{}' = 0$), rotational consts., and vibrational intervals. N. M. B.

Further resolution of two parallel bands of ammonia and the interaction between vibration and rotation. H. Y. Sheng, E. F. Barker, and D. M. Dennison (*Physical Rev.*, 1941, [ii], **60**, 786—794).—A re-examination under high dispersion of the fundamental low-frequency parallel band at 10 μ, and its upper-stage band at 16 μ. shows that most of the fine-structure lines hitherto reported as single are resolved into multiplets. An energy-level expression accounting accurately for the positions of the lines is given, and consts. are determined. The rotational consts. are discussed mathematically with reference to the average consts., averaged over the two levels of the double min., and the difference of the consts. A treatment of the latter is equiv. to a treatment of the change in the splitting of the two levels of the double min. due to the vibration–rotation interaction. The calc. and observed change in splitting of the first vibration levels are in close agreement. N. M. B.

Vibration–rotation energies of polyatomic molecules. H. H. Nielsen (*Physical Rev.*, 1941, [ii], **60**, 794—810).—Mathematical. The quantum Hamiltonian H for the general vibrating–rotating polyat. mol. of N atoms is expanded by the Wilson–Howard method (cf. A., 1936, 667) to second order of approximation. Solutions of the Schrödinger equation $(H - E)\psi = 0$ for asymmetric mols., axially symmetric mols., and linear mols. are obtained. Expressions for the anharmonic terms occurring in the vibration energy, the effective moments of inertia, the amplitudes of the internal angular momentum of oscillation, and the centrifugal distortion coeffs. are derived, so that when the normal co-ordinates are known the vibration–rotation energies of a polyat. mol. may be calc. from the results given. N. M. B.

Spectroscopic evidence of hydrogen bonds in hydrogen peroxide and hydrazine. P. A. Giguère (*Trans. Roy. Soc. Canada*, 1941, [iii], **35**, III, 1—8).—In liquid H_2O_2, the absorption max. 9720 A. of the vapour is shifted to 10,110 A. The corresponding shift in liquid N_2H_4 is much smaller, the liquid giving flat max. at ~10,700— 10,600 A., 10,340 A., and 10,225 A. N_2H_4,H_2O shows a shift of ~50 cm.$^{-1}$ of the N–H components towards higher frequencies in the liquid. Comparison of m.p., b.p., and heats of vaporisation of H_2O_2 and N_2H_4 with those of isoelectronic hydrides suggests strong association. L. J. J.

Near infra-red spectra of linear Y_2X_2 molecules. I. Theory. W. H. Shaffer and A. H. Nielsen (*J. Chem. Physics*, 1941, **9**, 847— 852).—Expressions for the vibration–rotation energies of X_2Y_2 mols. have been obtained in the form $E = hc(G_V + F_B)$. The vibrational term G_V agrees with recorded vals. but the rotational term F_B shows differences. W. R. A.

Absorption spectra of para- and dia-magnetic nickel complexes. J. E. Mills and D. P. Mellor (*J. Amer. Chem. Soc.*, 1942, **64**, 181—

182).—The absorption spectra of diamagnetic complexes in which Ni is linked to two N and two O atoms exhibit a band of appreciable intensity attributed to Ni, and the bands of the co-ordinated chelate mol. are slightly displaced, usually to longer $\lambda\lambda$. Paramagnetic complexes of Ni show no band attributable to Ni, and the observed absorption bands appear to be those of the org. chelate mol. displaced to longer $\lambda\lambda$. W. R. A.

Changes in the absorption spectrum of lead and nickel films at low temperatures. C. F. Squire (*J. Appl. Physics*, 1940, **11**, 779— 780).—The absorption spectra of thin films of Au, Cu, Cd, Al, Sn, Sb, Pb, and Ni at 298° and 80° K. have been compared. No influence of temp. was observed for metals other than Pb and Ni. Pb shows increased transmission in the ultra-violet at 80° K. Ni shows a decreased transmission in the visible at 80° K. O. D. S.

Far ultra-violet spectrophotometric studies of fatty acids by photoelectric and spectrographic methods. D. M. Kerns, R. Belkengren, H. Clark, and E. S. Miller (*J. Opt. Soc. Amer.*, 1941, **31**, 271—279). —Quant. absorption spectra data are given for conjugated and nonconjugated alcohols, acids, and esters between λ 2800 and 2000 A. These absorption curves can be used as practical reference standards for the determination of the substances to which they refer in mixtures. At least one new fatty acid has been detected in liverlipins from a fasted rat. It is not present in sufficient quantities to be measured in normal animals. The importance of stray light in the investigation of absorption spectra in accounting for discrepancies in the literature is discussed. A. J. M.

Oscillator strengths for the liquid phase. A. I. Mahan (*J. Opt. Soc. Amer.*, 1941, **31**, 248—259).—Methods involved in evaluating oscillator strengths of liquids from both dispersion and absorption equations are discussed. The resulting equations have been applied to infra-red bands of CH_2Cl_2, CH_2Br_2, and CH_2I_2. The abs. vals. obtained by the two methods show large discrepancies, but they show the same trend when the sets of vals. for the three compounds are compared. A. A. E.

Absorption spectra of the cyclic dienes in the vacuum ultra-violet. W. C. Price and A. D. Walsh (*Proc. Roy. Soc.*, 1941, **A**, 179, 201— 214).—The spectra of *cyclo*hexadiene (I), *cyclo*pentadiene (II), pyrrole, thiophen, and furan were investigated. The observed bands are due to the excitation of a π electron from the conjugated double bond electrons. Ionisation potentials are deduced. The structure of the mols. is discussed and it is concluded that only in the case of furan is there marked tendency towards homocyclic conjugation. It is thought that " hyperconjugation " plays a smaller part in the interpretation of the spectra of (I) and (II) than previously supposed. G. D. P.

Ultra-violet absorption spectra of the monomethylchrysenes. W. R. Brode and J. W. Patterson (*J. Amer. Chem. Soc.*, 1941, **63**, 3252—3255).—The ultra-violet absorption spectra of chrysene and its six Me$_1$ derivatives have been determined and show marked similarities, except that in 4- and 5-methylchrysene steric hindrance produces greater bathochromic and hypochromic shifts. W. R. A.

Negatively polarised emission of gelatin–dye phosphors. P. Fröhlich and L. Gombay (*Kolloid-Z.*, 1941, **94**, 147—152).—Dry gelatin films containing 0·03—3 wt./vol.-% of rhoduline-orange N, rhodulineyellow, methyl-violet 5 B, Na eosin, or erythrosin show either negatively polarised fluorescence or zero polarisation when excited with plane-polarised light, provided they have been cooled below a certain crit. temp., which depends on the dyestuff and its concn. On slowly raising the temp. from −180° the polarisation becomes less negative or more positive, reaches a max., and then falls to a const. val. The abs. val. of the degree of polarisation, whether negative or positive, increases with diminishing concn. If the films are previously heated at 100° they exhibit neither negative polarisation nor the positive max. F. L. U.

Light absorption in gelatin–dye phosphors and Beer's law. (Miss) H. Mischung (*Kolloid-Z.*, 1941, **94**, 153—157).—For dry gelatin films containing rhoduline-orange N Beer's law is valid, for $\lambda\lambda$ 254—546 mμ., only at concns. >0·003 g. per c.c.; below this the extinction increases as the concn. decreases. It is suggested that that part of the absorption which is responsible for the deviation from Beer's law is used to excite fluorescence. F. L. U.

Luminescence of meteorites.—See A., 1942, I, 120.

Supersonic cell fluorometer.—See A., 1942, I, 116.

Resonance and isotope effect in the Raman spectrum of carbon disulphide. L. Giulotto and P. Caldirola (*Z. physikal. Chem.*, 1941, **B, 49**, 34—42).—The Raman spectrum of liquid CS_2 has been investigated with high dispersion; it consists of two bands, the stronger having two components, 653·5 and 645·2 cm.$^{-1}$, and the weaker two components at 794·5 and 802·5 cm.$^{-1}$ Frequencies and intensities are in good agreement with Fermi's resonance theory. Each band shows a third component at 642 and 783 cm.$^{-1}$ which arises from the presence of ^{34}S. A weak displacement of 393 cm.$^{-1}$ corresponds with the forbidden transition ω_2. W. R. A.

Raman spectra of substituted sulphuric acids. I. J. Gupta and A. K. Majumdar (*J. Indian Chem. Soc.*, 1941, **18**, 457—460).—Raman spectra of $NH_2\cdot SO_3H$ and $NH_2\cdot SO_3Na$ are similar but are in some disagreement with the results of Angus *et al.* (A., 1938, I, 435). The structure is tetrahedral as in the sulphates. Force consts. are calc. and the possibility of the formation of $NH_3'\cdot SO_3'$ is considered.
F. R. G.

Effect of silver ion co-ordination on the Raman spectra of some unsaturated compounds. H. J. Taufen, M. J. Murray, and F. F. Cleveland (*J. Amer. Chem. Soc.*, 1941, **63**, 3500—3503).—Raman spectra of the following co-ordination complexes of Ag' ion support the formulation proposed by Winstein and Lucas (A., 1938, II, 224): *cis*- and *trans*-$\Delta\beta$-butene, *cyclo*pentene, *cyclo*hexene, ethyl-, propyl-, amyl-, and phenyl-acetylene, and C_6H_6. For all, except the C_6H_6 complex, solutions in conc. $AgNO_3$ were used. The C_6H_6 complex was examined in conc. $AgClO_4$ solution. The double-bond frequency in olefinic complexes is lowered by $\sim$65 cm.$^{-1}$; the triple-bond frequency in acetylenic complexes is lowered by $\sim$100 cm.$^{-1}$, and in the C_6H_6 complex the C—C stretching frequencies are significantly affected.
W. R. A.

Elastic after-effects and dielectric absorption in glass. N. W. Taylor (*J. Appl. Physics*, 1941, **12**, 753—758).—The relation between mechanical and dielectric strain in glasses is discussed. A parallel is drawn between delayed elastic adjustment in a stabilised glass (cf. A., 1941, I, 203) and the anomalous charging current accompanying dielectric polarisation (cf. Murphy and Lowry, A., 1930, 685). In general "memory" phenomena, such as the reversal of discharge current from a glass condenser, result from superposition of two or more independent operations with different relaxation times and directions, corresponding in the case of a glass with the orientation of independent structural units of different sizes. The effects discussed thus support X-ray and other evidence for a random ionic network in glass.
A. J. E. W.

Orientation polarisation and formation of supermolecules. H. Dunken, F. Judenberg, and K. L. Wolf (*Z. physikal. Chem.*, 1941, **B, 49**, 43—63).—By means of the law of mass action the dependence of orientation polarisation (P_o) on concn. has been quantitatively computed for the complete concn. range. The method gives a simple relationship and explanation of empirically derived formulæ connecting P_o and concn. More work on equilibrium const. and accurate measurements of dielectric const. is urged.
W. R. A.

Dipole moments and structures of five organometallic halides. P. F. Oesper and C. P. Smyth (*J. Amer. Chem. Soc.*, 1942, **64**, 173—175).—The following vals. for solutions in C_6H_6 at 25° are given: $GePh_3Br$ 2·35, $SnPh_3Cl$ 3·28, $CH_2Ph\cdot HgCl$ 3·05, $SbPh_3Cl_2$ (I) 1·19, $BiPh_3Cl_2$ (II) 1·17 D. Min. vals. for the metal–halogen bond moments have been calc. and used to estimate the min. amounts of ionic character in the Ge–, Sn–, and Hg–halogen linkings. The small vals. for (I) and (II) suggest that these mols. possibly do not have a symmetrical, trigonal, bipyramidal structure.
W. R. A.

Anomalous dispersion of dipolar ions. H. O. Marcy, 3rd, and J. Wyman, jun. (*J. Amer. Chem. Soc.*, 1941, **63**, 3388—3397).—Using a new oscillograph method (described), the relaxation times of lysyl-glutamic acid and triglycine at 115 megacycles are 4·31 and 1·29 × 10^{-10} sec., respectively, compared with 2·45 and 1·4 × 10^{-10} sec., calc. from Stokes' formula assuming that the mols. are rigid spheres. Both mols. would, therefore, appear to orient as rigid bodies in an applied electric field and there is no significant internal rotation in either mol. in periods shorter than those corresponding with the crit. frequencies.
W. R. A.

Simple refractometer.—See A., 1942, I, 116.

Refraction and dispersion of glasses.—See A., 1942, I, 92.

Refractive index of liquid water in the near infra-red. M. Centeno V. (*J. Opt. Soc. Amer.*, 1941, **31**, 244—247).—n for liquid H_2O has been calc. using the more accurate vals. of the reflectivity and extinction coeff. now available. The principal max. are 1·525 at 3·07 μ. and 1·358 at 6·20 μ., and the principal min. are 1·187 at 2·74 μ., 1·242 at 5·85 μ., and 1·110 at 11·47 μ.
A. J. M.

Optical properties of rubber. L. A. Wood (*J. Appl. Physics*, 1941, **12**, 119—126).—A review of the optical properties of rubber, dealing with absorption, scattering, n, and double refraction, is given. Data for the transmission of milled pale crêpe rubber and a soft vulcanised rubber compound are given for $\lambda\lambda$ 400—750 mμ. The apparent absorptive index at a given λ decreases with increasing thickness of specimen. For the particular compound used, vulcanisation increases the transmission at shorter $\lambda\lambda$ and decreases it at the longer $\lambda\lambda$. The variation of n of pale crêpe rubber with λ was investigated by using rubber prisms in a spectrometer. $n_F - n_C$ is a little higher for rubber than for glass. For unvulcanised rubber its val. is 0·01315 at 25°, which is not far removed from that for un-conjugated diolefine hydrocarbons of low mol. wt. The mol. refractivity confirms the chemical observation of the existence in the rubber mol. of a C_5H_8 unit containing one double linking.
A. J. M.

Thermal conductivity of dielectrics. I. Pomeranchuk (*Physical Rev.* 1941 [ii], **60**, 820—821).—Mathematical. The Peierls–Debye

relation, the thermal conductivity $\kappa \propto 1/T$, when T is $\gg \theta$ (the Debye temp.), is true only for dielectrics obeying the laws of sound velocity dispersion and dependence of sound velocity on direction. For all other dielectrics at $T \gg \theta$, $\kappa \propto 1/T^{3/2}$.
N. M. B.

Heat of sublimation of carbon and some absorption bands of three mesomeric hydrocarbons. G. J. Kynch and W. G. Penney (*Proc. Roy. Soc.*, 1941, **A, 179**, 214—231).—Spectroscopic analysis of the CO spectrum and thermochemical measurements on the burning of C in O_2 indicate that L, the heat of sublimation of C, is either 124 or 170 kg.-cal. per mol. An estimate of L is made by calculating the energies of excited states of C_6H_6, butadiene, and hexatriene, and agreement with experiment is found with $L = 170$. The equilibrium internuclear distances in the excited states are found and the potential function controlling some of the vibrations about these positions is determined. The excited state of C_6H_6 has the regular hexagonal configuration with a C—C distance of 1·45 A. compared with 1·39 in the ground state. The C breathing frequency in the excited state is calc. to be 920 cm.$^{-1}$, in fair agreement with experiment.
G. D. P.

Structure–property relations of isomeric octanols.—See A., 1942, II, 128.

Momentum distribution in molecular systems. VI. Shape of the Compton line for methane. C. A. Coulson and W. E. Duncanson (*Proc. Camb. Phil. Soc.*, 1942, **38**, 100—108; cf. A., 1941, I, 450).—Vals. for the mean radial distribution of momentum in the CH_4 mol. have been calc. using, respectively, the electron pair, the mol. orbital, and the self-consistent field approximations to the wave function of the mol. The shape of the Compton profile is deduced in each case. The relative accuracy of the three approximations is discussed. Compton profiles are in each case narrower than the experimental val. of Hughes and Starr (A., 1939, I, 230). The lack of agreement may be partly due to incorrect interpretation of the experimental results from which the latter is deduced.
O. D. S.

Molecular structures of the dimerides of aluminium dimethyl chloride, aluminium dimethyl bromide, and aluminium trimethyl, and of hexamethyldisilane. L. O. Brockway and N. R. Davidson (*J. Amer. Chem. Soc.*, 1941, **63**, 3287—3297).—Si_2Me_6 has been prepared by a new method; its v.p. is given by $\log_{10} p = -1920/T + 7·807$, b.p. (extrapolated) 109°. Electron diffraction by $Al_2Me_4Cl_2$, $Al_2Me_4Br_2$, Al_2Me_6, and Si_2Me_6 has been investigated and results are compared with those for Al_2Cl_6 and Al_2Br_6. Bond lengths and valency angles have been computed. In the halides the X–Al–X angle is $\sim$90° and the C–Al–C angle 115—135°. The Al Me halides have the bridged structure of two metal and two halogen atoms in a ring. Al_2Me_6 and Si_2Me_6 have structures similar to C_2H_6. Si_2Me_6 has the bond lengths and angles expected for a covalent structure. The C–Al–C angle in Al_2Me_6 is $\sim$115° and the Al—Al bond lengths are < would be expected by comparison with the Si—Si bond length. The joining together of two $AlMe_3$ mols. to give Al_2Me_6 cannot be explained.
W. R. A.

Electron diffraction investigation of the molecular structures of silicon tetrabromide, tribromosilane, and dibromodifluorosilane. R. Spitzer, W. J. Howell, jun., and V. Schomaker (*J. Amer. Chem. Soc.*, 1942, **64**, 62—67).—Electron diffraction measurements on $SiBr_4$, $SiHBr_3$, and SiF_2Br_2 indicate that the Si—Br distance in each is 2·16±0·03 A. and the angle Br–Si–Br is approx. the tetrahedral angle.
W. R. A.

Molecular surface energy of sulphur dioxide addition compounds. I. J. R. Bright and J. J. Jasper (*J. Amer. Chem. Soc.*, 1941, **63**, 3486—3488).—ρ and γ for the compound $NPhMe_2\cdot SO_2$ have been measured from 0° to 30° and equations for the temp. coeff. of ρ and γ are given. The parachor is 405·4. Possible electronic structures are considered and a structure containing a N–O linking is favoured.
W. R. A.

Relationship between refractive index and surface tension. R. C. Tripathi (*J. Indian Chem. Soc.*, 1941, **18**, 411—414).—The Lorentz–Lorenz formula for mol. refraction is combined with Sugden's parachor equation to give $(n^2 - 1)(n^2 + 2) = [R]\gamma^{1/4}/[P]$. Differences between observed and calc. vals. of γ are <3%.
F. R. G.

III.—CRYSTAL STRUCTURE.

Anomalous reflexions in X-ray patterns. G. D. Preston (*Proc. Roy. Soc.*, 1941, **A, 179**, 1—7).—The occurrence of diffuse background reflexions on Laue photographs is discussed with particular reference to those which increase in intensity at elevated temp. It is shown that an elastic wave in the crystal will produce a background; in order to avoid the theoretical difficulties it is suggested that the effects can be explained by supposing the crystal to be composed of a no. small nearly rigid blocks (cf. A., 1939, I, 553), but this view is only an approximation to the complete theory. The geometrical significance of Faxén's rule is briefly discussed.
G. D. P.

Experimental study of diffuse X-ray reflexion by single crystals. (Mrs.) K. Lonsdale and H. Smith (*Proc. Roy. Soc.*, 1941, **A, 179**, 8—50).—A brief historical outline of the subject is given. Numerous

Laue, oscillation, and rotation photographs (reproduced) are discussed, and rules for indexing the diffuse reflexions are given. The relations of the intensity, shape, and size of the diffuse spots to the nature, structure, perfection, orientation, and temp. of the crystal are considered in detail. Experiments carried out at low temp. show that, except in the case of diamond, the diffuse pattern is practically non-existent at liquid air temp. The use of the diffuse-spot pattern as a subsidiary method of crystal-structure determination is emphasised. It is pointed out that in reciprocal space each lattice point is surrounded by a region of diffuse scattering the physical significance of which is open to various interpretations. These regions are not in general spherical, but extend along reciprocal lattice planes and axes.   G. D. P.

Diffuse spots in X-ray photographs. (Sir) W. H. Bragg (*Proc. Roy. Soc.*, 1941, **A, 179,** 51—60).—The possibility of interpreting the diffuse pattern by diffraction due to a small group of atoms is considered. The patterns of KCl, diamond, and calcite are analysed in some detail and good agreement with the observed spots is found.   G. D. P.

Diffuse spots in X-ray crystal photographs. (Sir) W. H. Bragg (*Proc. Roy. Soc.*, 1941, **A, 179,** 94—101 ; cf. A., 1941, I, 402).—The pattern of diamond is analysed in detail and is found to conform to that to be expected from small groups of atoms. Although calculation indicates the presence of some spots where none are observed the agreement of the simple diffraction formula with observation prompts the question as to the reason for this success. The formula suggests the presence of small groups, and any other explanation must describe a condition which simulates the effects of such groups.   G. D. P.

Diffraction of monochromatic X-rays by crystals at high temperatures. (Sir) W. L. Bragg (*Proc. Roy. Soc.*, 1941, **A, 179,** 61—64).—The attempt to explain the diffuse spots observed in the patterns of crystals at high temp. by diffraction in a small group of atoms leads to difficulties in accounting for the sharpness of the Laue spots. It is better to treat the crystal and the elastic waves set up by the temp. vibrations as a diffracting unit. A qual. treatment of the mathematical theory of Debye and Waller is given; it explains the presence of the diffuse spots without impairing the sharpness of the normal reflexions.   G. D. P.

Diffuse reflexion of X-rays by crystals. C. G. Darwin (*Proc. Roy. Soc.*, 1941, **A, 179,** 65—66).—The diffuse spot pattern should be explicable by the Faxén–Waller theory, but it is possible that the formal analysis may become uninformative and that to ascribe the effects to diffraction by small rigid groups of atoms may still be a convenient way of describing the positions of the diffuse spots. It is not clear that the partial disorder of the small groups must spoil the sharpness of the Laue spots.   G. D. P.

Diffuse reflexions of X-rays by crystals. G. I. Finch (*Proc. Roy. Soc.*, 1941, **A, 179,** 67—68).—Somewhat similar effects to those described as diffuse X-ray reflexions have been observed by the method of electron diffraction (cf. A., 1939, I, 307). Both effects depend on imperfections introduced into the crystal by thermal agitation. The pattern observed by electron diffraction does not seem to have been observed by X-rays although this should be possible.   G. D. P.

Effect of thermal vibrations on the scattering of X-rays. M. Born and (Miss) K. Sarginson (*Proc. Roy. Soc.*, 1941, **A, 179,** 69—93).—The hypotheses proposed by Raman and Nilakantan and by Preston and Bragg are discussed; it is considered that the phenomena should be explained by the original theory of Debye. This theory is developed afresh, and expressions are obtained for the position and intensity of extra spots. The formulæ used by Sir William Bragg are a result of the theory.   G. D. F.

Temperature diffuse scattering. W. H. Zachariasen (*Physical Rev.*, 1941, [ii], **60,** 691).—Results previously reported (cf. A., 1941, I, 325) are shown to be identical with those of Born and Sarginson (cf. preceding abstract), whose conclusions are critically examined.   N. M. B.

X-Ray diffuse reflexions from sodium and lithium in relation to elastic anisotropy. (Mrs.) K. Lonsdale and H. Smith (*Nature*, 1941, **148,** 628—629).—Photographs (reproduced) of diffuse X-ray reflexions from single crystals of Li and of Na at various temp. show elaborate patterns of spots and streaks which are temp.- but not structure-sensitive. The diffuse spot detail for Na supports Jahn's theory (A., 1941, I, 195). The detail for Li is similar to that of Na, showing that the elastic consts. are of the same order of magnitude and anisotropy for both metals. Laue and rotation photographs of the single crystals do not support the view that Li is not isomorphous with Na.   L. S. T.

Graphical method for selecting suitable radiations for the precision determination of non-cubic lattice constants and for indexing back-reflexion lines in powder X-ray photograms. L. A. Carapella (*J. Appl. Physics*, 1940, **11,** 800—805).—Charts are illustrated and their use is described.   O. D. S.

Structure of liquid metals. A Latin (*Nature*, 1941, **148,** 616—618).—A review.   L. S. T.

Position of carbon atoms in austenite. N. J. Petch (*Iron & Steel Inst.*, 1942, *Advance copy*, 13 pp.).—X-Ray powder photographs of austenite show that the possible positions for C are at the centres of the unit cells and at the mid-points of the edges. The amount of C present is insufficient for each available position to be occupied, only ~1/12 of the positions being occupied in the case of a steel containing 1·7% of C. Other theories of the structure are discussed.   C. R. H.

Cadmium–bismuth oxide with imperfect oxygen lattice. L. G. Sillén and B. Sillén (*Z. physikal. Chem.*, 1941, **B, 49,** 27—33).—From a quickly cooled melt of CdO and Bi_2O_3 a body-centred, cubic phase was obtained, the cell of which contained 8 mols. of $Cd_{2-x}Bi_{2-2x}O_{3-x}$. X-Ray and ρ measurements indicate vacant positions in the O lattice, whereas the metal lattice is completely filled. The arrangement of the O atoms is discussed.   W. R. A.

Crystalline structure of Pt_3O_4. E. E. Galloni and A. E. Roffo, jun. (*J. Chem. Physics*, 1941, **9,** 875—877).—By X-ray diffraction it is shown that Pt_3O_4 crystals have a body-centred cube symmetry, 2 mols. per unit cell, edge of cube 6·226 A.   W. R. A.

Chain structure of linear polyesters. Trimethylene glycol series. C. S. Fuller, C. J. Frosch, and N. R. Pape (*J. Amer. Chem. Soc.*, 1942, **64,** 154—160 ; cf. A., 1939, I, 601).—The trimethylene glycol polyesters of succinic, glutaric, adipic, pimelic, suberic, azelaic, and sebacic acids, and of 1 : 9- **(I)**, 1 : 10- **(II)**, and 1 : 16- **(III)** -dicarboxylic acids have been examined by X-ray analysis in the unstretched and stretched fibre forms. In the cryst. regions, the chain mols. are planar, zigzag, and inclined at ~30° to the fibre axis. In the amorphous regions, disordered kinked chains are observed. Mesomorphic states, in which the chains are parallel but otherwise unordered, were detected, particularly with **(III)**. In the oriented state and in the absence of external stress, the crystallites are disposed with dipole layers perpendicular to the fibre direction. Stretching along the fibre direction decreases the inclination of the chains to the fibre axis and the formation of dipole layers inclined to the axis, resulting under certain conditions in a complete parallel alinement of the chain mols. **(I)** and **(II)** have been examined by electron diffraction methods and the results support the X-ray data.   W. R. A.

Size and shape of humic acid crystallites. R. Jodl (*Brennstoff-Chem.*, 1941, **22,** 256—257).—The crystallites in a prep. of Cassel-Brown humic acid when examined by X-rays were found to be ~8 A. high and ~25 A. in diameter, *i.e.*, disc-shaped.   R. B. C.

Demonstration of growing oxide layers on iron by means of the electron tester. M. Knoll (*Physikal. Z.*, 1941, **42,** 120—122).—If Fe which has been heated to redness in vac. is exposed for a short time to air, its secondary emission, as determined by the electron " tester," increases. A greater increase in secondary emission occurs when the Fe is rendered passive by immersion in HNO_3. By heating for a short time in vac. the original smaller secondary emission is regained, and the passivity is removed. It is possible to use this method of investigating secondary emission to study the thickness, rate of growth, and structure of protective oxide films.   A. J. M.

Secondary-electron emission from single crystals of copper, using small primary velocities. G. Bekow (*Physikal. Z.*, 1942, **41,** 144—145).—The secondary-electron yield of single crystals of Cu for primary electrons of different energies is investigated. The secondary emission is different from that for polycryst. Cu, and varies for the different faces. The highest yield is obtained from the (100) plane.   A. J. M.

Change in the electric resistance of a single crystal of magnetite by magnetic field at low temperature. H. Masumoto and Y. Shirakawa (*Physical Rev.*, 1941, [ii], **60,** 835).—Measurements of change of resistance and intensity of magnetisation for the principal [111] axis at 0°, −95°, and −195° in longitudinal fields of 0—1200 oersteds are plotted. The change of resistance is negative for all field strengths at temp. <0°; at 0° and −95° it decreases at first rapidly and then slowly with increase of field; at −195° it decreases linearly, after the allotropic transformation at ~−158° to −166°. In transverse fields the change of resistance is similar to that in the ferromagnetic metals.   N. M. B.

Electrical conductivity of zinc oxide. P. H. Miller, jun. (*Physical Rev.*, 1941, [ii], **60,** 890—895).—Measurements on average samples, having regard to O_2 pressure, temp., and ageing, show that the conductivity follows the equations $\sigma = 10^{-2} \exp(-2 \times 10^{-2}/kT)$ for $T < 25°$ and $\sigma = 10^2 \exp(-7 \times 10^{-1}/kT)$ per Ω. per cm. for 400° $< T < 700°$. The conductivity at $T < 25°$ is believed to be due to the ionisation of interstitial Zn atom pairs with ionisation energy $\not> 2 \times 10^{-2}$ v., and reaches saturation at approx. room temp. For 400—700° it increases and is due to the ionisation of single interstitial Zn atoms with ionisation energy 7×10^{-1} v., and reaches saturation at ~800°. Hall effect measurements show the free-electron density to be ~10^{15} per c.c. at room temp.   N. M. B.

Stability of crystal lattices. VII. Long-wave and short-wave stability for the face-centred cubic lattice. (Miss) S. C. Power. **VIII. Stability of rhombohedral Bravais lattices.** H. W. Peng and (Miss)

S. C. Power. IX. Covariant theory of lattice deformations and the stability of some hexagonal lattices. M. Born (*Proc. Camb. Phil. Soc.*, 1942, **38**, 61—66, 67—81, 82—99; cf. A., 1941, I, 198).—Mathematical. VII. It is proved, for the case of a face-centred cubic lattice in which the effects of all but the first 12 neighbours may be neglected, that a lattice stable with respect to macroscopic deformations, *i.e.*, elastic vibrations, will also be stable microscopically, *i.e.*, to thermal vibrations.

VIII. The stability of the rhombohedral Bravais lattice of arbitrary angle is investigated. It is shown that, of the three cubic Bravais lattices in the continuous series obtained by varying the rhombohedral angle, the simple cubic lattice corresponds with a max. and the face-centred and body-centred lattices with min. of potential energy. By numerical calculation of the characteristic curve it is shown that no other extrema exist and that the face-centred lattice corresponds with an abs. min. of potential energy.

IX. The theory of lattice deformations is presented in a new form using the tensor calculus. The case of central forces is investigated and results are applied to some simple hexagonal lattices. The Bravais hexagonal lattice is unstable but the close-packed hexagonal lattice is stable. The ratio of the elastic consts. of the latter is calc. and compared with experimental vals. for beryl, $Be_3Al_2(Si_6O_{18})$.
                                                                    O. D. S.

Elasticity of polycrystals with viscous grain boundaries. C. Zener (*Physical Rev.*, 1941, [ii], **60**, 906—908; cf. A., 1940, I, 353).—Mathematical. An investigation of the elastic properties of a specimen in which the grain boundaries are incapable of supporting shearing stresses shows that Young's modulus is 50—70% of its val. when no slip at grain boundaries occurs, depending on Poisson's ratio. This reduction should be observable by comparing vals. measured statically at high temp. with those measured dynamically.
                                                                    N. M. B.

Theory of plastic properties of solids. I. F. Seitz and T. A. Read (*J. Appl. Physics*, 1941, **12**, 100—118).—Theories of slip are considered, chiefly in connexion with single crystals. The theories of Becker and Smekal and the theory of dislocations are discussed.
                                                                    A. J. M.

Theory of plastic properties of solids. III. F. Seitz and T. A. Read (*J. Appl. Physics*, 1941, **12**, 470—486).—A review and discussion of creep, twinning, rupture, and fatigue phenomena in single-crystals, chiefly of metals. (For Part II see B., 1942, I, 161.)
                                                                    A. J. E. W.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Electrical conductivity of uranium oxides. K. Hauffe (*Z. physikal. Chem.*, 1941, **B**, **48**, 124—130).—The electrical conductivities of UO_2 and U_3O_8 in the temp. range 800—1000° under various pressures of O_2 have been determined. The conductivity is almost independent of pressure of O_2. If the variation of conductivity, χ, of U_3O_8 with temp. is represented by $\chi = $ const. $\times e^{-\Delta E/RT}$, the energy increment ΔE is $\sim$5 kg.-cal.
                                                                    A. J. M.

Increase in residual magnetism caused by a current flowing through an iron bar. H. A. Perkins and H. D. Doolittle (*Physical Rev.*, 1941, [ii], **60**, 811—817).—If a bar of high-grade wrought Fe or of permalloy is placed in a magnetic field and if this field is abruptly (but not if gradually) reduced to zero, a current set up in the metal causes an increase of the residual magnetism. The effect is not obtained if the current flows in a wire along the hollow axis of the Fe, unless the cylinder is slotted longitudinally. Magnetisation curves are given and discussed. Two effects seem to be involved : one results in decreasing the residual magnetism, and is apparently associated with the circular flux set up in the bar by the current through the bar or axial wire; the other, if it could be isolated, would probably produce only increases in residual magnetism, and seems to depend on an unstable condition of the magnet.
                                                                    N. M. B.

Gyromagnetic effects in ferromagnetic substances. C. J. Gorter (*Physical Rev.*, 1941, [ii], **60**, 836).—Revised lower vals. recently reported by Barnett for the deviations of the ratio of mechanical to magnetic moment from the spin-only val. are considered. Results fall into four groups : Ni and alloys, Co and alloys, Fe and alloys, and Heusler's alloy. Vals. calc. from the deviations of the susceptibilities of bivalent paramagnetic salts from the spin-only vals. show a parallelism, but deviations from unity are $\sim$3 times the experimental ferromagnetic deviations.
                                                                    N. M. B.

Change in magnetic susceptibility of nickel disalicylaldehyde on hydrogenation. M. A. Fobes and G. N. Tyson, jun. (*J. Amer. Chem. Soc.*, 1941, **63**, 3530).—When green Ni disalicylaldehyde is hydrogenated it becomes yellow-brown. Both compounds are paramagnetic and have two unpaired electrons.
                                                                    W. R. A.

Magnetic susceptibility of strontium. S. R. Rao and K. Savithri (*Current Sci.*, 1941, **10**, 363).—The mean val. of $\chi_{sp.}$ for Sr containing traces of Ca and Pb, determined by the Curie method at 3—8 kG., is $+1.05 \times 10^{-6}$, giving $\chi_{at.} = +92.0 \times 10^{-6}$. Since χ for Sr·· is -15.6×10^{-6} (Kido, A., 1934, 14) the two valency electrons

in Sr contribute 107.6×10^{-6} to the χ val.; the width of the occupied energy range in their completely degenerate state is $\sim$0.6 v.
                                                                    A. J. E. W.

Temperature variation of sound velocity in liquids. G. Suryan (*Current Sci.*, 1941, **10**, 489).—The velocity of sound in a liquid is given by $v = Le^{S/T}$, where the consts. L and S depend on the mol. wt. and structure of the liquid. This relation is verified graphically for glycerol, H_2O, $COMe_2$, Et_2O, C_7H_{16}, C_6H_6, PhMe, and NH_2Ph.
                                                                    A. J. E. W.

Distribution of lattice vibrations of the potassium chloride crystal. M. Iona, jun. (*Physical Rev.*, 1941, [ii], **60**, 822—826).—The distribution of characteristic vibrations has been calc. by the Born–Kármán–Blackman method on the assumption of both electrostatic and repulsive forces between the ions. The latter forces are calc. for the 18 nearest neighbours from the elastic consts. and the residual-ray frequency. Full data are tabulated. The distribution is applied to the evaluation of the sp. heat at low temp.
                                                                    N. M. B.

Specific heat of α-quartz. B. D. Saksena (*Current Sci.*, 1941, **10**, 484).—Vals. of the sp. heat at 50—273° κ., derived from Anderson's data (cf. A., 1936, 673), are in agreement with the author's calc. vals. (cf. A., 1940, I, 402).
                                                                    A. J. E. W.

Specific heat of calcium carbide at low temperatures. K. K. Kelley (*Ind. Eng. Chem.*, 1941, **33**, 1314—1315).—The sp. heat of CaC_2 (91%) has been determined at 51—298° κ. and corrections for the impurities present are applied to the results. The entropy of CaC_2 at 298.16° κ. is calc. as 16.8 ± 0.5 entropy units per g.-mol. and the free energy of its formation from Ca and graphite $-15,300$ g.-cal. per g.-mol.
                                                                    J. W. S.

Nitromethane : heat capacity of the gas, vapour density, and barrier to internal rotation. K. S. Pitzer and W. D. Gwinn (*J. Amer. Chem. Soc.*, 1941, ·**63**, 3313—3316).—C_p for gaseous $MeNO_2$ has been measured from 340° to 450° κ. at from 0.11 to 1.0 atm. The vapour density has been measured from 380° to 425°. The heat of vaporisation at the b.p. is 8225 ± 25 g.-cal. per mol. The second virial coeff., the heat capacity of the perfect gas, the barrier to internal rotation (800 g.-cal.), and the entropy ($S_{298.1} = 65.64 \pm 0.15$ g.-cal. per degree per mol.) have been calc.
                                                                    W. R. A.

Heat capacity, entropy, and heats of transition, fusion, and vaporisation of dimethylacetylene. Free rotation in the dimethylacetylene molecule. D. M. Yost, D. W. Osborne, and C. S. Garner (*J. Amer. Chem. Soc.*, 1941, **63**, 3492—3496).—C_p vals. for C_2Me_2 have been obtained from 14.7° to 284.3° κ. The m.p. is $240.93 \pm 0.05°$ κ., and the heat of fusion 2207 ± 2 and of vaporisation 6440 ± 6 g.-cal. per mol. at 291.00° κ. and 536 mm. The entropy of the ideal gas from C_p measurements is 67.48 ± 0.20 g.-cal. per degree per mol. at 1 atm. and 291.00° κ. and 67.93 at 1 atm. and 298.16° κ. The entropy of the liquid is 46.63 ± 0.1 g.-cal. per degree per mol. The difference between the statistical and calorimetric entropies indicates that the barrier restricting rotation of the Me groups is $\not> 500$ g.-cal. per mol.
                                                                    W. R. A.

Heat capacity, entropy, heats of fusion and vaporisation, and vapour pressure of trichlorofluoromethane. D. W. Osborne, C. S. Garner, R. N. Doescher, and D. M. Yost (*J. Amer. Chem. Soc.*, 1941, **63**, 3496—3499).—C_p vals. for CCl_3F have been obtained from 14.74° to 287.82° κ. The m.p. is $162.68 \pm 0.05°$ κ.; heats of fusion and vaporisation are 1648 ± 2 and 6025 ± 6 g.-cal. per mol. The v.p. is given by $\log p$ (int. mm. Hg) $= 18.54101 - 1841.72/T - 3.82423 \log T$ in the range 236—293° κ., giving the b.p. as 296.82°. The entropy of the ideal gas from calorimetric data is 74.07 ± 0.1 g.-cal. per degree per mol. at 298.16° κ., within 0.02 unit of the val. from mol. data. The entropy of the liquid is 53.92 ± 0.1 g.-cal. per degree per mol. at 298.16° κ. and 1 atm.
                                                                    W. R. A.

Heat capacity, entropy, heats of fusion, transition, and vaporisation, and vapour pressures of methyl mercaptan. H. Russell, jun., D. W. Osborne, and D. M. Yost (*J. Amer. Chem. Soc.*, 1942, **64**, 165—169).—C_p vals. for MeSH from 14.97° to 279.12° κ. (b.p.) have been measured and show that there is a slow isothermal transition at 137.6 ± 0.1 κ. with a heat of transition of 52.5 ± 0.5 g.-cal. per mol. The m.p. is $150.16 \pm 0.02°$ κ.; heats of fusion and vaporisation are 1411.4 ± 2.0 and 5872 ± 4 g.-cal. per mol. In the range 222—279° κ. the v.p. is represented by $\log_{10} p_{(mm.)} = 18.2749 - 1769.05/T - 3.70248 \log_{10} T$. The entropy of the ideal gas at 1 atm. and b.p. is 60.16 ± 0.10 g.-cal. per degree per mol. The barrier restricting rotation of the Me group is 1460 ± 270 g.-cal. per mol.
                                                                    W. R. A.

Heat capacity, heats of fusion and vaporisation, vapour pressure, and entropy of dimethyl sulphide. D. W. Osborne, R. N. Doescher, and D. M. Yost (*J. Amer. Chem. Soc.*, 1942, **64**, 169—172).—Vals. for C_p of Me_2S from 14.08° to 286.69° κ. have been measured. The m.p. is $174.86 \pm 0.02°$ κ., the heat of fusion is 1908.4 ± 1 and of vaporisation 6688 ± 7 g.-cal. per mol. For the range 250.6—290.2° κ. v.p. is represented by $\log_{10} p_{(mm.)} = 16.51798 - 1876.370/T - 3.04727 \log_{10} T$. The entropies at 298.16° κ. are 68.28 ± 0.1 for the ideal gas and 46.94 ± 0.07 g.-cal. per degree per mol. for the liquid. The statistical entropy exceeds the calorimetrical val. by an amount corresponding with a barrier potential of 2000 g.-cal. per mol. hindering the rotation of each Me.
                                                                    W. R. A.

Heat capacity of gaseous $\beta\beta\delta$-trimethylpentane. M. Kiperash and G. S. Parks (*J. Amer. Chem. Soc.*, 1942, **64**, 179).—C_p vals. for gaseous $CH_2Pr^\beta Bu^\gamma$ for the range 442—458° к. are given and compared with those calc. from Pitzer's equation (A., 1941, I, 458). W. R. A.

Regularities in the clear and transition points in homologous series of liquid-crystalline substances. II. Chemical morphology of liquids. C. Weygand and R. Gabler (*Z. physikal. Chem.*, 1941, **B, 48**, 148—153).—Some characteristics of the fixed temp. of homologous series of liquid-cryst. substances are discussed. A. J. M.

Is sharpness of melting influenced by isotopes? Triple-point pressures of carbon monoxide, argon, nitrous oxide, hydrogen chloride, and hydrogen bromide. K. Clusius [with L. Staveley] (*Z. physikal. Chem.*, 1941, **B, 49**, 1—12).—Sharpness of melting is defined as $T/\Delta T$, where T is m.p. and ΔT the lowering of f.p. or, in formation of mixed crystals, the interval of melting. Isotopes have no effect on sharpness of melting. Triple-point pressures are given for CO, A, N_2O, HCl, and HBr. W. R. A.

Retrograde transition of ND_4Br. II. Piezo-electric studies. A. Smits and P. G. Meerman (*Z. physikal. Chem.*, 1941, **B, 49**, 13—20).—Neither form of ND_4Br exhibits piezo-electric behaviour from room temp. to liquid air temp. This is interpreted on the theory of equilibrium of the two modifications. W. R. A.

Thermodynamic properties of nitrogen at high pressures as analytic functions of temperature and pressure. S. H. Maron and D. Turnbull (*J. Amer. Chem. Soc.*, 1942, **64**, 44—47).—An equation of state for N_2, which reproduces the P–V–T behaviour from —70° to 600° and for pressures up to 1000 atm. has been developed. Analytic functions of P and T for activity coeffs., heats, entropies, heat capacities of compression, and the Joule–Thomson coeffs. have been deduced from the equation. Results are compared with those of Deming and Shupe (A., 1931, 553). W. R. A.

Densities of aliphatic amines. E. Swift, jun. (*J. Amer. Chem. Soc.*, 1942, **64**, 115—116).—Vals. of ρ at 0°, 15°, 25°, and 35° have been measured for $NHMe_2$, NMe_3, NH_2Et, $NHEt_2$, and NEt_3 and fit the equation $\rho\theta = \rho\theta_1 + 10^{-3} \cdot a(\theta - \theta_1) + 10^{-6} \cdot \beta(\theta - \theta_1)^2$. a and β have been evaluated. W. R. A.

p-Cymene. VI. Vapour pressure of p-cymene, some of its derivatives, and related compounds. K. A. Kobe, T. S. Okabe, M. T. Ramstad, and P. M. Huemmer (*J. Amer. Chem. Soc.*, 1941, **63**, 3251—3252).—V.p. equations are given for p-cymene and 16 derivatives and closely related compounds : cumene, 2- and 3-nitro-, 2- and 3-hydroxy-, 2- and 3-chloro-, 2- and 3-bromo-p-cymene, p-$C_6H_4Me\cdot COMe$, p-$C_6H_4Me\cdot NO_2$, p-$C_6H_4Me\cdot NH_2$, carvone, fenchone, *iso*pulegol, menthol. W. R. A.

Vapour of propionic acid at 45°, 50°, 55°, 60°, and 65°. F. H. MacDougall (*J. Amer. Chem. Soc.*, 1941, **63**, 3420—3424).—Vals. for pV of the vapour of $EtCO_2H$ have been determined at 5° intervals from 45° to 65° and pressures of 3—20 mm. The vapour is associated to dimerides and higher polymerides and equilibrium consts. for the association reactions have been determined. Heats of formation of di- and tri-merides yield a val. of 9 ± 1 kg.-cal. for the "strength" of the H-bond. W. R. A.

Vapour pressure curve. K. Fuchs (*Proc. Roy. Soc.*, 1941, **A, 179**, 194—201).—Exact equations are derived for the v.p. and condensation vol. of the gas in terms of the virial coeffs. and the free energy of the condensed phase. The formula for the v.p. reduces to that of Stern as a first approximation. G. D. P.

Spark patterns of the elements. W. Baukloh (*Arch. Eisenhüttenw.*, 1940, **13**, 543—547; *Bull. Iron Steel Inst.*, 1941, No. 70, 224A).—The ability of 39 elements to form sparks when ground with an alundum wheel was studied. The spark-forming elements belong mainly to the first sub-groups of the three long periods of the periodic system. No direct relation exists between either the hardness or the heat of combustion and the ability to form sparks. A sufficiently high heat of combustion is a necessary condition for spark formation, and the nature of the pattern depends on the combustion process and the constitution of the liquid or solid products of combustion. The occurrence of minute explosions (seen as small stars) is caused by either the formation of gaseous products of combustion or the vaporising of the metal. The process of spark-pattern formation is a result of a complicated heterogeneous decomp. R. B. C.

Low-temperature properties of gaseous helium. II. R. A. Buckingham, J. Hamilton, and H. S. W. Massey (*Proc. Roy. Soc.*, 1941, **A, 179**, 103—122).—Earlier calculations are extended (cf. A., 1939, I, 135, 191). The second virial coeff. is calc., using exact quantum formulæ, for several different forms of interat. potential, and the theoretical results are compared with experimental. A similar treatment of the viscosity coeff. leads to contradictory results but the observational data are too few to prove that the theory is at fault. G. D. P.

Frictional phenomena. II. A. Gases. A. Gemant (*J. Appl. Physics*, 1941, **12**, 626—633; cf. A., 1942, I, 51).—An explanation of the viscous forces within a gas, and the frictional forces between a gas and a wall, is given on the basis of the kinetic theory. Comparison of experimental results with theory shows, in general, satisfactory agreement. The importance of the theory of slip in connexion with experimental determinations of η is emphasised. A. J. M.

Frictional phenomena. III. Absorption of sound waves and supersonics. IV. Sound-absorbing materials. V. B. Liquids; theory and experimental facts. A. Gemant (*J. Appl. Physics*, 1941, **12**, 718—724, 725—734, 827—836; cf. preceding abstract).—III. The effect of viscosity on absorption of freely-propagated acoustic waves in gases is examined theoretically. A large divergence between calc. and experimental absorption coeff. vals. for air, A, CO_2, and O_2 is attributed to intramol. vibration effects.

IV. The sound-absorbing properties of porous materials are discussed in relation to gas viscosity effects in the pores. The "radiation resistance" of an absorbent is largely determined by its resistance to gas flow, the measurement of which is discussed. The optimum structural characteristics of an ideal absorbent are determined.

V. Theories of liquid viscosity, particularly that of Eyring, are discussed, and the effects of constitution, temp., pressure, and mixture composition are illustrated by reference to previous data. The incidence and character of turbulent flow are briefly discussed. A. J. E. W.

Viscosity of ethylene and of carbon dioxide under pressure. E. W. Comings and R. S. Egly (*Ind. Eng. Chem.*, 1941, **33**, 1224—1229). —The viscosities (η) of C_2H_4 and of CO_2 at 40°/4·4—137·1 atm. have been determined by observation of the rate of passage of the gas through a capillary tube under the pressure exerted by a Hg pellet. At pressures < the crit. pressure η for C_2H_4 increases less rapidly with increasing pressure than is predicted theoretically, but at higher pressures the observed vals. increase more rapidly with increasing pressure and are > the theoretical vals. J. W. S.

Determination of diffusion coefficients.—See A., 1942, I, 90.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Compressibilities of gaseous mixtures of methane and n-butane. Equation of state for gas mixtures. J. A. Beattie, W. H. Stockmayer, and H. G. Ingersoll (*J. Chem. Physics*, 1941, **9**, 871—874).— The compressibilities of three gaseous mixtures of CH_4 and n-C_4H_{10} have been measured from 100° to 300° and from 1·25 to 10 mol. per l. (max. pressure 350 atm.). These data and data on CH_4 and n-C_4H_{10} are used to study several methods of combination of consts. in the Beattie–Bridgeman equation of state extended to gas mixtures. W. R. A.

Second virial coefficients of polar gas mixtures. W. H. Stockmayer (*J. Chem. Physics*, 1941, **9**, 863—870).—The empirical equation used by Keyes for the second virial coeff. of polar gases is compared with a theoretical expression (A., 1941, I, 293), and consts. in the latter are discussed in terms of intermol. forces and in relation to consts. in the Beattie–Bridgeman equation for non-polar gases. Rules are given for the calculation of the second virial coeffs. of any gas mixture if the second virial coeffs. and dipole moments of its components are known. These rules are successfully applied to H_2O–CO_2, N_2–NH_3, and N_2–H_2O mixtures, except that, at higher temp., the N_2–H_2O mixtures exhibit discrepancies which are only partly counteracted by inclusion of higher virial coeffs. W. R. A.

Velocity of diffusion in a mixed gas; second approximation. S. Chapman and T. G. Cowling (*Proc. Roy. Soc.*, 1941, **A, 179**, 159— 169).—The general equation of diffusion in a mixed gas in non-uniform motion, in the presence of forces imparting differential accelerations to the two constituents, and of gradients of composition, pressure, and temp., has been carried to a second approximation. This adds nine new terms to the expression for the velocity of diffusion, and each new term involves a new "second-order" diffusion coeff. All the new terms depend on the gradients of the mean motion of the gas and vanish if this is uniform. The expressions for the nine new diffusion coeffs. are very complicated and are evaluated only approx. With one exception they are of negligible magnitude compared with the first-order terms in the velocity of diffusion. G. D. P.

Viscosity of formamide–dioxan solutions at 5°, 25°, and 40°. W. G. Parks, I. M. LeBaron, and E. W. Molloy (*J. Amer. Chem. Soc.*, 1941, **63**, 3331—3336).—Measurements of η and ρ for $HCO\cdot NH_2$ (I)–dioxan solutions (0—100 wt.-%) at 5°, 25°, and 40° are compared with those for (I) solutions of AcOH, EtOH, and H_2O. Mathematical equations have been derived for the variation of ρ with temp. for both compounds, and for the relationships between the composition of the solution and its ρ and η. η increases with increasing concn. of (I) to a max. at 91 wt. %, indicating the formation of the compound $C_4H_8O_2,5HCO\cdot NH_2$. On mixing the change in vol. is negligible. W. R. A.

Region of critical solution of binary liquids; evidence for an anomalous first-order transition in the system triethylamine–water.

L. D. Roberts and J. E. Mayer (*J. Chem. Physics*, 1941, **9**, 852—858).—The change of fugacity with composition of the system NEt_3-H_2O near the crit. solution temp. (θ_c) is zero for at least 5° on the one-phase side and for compositions of liquid between 20 and 50 wt.-%. This is interpreted as evidence for the existence of a range of anomalous first-order transition near θ_c.   W. R. A.

Specific gravity of sodium dichromate solutions. D. F. Altimier (*J. Amer. Chem. Soc.*, 1942, **64**, 175—176).—Vals. of sp. gr. $(15·6°/15·6°)$ for aq. $Na_2Cr_2O_7$ (1·50—63·92 wt.-%) are given.   W. R. A.

Compressibility of solutions of uni-univalent electrolytes. B. Lundén (*Svensk Kem. Tidskr.*, 1941, **53**, 86—96).—κ for aq. solutions (0·02—1·25M.) of the salts (Li, Na, K, Rb, Cs, NH_4)(F, Cl, Br, I, NO_3, ClO_3, ClO_4) has been measured by the standing supersonic wave method. Vals. are given for $\phi(\kappa) = (\kappa V - \kappa_{H_2O} V_{H_2O})/n$, the apparent molar compressibility, involving the determination of d for several of the salts. $\phi(\kappa)$ varies inversely with $\sqrt{c}$, and vals. for $\phi(\kappa_0)$ are extrapolated. The ionic vals. of $\phi(\overline{\kappa_0})$ are additive, $Na^+ > K^+ > Rb^+ > Li^+ > Cs^+ \gg NH_4^+$, and $F^- \gg Cl^- > Br^- > ClO_3^-$, $NO_3^- > ClO_4^- > I^-$ in agreement with theory except for Li^+ and NH_4^+. Vals. for the slope of the $\phi(\kappa)$-$\sqrt{c}$ line are ~6·0, in agreement with Debye's theory, but fluorides are high (~16) and NH_4 salts low. $\phi(\kappa)$ for NH_4ClO_4 varies directly with $\sqrt{c}$, with a slope of −1·8.   M. H. M. A.

Line co-ordinate chart for vapour pressures of saturated aqueous solutions. D. S. Davis (*Ind. Eng. Chem.*, 1941, **33**, 1278).—A chart which permits calculation of the v.p. of saturated aq. solutions of Na_2SO_4, K_2SO_4, NaCl, KCl, and CsCl at 0—27° is given.   J. W. S.

Modification of cupric chloride crystallisation patterns by traces of protein.—See A., 1942, III, 264.

Rates and mechanism of phase changes in binary mixtures of alkali halides. F. A. Matsen and J. Y. Beach (*J. Amer. Chem. Soc.*, 1941, **63**, 3470—3473).—By means of *X*-ray powder photographs the rates and mechanisms of formation of solid solutions in equimol. mixtures of KCl–KBr, NaCl–NaBr, and NaCl–KCl have been investigated at various temp., and the rate of decomp. of the solid solution of NaCl–KCl has been qualitatively observed. The prep. of a solid solution of NaCl–KCl is discussed.   W. R. A.

***X*-Ray study of binary alloys of platinum with cobalt, molybdenum, and tungsten.** R. Hultgren and R. I. Jaffee (*J. Appl. Physics*, 1941, **12**, 501—502).—The high magnetic remanence and coercivity of an alloy of the composition PtCo (cf. Jellinghaus, *Z. tech. Physik*, 1936, **17**, 33) are due to the formation of a tetragonal superlattice (a_0 3·818, c_0 3·639 A., c_0/a_0 0·953) with an AuCu structure; this is stable at 600°, but gives a face-centred cubic disordered phase (a_0 3·761 A.) at 1000°. A body-centred cubic phase (a_0 2·87 A.) is formed at 400°. At 1000° Pt forms solid solutions containing >50 at.-% of Mo or 35 at.-% of W; these have face-centred cubic structures with parameters approx. equal to that for Pt.   A. J. E. W.

Passivity of iron in strongly alkaline solutions, studied with the help of organic reagents for metals. G. Nilsson (*Svensk Kem. Tidskr.*, 1941, **53**, 81—86).—Alkaline solutions of $(CS \cdot NH_2)_2$ attack soft Fe giving a bright blue complex ion, and may be used for passivity studies. $NHPh \cdot CS \cdot CS \cdot NH_2$, $NH_2 \cdot C(:NH) \cdot NH \cdot NO$, and $CN \cdot C(:N \cdot OH) \cdot CO \cdot NH_2$ are also suitable.   M. H. M. A.

Interaction of ions and dipolar ions. III. Solubility of thallous salts in glycine and in alanine solutions. R. M. Keefer and H. G. Reiber (*J. Amer. Chem. Soc.*, 1941, **63**, 3504—3507).—The solubilities of TlBr in solutions of KNO_3, glycine, alanine, and glycine + KNO_3 and of $TlIO_3$ in glycine and in alanine solutions have been determined. TlBr shows normal behaviour in respect to the limiting law (cf. A., 1941, I, 264), but $TlIO_3$ shows some irregularities.   W. R. A.

Solubility of strychnine acid sulphate in sulphuric acid. B. M. G. Zwicker and R. J. Robinson (*J. Amer. Chem. Soc.*, 1941, **63**, 3538).—The solubility of strychnine H sulphate in H_2SO_4 (19·4—59·7 wt.-%) has been determined at 20°. The solubility curve passes through a min. at ~28·5 wt.-% of H_2SO_4 where the solubility is 0·029 g. per 100 g. of aq. H_2SO_4.   W. R. A.

Partition ratios of some organic acids between water and ethyl ether. O. C. Dermer, W. G. Markham, and H. M. Trimble (*J. Amer. Chem. Soc.*, 1941, **63**, 3524—3525).—The distribution between H_2O and Et_2O has been measured at 25° for HCO_2H, $CH_2Cl \cdot CO_2H$, $CHCl_2 \cdot CO_2H$, $CCl_3 \cdot CO_2H$, $CH_2Br \cdot CO_2H$, $OH \cdot CH_2 \cdot CO_2H$, glycine, $OH \cdot CMe_2 \cdot CO_2H$, $PhSO_3H$, acrylic, adipic, barbituric, crotonic, furoic, succinic, and tartaric acids. A tenfold range of concn. was studied and only $OH \cdot CH_2 \cdot CO_2H$ gives a const. partition ratio. The other acids give mostly a ratio which decreases as concn. increases, but glycine, tartaric acid, and $PhSO_3H$ give ratios which increase with increasing concn.   W. R. A.

Adsorption isotherms of synthetic resin ion-exchange adsorbents. R. J. Myers, J. W. Eastes, and D. Urquhart (*Ind. Eng. Chem.*, 1941, **33**, 1270—1275).—Cationic and anionic exchange by synthetic resins, although involving chemical reaction, are controlled by diffusion and reaction velocity factors to such an extent that they

can be considered as a type of chromatographic adsorption. The capacity of columns of the resins prior to the appearance of the exchanging ion in the effluent H_2O (" break-through capacities ") is correlated with Freundlich adsorption isotherms determined under conditions simulating those in the columns. It is shown that adsorption methods can be used for the rapid evaluation of resins. The preferential adsorption phenomena with synthetic resins is in some cases observable visually through chromatographic banding.   J. W. S.

Surface tension of solutions of electrolytes as a function of concentration. III. Sodium chloride. G. Jones and W. A. Ray (*J. Amer. Chem. Soc.*, 1941, **63**, 3262—3263; cf. A., 1941, I, 165).—Vals. of relative γ for aq. NaCl (0·0001—2·00M.) have been measured at 25°. The γ-concn. curve shows a min. for extremely dil. solutions, indicating that NaCl behaves as a capillary-active substance, whereas at moderate and high concn. NaCl acts like a typical capillary-inactive salt.   W. R. A.

Supermolecule formation at interfaces. H. Dunken, I. Fredenhagen, and K. L. Wolf (*Kolloid-Z.*, 1941, **95**, 186—188).—The interfacial tension–concn. curves for solutions of $BuCO_2H$ in C_7H_{16} and in *cyclo*hexane (but not in C_6H_6) show a very sharp min. at a mol. fraction ~10^{-4}. This is attributed to the existence at very low concns. of single mols. of the acid, which are assumed to exert a higher surface activity than double mols.   F. L. U.

Immobile layer at the solid–liquid interface. J. J. Bikerman (*J. Chem. Physics*, 1941, **9**, 880).—Polemical against Eversole and Lahr (A., 1941, I, 413).   W. R. A.

Surface chemistry of carotenoids. I. Astacene. J. F. Danielli and D. L. Fox (*Biochem. J.*, 1941, **35**, 1388—1395).—A solution of astacene in light petroleum (yellow) turns pink on emulsification with H_2O, irrespective of p_H or salt concn. This phenomenon is not due to increased ionisation at the interface. The chief cause is probably the fact that the interface is a different solvent, since other non-ionising and non-enolising carotenoids show a similar phenomenon on adsorption. The interface behaves as a more polar solvent than light petroleum, but enolisation may be a contributory cause with astacene.   P. G. M.

Composition of the ultrafiltrate obtained from electrolytes and sols by the sieve action of collodion membranes. W. Hacker (*Kolloid-Z.*, 1941, **95**, 194—206; cf. A., 1942, I, 96).—Equations are derived for calculating the sp. conductance (κ) of the ultrafiltrate from an electrolyte solution at different stages. Vals. calc. on the limiting assumptions of (*a*) complete absence of mixing and (*b*) complete mixing at the exit surface of the membrane differ only for the initial stages. Vals. calc. for HCl and NaCl solutions agree well with experiment. In the ultrafiltration of sols the Donnan effect is superposed on the sieve action and plays an increasingly important part as the vol. of liquid on the filter decreases. Methods of calculating κ of the micellar constituent of the sol from observations on the ultrafiltrate are discussed.   F. L. U.

Osmotic pressure and membrane action. A. Thiel (*Kolloid-Z.*, 1941, **94**, 348—349).—Reply to Metcalf (A., 1942, I, 90).   F. L. U.

Hydrogel of zirconia. I. Time of set. C. B. Hurd, W. A. Fallon, and R. W. Hobday (*J. Amer. Chem. Soc.*, 1942, **64**, 110—114).—The time of set (*t*) of hydrogels of ZrO_2, prepared by mixing solutions of Na_2CO_3 and NaOAc with $ZrOCl_2$, has been studied in terms of temp., p_H, and concn. of added electrolyte, KCl. On mixing the solutions, an increase of p_H from 0·1 to 2—5 was observed. The energy of activation varied from 21,000 to 29,000 g.-cal. The gels are softer than silicic acid gels, but do not hold their form. Quick-setting gels formed by using NaOAc at 25° often reliquefied in a few hr. On raising the temp. to 60° re-gelation occurred but, on cooling, the gel liquefied again. *t* is decreased greatly by KCl in low concn. A theory of setting, which involves condensation of $ZrO(OH)_2$, is advanced on the assumption that $ZrO(OH)_2$ is amphoteric.   W. R. A.

Colloid chemistry of system soaps–cresol–water. VI. Viscosity of sodium and potassium stearate solutions in presence of phenols. E. Angelescu and T. Manolescu (*Kolloid-Z.*, 1941, **94**, 319—327; cf. A., 1940, I, 254).—The η of 0·2N-Na and -K stearate solutions in presence of various phenols has been measured at 50—80°. In all cases the max. observed at a certain phenol concn. becomes less marked with rise of temp. Compared with the max. produced by the cresols, it is depressed by those phenols which are more sol. than the cresols in H_2O, and accentuated by those which are more sol. in hydrocarbons. Of the substances studied, PhOH, *o*- and *m*-$C_6H_4(OH)_2$, *o*- and *m*-$NO_2 \cdot C_6H_4 \cdot OH$, *p*-$NH_2 \cdot C_6H_4 \cdot OH$, *α*- and *β*-$C_{10}H_7 \cdot OH$, the last-named give rise to the sharpest max., and $C_6H_4(OH)_2$ abolishes it completely. The results are interpreted in terms of external and internal solvation.   F. L. U.

Determination of polydispersity from diffusion measurements by Lamm's scale method. N. Gralén (*Kolloid-Z.*, 1941, **95**, 188—194).—Formulæ are derived for calculating the polydispersity of a solute from the refractometric data obtained by Lamm's method and examples of their application are given. Diffusion measurements

are specially suitable for determining the polydispersity of long-chain mols.   F. L. U.

Molecular orientation and some associated properties in macromolecular substances with filamentous and reticular structures. I. F. H. Müller (*Kolloid-Z.*, 1941, **95**, 138—181).—The substances considered are branched or unbranched linear mols. that do not tend spontaneously to form crystallites or micelles. The behaviour of such mols. under mechanical deformation is determined by the effect of the applied forces on the orientation of the individual monomeric units. The various types of orientation are classified and its effects on mechanical, optical, and thermal properties are illustrated, chiefly from data relating to polystyrene. The subject is treated theoretically by the use of an orientation distribution function which defines the mean orientation of the monomeric units.   F. L. U.

Macromolecular properties of linear polyesters. Viscous flow and kinetic interaction in solution of ω-hydroxyundecoic self-polyesters. W. O. Baker, C. S. Fuller, and J. H. Heiss, jun. (*J. Amer. Chem. Soc.*, 1941, **63**, 3316—3321).—The concn. (*c*) dependence of the solution viscosity (η_r) of several ω-hydroxyundecoic self-polyesters of known average chain length has been studied at 25° in CHCl₃, and related to the wt.-average mol. wt. (M_W) by $\log_e \eta_r/c = K_W M_W + B$, where K_W and B are consts. With increasing *c* and chain length an extra flow mechanism of chain articulation is introduced. Measurements with mixed polyesters show that M_W must be used for viscosity studies on inhomogeneous polymerides. K_W is independent of mol. wt. down to $M_W = 5000$. *B* has similar vals. for several of the polymerides provided that the chain length exceeds a min. val., and is probably connected with chain kinking. Flow orientation in conc. solutions has been studied by varying the shearing stress. η_r appears to exhibit a melt-like mechanism over a wide range of *c*.   W. R. A.

Viscosity relations in concentrated solutions of synthetic resins from aniline and formaldehyde. W. Scheele, L. Steinke, and I. Avisiers (*Kolloid-Z.*, 1941, **94**, 294—310; cf. *ibid.*, 1940, **93**, 1).—Viscosities (η) of cresol solutions of NH_2Ph-CH_2O resins have been determined at concns. up to 30% and over the temp. range 40—90°, and the results are given in tables and diagrams. For the more conc. solutions η cannot be expressed by Arrhenius' formula or by the simple 6th-power formula of Bredée and de Booys (cf. A., 1937, I, 303), but if the correction term for the latter is introduced vals. of the "extension factor" are obtained which indicate that the particles in these solutions should be represented as only slightly elongated ellipsoids rather than as long chains. There is a linear relation between $\log(1/\eta_{rel.})$ and $1/T$.   F. L. U.

Colloid-chemical properties of humus. Disperse chemistry of lignin. E. Junker (*Kolloid-Z.*, 1941, **95**, 213—250).—Lignin (**I**) is prepared from spruce sawdust, previously extracted with EtOH–C_6H_6, by extraction at 95° with dioxan containing 0·5% of conc. HCl, in which (**I**) dissolves and can be separated, after removing most of the solvent, by addition of H_2O. The crude product is boiled with 4% aq. H_2SO_4 to hydrolyse impurities and the residual (**I**) is electrodialysed. The product contains no N, and the C, H, and OMe contents vary with the % of HCl used for the extraction, suggesting that (**I**) is a complex mixture of chemically similar compounds. (**I**) can be dispersed in HCO_2H, AcOH, AcBr, PhCHO, $CH_2Ph\cdot OH$, C_5H_5N, and aq. NaOH. Adsorption isotherms for H_2O vapour are given; they indicate that (**I**) is less hydrophilic than casein, Li-permutit, or H-kaolinite. Potentiometric and conductometric titrations with NaOH indicate 2·6 m-equiv. of exchangeable H per g. of (**I**). The base-exchange capacity under the most favourable conditions of dispersion is 2·5—2·8 m-equiv. per g., but this is reached only at p_H vals. considerably > those found in soils. (**I**) sols absorb O_2 from the air to the extent of 3·14 m-equiv. of O per g. in pure H_2O, increased in presence of NaOH to 7·6 m-equiv. for 0·14N-NaOH. Finely dispersed $CaCO_3$ increases, and $Mn(OH)_2$ and $Fe(OH)_3$ diminish, the absorption of O_2. Oxidised (**I**) is more easily dispersible than (**I**) and its exchangeable H is increased to 4·25 m-equiv. per g. The dispersibility of (**I**) in dil. NaOH is related to the presence of phenolic OH, fully acetylated (**I**) being non-dispersible. Coagulation vals. of cations for (**I**) sols are recorded; the vals. agree in order of magnitude with those for clay sols.   F. L. U.

Hydrocolloidal cellulose and cellulose hydrosols. R. Haller (*Kolloid-Z.*, 1941, **94**, 310—312).—When cellulose (**I**) (bleached linters) is treated with conc. aq. NaOCl (*d* 1·21) and then heated on a water-bath vigorous action occurs, CO_2 and H_2O are evolved, and the product forms a white powder weighing ∼55% of the original (**I**). The residue on washing with H_2O forms a stable hydrosol, coagulated by electrolysis, and showing all the properties of (**I**). Fehling's solution is not reduced, and no oxycellulose can be detected. No particles are visible in the ultramicroscope until electrolyte is added. Addition of Diamine-blue 3R and a little NaCl produces a red coagulum, whilst under the same conditions massive (**I**) is dyed blue. It is considered that the NaOCl breaks up part of the (**I**) completely while leaving the rest unaffected, since no intermediate oxidation products can be detected.   F. L. U.

Dependence of viscosity on concentration in cellulose acetate. M. Takei and H. Erbring (*Kolloid-Z.*, 1941, **95**, 207—211).—The η of solutions of cellulose acetate in $CHCl_2\cdot CO_2H$, NH_2Ph, Ac_2O, $OH\cdot CHMe\cdot CO_2Et$, $OH\cdot CHMe\cdot CH_2\cdot OAc$, and $COMe_2$ was measured at concns. up to 12% and the vals. are compared with those calc. from the formulæ of Arrhenius (1), Bredée and de Booys (2), and Philippoff and Hess (3). (1) is unsatisfactory for all the solvents, whilst (2) gives good results for all, the val. of the const. *A* varying with the solvent from 2·73 to 3·25. (3) gives satisfactory vals. for those solvents for which *A* in the preceding formula is <3, but not for those for which *A* is >3. A correction term for (3) is proposed, the effect of which is to make the formula applicable to all the solutions.   F. L. U.

Dielectric investigations with cellulose acetate in various solvents. M. Takei and H. Erbring (*Kolloid-Z.*, 1941, **94**, 312—318).—The *d* and *n* of solutions of cellulose acetate (OAc 53·2%) (**I**) in Et lactate (**II**), Ac_2O (**III**), $CHCl_2\cdot CO_2H$ (**IV**), $COMe_2$, $OH\cdot CHMe\cdot CH_2\cdot OAc$, and NH_2Ph change linearly with the wt.-concn. of (**I**) up to the highest concn. (∼12%) studied. Extrapolation to 100% of (**I**) gives d^{20} 1·301 and n^{20} 1·485. The sp. polarisation of (**I**) is independent of concn. in (**II**) and (**III**), shows a slight max. in (**IV**), and falls slightly with increasing concn. in the remaining solvents. The mean val. of the dipole moment of (**I**) is 2·11 D. The solvation calc. from the loss of polarisation in the various solvents amounts to 0·29—0·90 g. of solvent for 1 g. of (**I**).   F. L. U.

Properties of carboxymethylcellulose and its salts.—See B., 1942, II, 10.

Rigidity and moisture hysteresis in gels. W. W. Barkas (*Nature*, 1941, **148**, 629—630).—Hysteresis in a gel is interpreted in terms of its elastic properties.   L. S. T.

VI.—KINETIC THEORY. THERMODYNAMICS.

Isomerisation equilibrium among the branched-chain pentenes. R. H. Ewell and P. E. Hardy (*J. Amer. Chem. Soc.*, 1941, **63**, 3460—3465).—Pure pentene isomerides were isomerised by pumping their vapours over solid catalysts at const. temp. The isomerides formed were separated by fractional distillation. Equilibrium consts. have been calc. for the reactions $CH_2\!:\!CMeEt$ (**I**) $= CMe_2\!:\!CHMe$ (**II**), $CH_2\!:\!CHPr^\beta$ (**III**) $=$ (**II**), and (**III**) $=$ (**I**), and these data with calc. heats of isomerisation yield vals. for the entropy differences between the pairs of $-0·64\pm0·05$, $0·8\pm0·1$, and $1·4\pm0·2$ entropy units, respectively.   W. R. A.

Vapour-phase esterification equilibrium. J. O. Halford and D. Brundage (*J. Amer. Chem. Soc.*, 1942, **64**, 36—40).—The equilibrium const. (*K*) for the esterification of AcOH by EtOH has been determined at 40—100° for dil. solutions of AcOH and EtOAc in a solvent containing 1·2237 mols. of H_2O per mol. of EtOH. The result at 40° has been converted into the vapour-phase const. For vapour-phase esterification $K(g)_{313}$ is 122 ± 3, ΔG^0_{313} is -2990 g.-cal. per mol., and $\Delta G^0 = -3970\pm3\cdot1T$.   W. R. A.

Calculation of equilibria in dilute water solutions. D. S. McKinney (*Proc. Amer. Soc. Test. Mat.*, 1939, **39**, 1191—1203).—The method of calculating the equilibrium concns. of the constituents of aq. solutions from the equilibrium consts., the law of the conservation of matter, and the principle of electrical neutrality is described. The use of the activity function is discussed and formulæ are given for calculating the activity coeffs. of ions from the Debye–Hückel equation. The effect of temp. on the equilibria is discussed. Formulæ relating the equilibrium consts. to other thermodynamic quantities, *e.g.*, free energy, heats and entropies of reaction, and the e.m.f. of cells, are given. The use of the various formulæ is illustrated by examples selected from the field of corrosion or H_2O treatment.   R. B. C.

Exchange and transfer equilibria of acids, bases, and salts in deuterium–protium oxide mixtures. Ion product constant of deuterium oxide. R. W. Kingerley and V. K. LaMer (*J. Amer. Chem. Soc.*, 1941, **63**, 3256—3262).—The equilibrium process $0·5H_2O + KOD(D_2O) + KBr(H_2O) = 0·5D_2O + KOH(H_2O) + KBr(D_2O)$ has been determined from analytical measurements of the process $0·5HgO$ (solid) $+ 0·5Hg.$ (liq.) $+ 0·5H_2O + KBr(H_2O) = 0·5Hg_2Br_2$ (solid) $+ KOH(H_2O)$ in H_2O–D_2O mixtures. Ascertained vals. agree well with those calc. by indirect methods. For H_2O measurements were made at 20°, 25°, 30°, and 35°, whilst with D_2O the temp. were 20°, 25°, and 30°. From the temp. coeff. thermodynamic functions have been computed. The difference between exchange and transfer free energy is emphasised. The solubilities of TlCl and $Ca(OH)_2$ in H_2O and in D_2O have been determined at 25°. The exchange coeff. of $Ca(OH)_2$ in H_2O–D_2O has been determined and transfer equilibrium consts. for TlCl and $Ca(OH)_2$ have been calc. The ion product const. of D_2O has been deduced as $1·54 \times 10^{-15}$ in good agreement with the recorded val. (A., 1935, 1076). Equilibria in H_2O–D_2O mixtures is influenced to a greater extent by the free energy of transfer than by free energy of exchange.   W R A

Oxidation-decomposition of methane. T. Ogura (*Bull. Chem. Soc. Japan*, 1941, **16**, 262—273).—Introduction to a summary of the author's work. Vals. of equilibrium consts. for a no. of reactions in which CH_4 is oxidised by O_2, H_2O, or CO_2 to CO or CO_2 and H_2 are calc. and tabulated.   F. J. G.

Dissociation of calcium and magnesium carbonates and bicarbonates. I. Greenwald (*J. Biol. Chem.*, 1941, **141**, 789—796).—The H˙ dissociation of H_2CO_3 in $CaCl_2$ or $MgCl_2$ is > in KCl of similar ionic strength; the solubility product $[Ca^{••}][CO_3^{''}]$ in $KHCO_3$ is > in KCl (all salts in aq. solution). These differences are probably due to the formation of complexes of the types $MHCO_3^{•}$ and MCO_3. The physiological significance of this complex formation in plasma and serum is discussed.   D. F. R.

Electron-sharing ability of organic radicals. XIV. Effect of the radicals on the ionising power of organic solvents. F. J. Moore and I. B. Johns (*J. Amer. Chem. Soc.*, 1941, **63**, 3336—3338; cf. A., 1942, I, 99).—Conductances and ionisation consts. of picric acid in $COMe_2$, COMeEt, $COPhMe$, EtCN, and PhCN are determined. The ionisation const. depends on the electron-sharing ability of the radicals of the solvent mol. (the effect being of the same order for ketones and nitriles) and not on the dielectric const. of the solvent.   R. S. C.

Ionisation constant of propionic acid in dioxan–water mixtures. H. S. Harned and T. R. Dedell (*J. Amer. Chem. Soc.*, 1941, **63**, 3308—3312).—From the e.m.f. in the temp. range 0—50° of the cell $H_2|EtCO_2H$ (m_1), $EtCO_2Na$ (m_2), NaCl (m_3), dioxan (X), H_2O (Y)$|AgCl$–Ag the ionisation const. (K) of $EtCO_2H$ has been determined. Vals. of K for HCO_2H, AcOH, and $EtCO_2H$ in dioxan–H_2O are compared and expressed in terms of an equation, from the consts. of which vals. for the changes accompanying ionisation in free energy, heat content, heat capacity, and entropy have been calc. at 25°. The results are discussed in relation to existing theories.   W. R. A.

Position of two alicyclic hydrocarbons in the acidity series. R. D. Kleene and G. W. Wheland (*J. Amer. Chem. Soc.*, 1941, **63**, 3321—3322).—Acid strength decreases in the order: CH_2Ph_2 > phenyl*cyclo*pentane > $PhPr^{\beta}$ **(I)** > phenyl*cyclo*hexane. $CHPh_3$ and $CH(C_5H_4Me_2$-3 : 5)$_3$ could not be compared with each other, but both are stronger than **(I)**.   W. R. A.

Activity coefficients of the undissociated part of weak acids. II. Oxalic acid. W. D. Larson and W. J. Tomsicek (*J. Amer. Chem. Soc.*, 1941, **63**, 3329—3331).—The activity coeff. of undissociated $H_2C_2O_4$ does not change in the ionic strength range 0·02—0·33. The e.m.f. of the $Hg|Hg_2C_2O_4(s)$, C_2O_4'' electrode has been found to be $-0·4173 \pm 0·001$ v. from measurements of the cell $Hg|Hg_2C_2O_4(s)$, $H_2C_2O_4(c)|H_2$. Recalculation of the e.m.f. data (A., 1938, I, 31) for the cell $Cd(Hg)|CdC_2O_4,3H_2O(s)$, $H_2C_2O_4(m)$, quinhydrone$|(Pt)$ confirms the constancy of the activity coeff. of $H_2C_2O_4$.   W. R. A.

Hydration of aluminium sulphate. N. O. Smith (*J. Amer. Chem. Soc.*, 1942, **64**, 41—44).—From a study of parts of the ternary systems MSO_4–$Al_2(SO_4)_3$–H_2O (M = Cu, Fe, Ni) at 25° evidence is adduced that the heptadecahydrate is the stable form of $Al_2(SO_4)_3$ in equilibrium with its saturated aq. solution. $Al_2(SO_4)_3,17H_2O$ has been prepared by crystallisation at low temp.   W. R. A.

System silver nitrate–dioxan–water at 25°. J. A. Skarulis and J. E. Ricci (*J. Amer. Chem. Soc.*, 1941, **63**, 3429—3431).—The system $AgNO_3$–H_2O–dioxan has been investigated at 25° and evidence for a solid dioxanate of $AgNO_3$, $(AgNO_3)_8,C_4H_8O_2$ ($AgNO_3$ ∼94%), is presented.   W. R. A.

System aniline–chlorobenzene. Equilibria between liquid and vapour at pressures below atmospheric. K. E. Coulter, R. A. Lindsay, and E. M. Baker (*Ind. Eng. Chem.*, 1941, **33**, 1251—1253).—A modified equilibrium still for the determination of liquid and vapour equilibria at < atm. pressure is described. The v.p. of pure PhCl and NH_2Ph and the variations of the vapour composition and b.p. with concn. in the system PhCl–NH_2Ph at various total pressures are recorded in curves. Contrary to the usual belief that reduced pressure facilitates separation by distillation, the relative volatility in this system decreases slightly with reduction in pressure.   J. W. S.

Equilibrium diagram of the system carbon tetrachloride–*tert*-butyl chloride as revealed by dielectric constant measurements. W. P. Conner and C. P. Smyth (*J. Amer. Chem. Soc.*, 1941, **63**, 3424—3428).—The dielectric consts. (ϵ) of a continuous series of solid solutions of CCl_4 and $Bu^{\gamma}Cl$ have been measured at 170—270° K. at frequencies of 0·5, 5, and 50 kilocycles per sec. The temp. of rotational transition of each compound is lowered by addition of the other compound. An equilibrium diagram for the system has been constructed. So long as the mols. in the solid possess freedom of rotation their lattices are isotropic, but when mol. rotation is stopped the lattices become anisotropic.   W. R. A.

Iron–iron sulphide–iron silicide system. R. Vogel, C. Uschinski, and U. Theune (*Arch. Eisenhüttenw.*, 1941, **14**, 455—462; *Bull. Iron Steel Inst.*, 1941, No. 72, 72 A).—The system was studied by thermal and microscopical examinations of melts prepared by first adding Si to molten Fe, allowing time for the temp. rise due to Fe silicide formation to subside, and then adding S. In the liquid state Fe sulphide and Fe silicide are only slightly sol. in each other. This is the cause of the extensive miscibility gap in the region investigated. Its course and that of the tie-lines and the occurrence of a lower crit. point near to the Fe–Fe sulphide boundary have been established. Special details are a three-phase equilibrium, a max. temp. on the miscibility surface, and a three-phase eutectic with a temp. max., one solid phase of which is the superstructure solid solution Fe_2Si. Si, like C and P, when added to molten Fe containing S causes a S-rich layer to separate out; it thus favours the effect of Mn in desulphurising pig Fe.   R. B. C.

Heats of dissociation of some hexa-arylethanes. R. Preckel and P. W. Selwood (*J. Amer. Chem. Soc.*, 1941, **63**, 3397—3403).—Vals. of the magnetic susceptibility χ have been obtained by the Gouy method for PhMe solutions of C_2Ph_6, $C_2Ph_4(C_6H_4Me$-$o)_2$, $C_2Ph_4.(C_{10}H_7$-1)$_2$, and $C_2Ph_2(C_6H_4Me$-$o)_4$ for different temp. and concns.; the data support the "resonance," rather than the "steric," theory of free radical stability. Ebullioscopic measurements and the intensity of the colour of solutions are considered to be inaccurate in studying free radical behaviour and concn. The extent of the dissociation is obtained from the magnetic data, and from the equilibrium consts. and their variation with temp. vals. of ΔF, ΔH, and ΔS are derived and tabulated.   W. R. A.

Thermodynamic theory of solutions of two liquids at all concentrations. J. L. Finck (*J. Franklin Inst.*, 1942, **233**, 51—70).—The treatment previously described (A., 1938, I, 311) is extended to the mixing of two chemically pure liquids, to form a solution of any concn. The presence of a catalyst is postulated. The process of mixing is analogous to evaporation, and osmotic pressure is analogous to v.p. Relations between osmotic pressure and the e.m.f. of a concn. cell are developed, and a mathematical relation between latent heat of dissolution, the sp. vols. of the two liquids and the solution, concn., and e.m.f. and charge of the concn. system is derived.   F. L. U.

Entropies of nitric acid and its mono- and tri-hydrates. Heat capacities from 15° to 300° K. Heats of dilution at 298·1° K. Internal rotation and free energy of nitric acid gas. Partial pressures over its aqueous solutions. W. R. Forsythe and W. F. Giauque (*J. Amer. Chem. Soc.*, 1942, **64**, 48—61).—Vals. of C_p have been determined for HNO_3 (13·51—302·89° K.), HNO_3,H_2O (14·91—298·63° K.), and $HNO_3,3H_2O$ (14·84—295·58° K.). The m.p. are, respectively, 231·51°, 235·48°, and 254·63° K.; heats of fusion 2503 ± 2, 4184 ± 1, and 6954 ± 4 g.-cal. per mol.; heats of dilution at 298·1° -7971 ± 10, -4732 ± 8, and -2123 ± 5 g.-cal. per mol.; entropies 37·19, 51·84, and 82·93 g.-cal. per degree per mol. Available partial pressure data over aq. HNO_3 have been investigated by the Duhem equation and errors in existing experimental data have been revealed. No appreciable association exists in the vapour over HNO_3 solutions. The partial pressure data have been extended over the range 50—100% HNO_3 at 20°. Using entropy vals. derived, entropy of H_2O and measured heats of hydration, vals. for free energies of hydration of both hydrates have been calc. in excellent agreement with free energies for isothermal hydration. It is, therefore, concluded that if H-bonding occurs in the lattice structure, as is probable, no randomness exists at low temp. The entropy of gaseous HNO_3 is 63·62 g.-cal. per degree per mol. at 298·1° K. and 1 atm.; this val., combined with mol. data, indicates that there is a double potential barrier of 7000 g.-cal. per mol. restricting internal rotation. The following have also been computed : free energy, heat content, and entropy functions of HNO_3 gas; heat of reaction at 0° K. and equilibrium const. at 500° K. for $2HNO_3(g) + NO = H_2O(g) + 3NO_2$, $2HNO_3(g) = H_2O(g) + 2NO_2 + 0·5O_2$, and $2HNO_3(g) = H_2O(g) + 2NO + 1·5O_2$; and free energies and heats of formation from the elements for $HNO_3(liq.)$, $HNO_3(g)$, and $HNO_3(aq.$ $a = 1)$.   W. R. A.

Entropy of acetic acid. J. O. Halford (*J. Chem. Physics*, 1941, **9**, 859—863).—From third-law measurements (v.p. and v.d.) the entropy of monomeric AcOH at 25° is $69·4 \pm 1·0$ g.-cal. per degree per mol., whereas the val. calc. from the vapour-phase EtOAc equilibrium is 68·7 and that calc. for a model based on $COMe_2$, and approx. representing free rotation, is 72·7. It is assumed that in the entire rotational cycle there is only a single potential min. of sufficient depth to trap the OH group. For such a model, with vibration restricted to the ground state, the entropy would be 68·3 plus a small increment owing to the use of the $COMe_2$ vibrational entropy.   W. R. A.

VII.—ELECTROCHEMISTRY.

Calculation of corrections to conductivity measurements [of water] for dissolved gases. D. S. McKinney (*Amer. Soc. Test. Mat., Preprint*, June, 1941, 11 pp.).—Methods based partly on the author's earlier work (*ibid.*, 1939, **39**, 1191) are outlined. Procedures for correcting the conductivity of condensed steam when analysis only of the steam is available, and for calculating the correction to be applied to a steam sample from partial analysis of steam and boiler-

H_2O are given. Tables of data needed for the calculations showing (a) the ionic equiv. conductance, λ_0, of the ions commonly found in industrial H_2O; (b) the variation of the equiv. conductance Λ, with concn. for Na_2SO_4, NaCl, and NaOH; and (c) the distribution of the ions of the weak electrolytes H_2O, H_2S, CO_2, SO_2, NH_3, and H_3PO_4 as a function of p_H, are presented.　　　　R. B. C.

Conductance of potassium iodate at 25° and mobility of the iodate ion. K. A. Krieger and M. Kilpatrick (J. Amer. Chem. Soc., 1942, **64**, 7—9).—Vals. of Λ for aq. KIO_3 (0·0001—0·1M.) have been measured at 25°; Λ_0 is 114·00±0·05. From existent data for Λ_{0KCl} and $\lambda_{0Cl'}$, $\lambda_{0IO_3'}$ is 40·48±0·05.　　　　W. R. A.

High mol. wt. aliphatic amines and their salts. IV. Electrical conductivities of aqueous solutions of hydrochlorides and acetates of dodecyl- and octadecyl-amines. A. W. Ralston, C. W. Hoerr, and E. J. Hoffman (J. Amer. Chem. Soc., 1942, **64**, 97—101; cf. A., 1942, I, 58).—Vals. of conductivities and ρ of aq. acetates and hydrochlorides of $C_{12}H_{25}\cdot NH_2$ (I) and $C_{18}H_{37}\cdot NH_2$ (II) have been determined from 0° to 60°. Conductivity curves show the three ranges characteristic of colloidal electrolytes. Over the first range the salts behave as strong electrolytes, agreeing with the Onsager equation. Micelle formation begins at approx. 0·013M. for (I) and 0·0003M. for (II). Vals. for Λ_0, l_e, and n_e at infinite dilution have been calc.　　　　W. R. A.

Oxidation–reduction equilibrium, over the whole p_H range, of oxonine and related dyes.—See A., 1942, II, 118.

VIII.—REACTIONS.

Isotope separation and combustion mechanism in ascending hydrogen–deuterium flames. K. Clusius, W. Kölsch, and L. Waldmann (Z. physikal. Chem., 1941, **A**, 189, 131—162).—At 600 mm. total pressure the lower ignition limit for H_2 in O_2 lies at 3·80% of H_2 and for D_2 in O_2 at 5·30% of D_2; for a 1 : 1 H_2–D_2 mixture the limit lies at 4·55% of mixture. The ratio of the limiting concns. for the two gases is approx. the same as the ratio of their diffusion coeffs. against O_2. The difference between the two limits can be made use of in order to separate H_2 from D_2 in admixtures, H_2 being preferentially burnt in presence of O_2, so increasing $[D_2]$ in the residual gas. The mechanism of the combustion is discussed theoretically.　　　　C. R. H.

Oxidation of nitric oxide. Rate of reaction between carbon monoxide and nitrogen dioxide. F. B. Brown and R. H. Crist (J. Chem. Physics, 1941, **9**, 840—846; cf. A., 1939, I, 568).—The initial rate of reaction between CO and NO_2 has been measured from 225° to 290° under conditions which precluded decomp. of NO_2. Combined with existing data the reaction over a range of 300° has been studied. The energy of activation is 27·8 kg.-cal. The rate of the reaction is so low that no correction for it is necessary in the experiments on CO, O_2, NO, and NO_2 mixtures between 25° and 256°. Oxidation of NO at 25° and at pressures of NO 0·01 to 0·1 mm. is of the third order over a 3- and 6-fold change in reactants. The production of CO_2 and NO_2 at ~150° in mixtures of NO, CO, and O_2 has been measured, precautions being taken to prevent formation of CO_2 by reaction between CO and NO_2. The intermediate formation of NO_3 in the oxidation of NO is postulated. The rate of reaction between NO_3 and NO is > that between NO_3 and CO. A new apparatus containing greaseless valves and capable of handling 10^{-3} mm. of products is described. A method of analysis of products with a precision of 3×10^{-6} mm. has been developed.　　　　W. R. A.

Mechanism and kinetics of reactions involving free radicals. W. A. Waters (Trans. Faraday Soc., 1941, **37**, 770—780).—A general survey.　　　　F. L. U.

Statistics of intramolecular aldol condensations in unsaturated ketone polymerides. P. J. Flory (J. Amer. Chem. Soc., 1942, **64**, 177—179).—Intramol. condensation of neighbouring substituents of a long-chain polymeride, where each substituent is bifunctional, is treated statistically.　　　　W. R. A.

Exchange reaction of diacetyl with deuterium oxide. W. D. Walters (J. Amer. Chem. Soc., 1941, **63**, 2850—2851).—The exchange reaction of Ac_2 with D_2O (98%) alone and in admixture with HCl has been studied at 25° and 56° and vals. of the rate of exchange (k') are tabulated. $k' \propto$ [HCl] over a five-fold change in [HCl] up to 1N. The activation energy for the reaction is ~23·9 kg.-cal. k' is compared with existent data for $COMe_2$ and the mechanism of the reaction is briefly discussed.　　　　W. R. A.

Kinetic considerations of the thermal decomposition of benzenediazonium chloride in various solvents. C. E. Waring and J. R. Abrams (J. Amer. Chem. Soc., 1941, **63**, 2757—2762).—The rate of decomp. (k) of PhN_2Cl has been studied in isoamyl (I) and active amyl (II) alcohols and in tert.-amyl alcohol and $CHMePr^\alpha\cdot OH$ in admixture with EtOH to effect dissolution, over the temp. range 20° to 40°. k is approx. const. in all solvents and the activation energy (E) is 26,620 for (I) and 27,260 g.-cal. per mol. for (II). Comparison with existent data for six alcohols, four acids, and H_2O shows a diverg-

ence in E, indicating the variation in some function such that k remains const. Log PZ varies linearly with E and the relative importance of bond strengths and repulsive energies involved in the decomp. of PhN_2Cl is discussed. The proposed mechanism for the decomp. involves the initial solvation of PhN_2Cl and then formation of the free radicals Ph and Cl which then react with solvent mols. The mechanism is in agreement with observed results, i.e., constancy of k in all solvents and in the presence of acids or common ions. The variation of E with the no. of C atoms in the solvents is represented graphically and yields a min., the theoretical implications of which are discussed.　　　　W. R. A.

Dielectric and solvent effects on alkaline fading of bromophenol-blue. E. S. Amis and S. E. Cook (J. Amer. Chem. Soc., 1941, **63**, 2621—2625).—The reaction between the negative bromophenol-blue ion and OH′ (from NaOH) has been investigated from 10° to 60° in iso-composition and iso-dielectric glycerol (I)–H_2O media. The trend of the energies of activation is opposite to the electrostatic theory and is attributed to an equilibrated reaction between NaOH and (I). At high concns. of (I) the observed rates (k), corr. for dielectric effects, $\propto$ the mol. fraction of (I), whilst at low concns. of (I) k rapidly approached the H_2O point due to hydrolysis of the compound formed between NaOH and (I). An equation is derived for the difference of the Arrhenius frequency factor B in iso-composition and iso-dielectric media. Observed results agree with other data.　　　　W. R. A.

Kinetics and mechanism of electrophilic benzene substitution reactions. A. E. Bradfield and B. Jones (Trans. Faraday Soc., 1941, **37**, 726—743).—The processes of nitration, sulphonation, chlorination, and bromination of C_6H_6 and its derivatives are discussed. Probably all involve simple bimol. mechanisms unaccompanied by unimol. Changes in reaction rate caused by varying the substituents are due entirely to changes in the activation energy E, whilst the val. of E is determined additively by characteristic quota E_1, E_2, etc., contributed by the individual substituents.　　　　F. L. U.

Mechanism and kinetics of anionotropic change. M. P. Balfe and J. Kenyon (Trans. Faraday Soc., 1941, **37**, 721—725).—Examples are given of reactions that can be recognised as taking place by rearrangement or by replacement according to whether the rotatory power due to an optically active group originally present is or is not retained. The spontaneous rearrangement of (+)·$CHEt\cdot CH\cdot CHMe\cdot OH$ into (+)·$CHMe\cdot CH\cdot CHEt\cdot OH$, which is accompanied by some racemisation, appears to be reversible and intramol.　　　　F. L. U.

Mechanism and kinetics of elimination reactions. E. D. Hughes and C. K. Ingold (Trans. Faraday Soc., 1941, **37**, 657—685).—1 : 2-Elimination from saturated compounds is surveyed and discussed from the points of view of mechanism and environmental and constitutional influences.　　　　F. L. U.

Mechanism and kinetics of aromatic side-chain substitution. Interpretation of reaction data by the method of relative energy levels. J. W. Baker (Trans. Faraday Soc., 1941, **37**, 632—644).—A survey dealing mainly with bimol. nucleophilic substitutions.　　　　F. L. U.

Mechanism and kinetics of substitution at a saturated carbon atom. E. D. Hughes (Trans. Faraday Soc., 1941, **37**, 603—631).—A survey of recent progress.　　　　F. L. U.

Mechanism and kinetics of ring closure. G. M. Bennett (Trans. Faraday Soc., 1941, **37**, 794—803).—A survey of recent work dealing principally with the formation of large rings.　　　　F. L. U.

Activation energy of ionic substitution. E. C. Baughan and M. Polanyi (Trans. Faraday Soc., 1941, **37**, 648—654).—A simplified theory applying to negative substitutions of the type Cl′ + RCl = ClR + Cl′ is based on one previously developed (cf. A., 1935, 452) for the closely related unsymmetrical reaction. The method employed is to determine the curve along which the energy surfaces relating to the initial and final chemical states cross, without plotting the surfaces themselves.　　　　F. L. U.

Mechanism and kinetics of additions to olefinic compounds.—See A., 1942, II, 125.

Mechanism of the Cannizzaro reaction and some allied processes.—See A., 1942, II, 131.

Mechanism and kinetics of carboxylic ester hydrolysis and carboxyl esterification. J. N. E. Day and C. K. Ingold (Trans. Faraday Soc., 1941, **37**, 686—705).—A survey of recent work. Three out of the seven theoretically deduced mechanisms have already been confirmed by kinetic studies.　　　　F. L. U.

Saponification of acetylsalicylic acid at 35°. J. M. Sturtevant (J. Amer. Chem. Soc., 1942, **64**, 77—80).—The velocity of saponification of acetylsalicylic acid (I) at 35° has been investigated by the calorimetric method and results agree with those required by Brönsted's theory. The heat of ionisation of (I) at 35° is −3500 joules per mol.　　　　W. R. A.

Cleavage of the alkyl–oxygen bond in the hydrolysis of esters.—See A., 1942, II, 141.

Graphical calculation of non-isothermal reactions. J. W. Greene, J. B. Sutherland, and G. Sklar (*Ind. Eng. Chem.*, 1942, **34**, 65—67). —A graphical method for calculating the variation of reaction coeff. with time for reactions accompanied by temp. change and thence calculating the degree of completion of the reaction after the elapse of various periods of time is developed. The calc. results are in accord with experiment for the hydrolysis of corn starch in N-acid. J. W. S.

Kinetic studies in ester hydrolysis. I. Hydrolysis of halogeno-aliphatic esters. II. Influence of solvent on reaction. S. V. Anantakrishnan and S. Krishnamurti (*Proc. Indian Acad. Soc.*, 1941, **A, 14**, 270—278, 279—288).—I. The kinetics of the acid hydrolysis of Et esters of AcOH, $CH_2X \cdot CO_2H$ (X = Cl, Br, I), $EtCO_2H$, α- and β-chloro-, -bromo-, and -iodo-propionic acids, and Pr^nCO_2H by 0·1N-HCl in 60% dioxan–H_2O have been investigated at 35°, 42°, 56°, and 60°. The effect of halogen substitution on E and PZ in the Arrhenius equation is discussed from the viewpoint of the electronic theory of org. reactions.

II. Previous work is extended to EtOAc, $EtCO_2Et$, and $CH_2Cl \cdot CO_2Et$ in aq. glycerol of various concn. and compared with aq. dioxan and aq. EtOH. η and ε of the solvent influence the reaction and a correlation of vals. of E and PZ is shown. W. R. A.

Kinetics of the degradation of non-degraded potato and maize starches by β-amylase.—See A., 1942, II, 82.

Rate of reaction of phosphorus pentoxide with rock phosphate.—See B., 1942, I, 137.

Production of atomic iodine in the reaction of peroxides with iodide ion. H. Taube (*J. Amer. Chem. Soc.*, 1942, **64**, 161—165).—The oxidation of C_2O_4'' ions is induced by S_2O_8'' and Ac_2O_2 but not by AcO_2H and H_2O_2. The induced oxidation involves the production of at. I. W. R. A.

Reaction between ethyl iodide and copper salts. V. D. Taskar, M. S. Telang, and V. V. Nadkarny (*Current Sci.*, 1941, 10, 404).—The apparent accelerating effect of a Cu salt on the persulphate–alkyl iodide (I) reaction (cf. A., 1940, I, 121) is due to a reaction between the Cu salt and (I) in which free I is produced. This reaction can be followed iodometrically if the I is extracted from the reaction products with C_6H_6 before titration; it is of the first order with respect to (I), and probably occurs by dissociation of the (I), followed by a faster reaction of Cu'' with I or I'. A. J. E. W.

Dielectric properties of hydrocarbons and hydrocarbon oils. Influence of oxidation. J. C. Balsbaugh, A. G. Assaf, and J. L. Oncley (*Ind. Eng. Chem.*, 1942, **34**, 92—100).—Oxidation of cetane in presence of Cu proceeds rapidly after an initial induction period, a Cu salt, probably Cu glutarate, being formed. The oxidation is less rapid in the absence of Cu. cis-Decalin is oxidised rapidly but Cu and paper inhibit this oxidation after the O_2 absorption has exceeded ~13 l. per kg. The oxidation of decane shows no induction period and in its early stages is unaffected by the presence of Cu, although Cu acts as an inhibitor in the later stages, when a Cu salt is formed. Cetene is not oxidised more rapidly than the saturated hydrocarbons. Various hydrocarbon oils show oxidation phenomena similar to those of the pure compounds. Electrical conductivity and ε measurements on the oils alone and in the presence of paper have been correlated with the degree of oxidation. The use of a limited oxidation test for evaluating the power factor stability of an oil in presence of Cu is suggested. J. W. S.

Prototropic changes of carbonyl compounds. H. B. Watson (*Trans. Faraday Soc.*, 1941, **37**, 713—716).—Acid- and base-catalysed prototropic changes are briefly discussed. The influence of electron-attracting substituents in directing the change via the basic mechanism is illustrated by the reactions of the halogenated acetones. F. L. U.

Mechanism of addition and condensation reactions of carbonyl compounds. H. B. Watson (*Trans. Faraday Soc.*, 1941, **37**, 707—713).—Reactions of the aldol type (Knoevenagel, Claisen, Perkin) and ester condensation (Claisen) type are discussed. The mechanisms accepted are substantially those put forward by Lapworth. The functions of acid and basic catalysts are considered. Reactions of CO compounds with NH_2OH and N_2H_4 and its derivatives probably follow an analogous course. F. L. U.

cis-trans isomerisations. I. Mechanism of a catalysed isomerisation of maleic acid to fumaric acid. K. Nozaki and R. Ogg, jun. **II. Mechanism of the amine-catalysed isomerisation of diethyl maleate.** K. Nozaki (*J. Amer. Chem. Soc.*, 1941, **63**, 2583—2586, 2681—2683).—I. The isomerisation of maleic to fumaric acid in H_2O at 99·9° catalysed by HCl, HBr, H_2SO_4, KCNS, NH_4CNS, and NaBr, and at 79·8° catalysed by HCl and KCNS, has been investigated. The activation energy with HCl is 24,900 g.-cal. and with KCNS 18,800 g.-cal. The proposed mechanism of isomerisation involves the addition of a proton and the anion of the catalysing agent, a shift of double bond, and a Walden inversion, and is in

agreement with observed results. The application of the mechanism to other cis–trans isomerisations is discussed.

II. Extension of previous work to the isomerisation of Et_2 maleate to Et_2 fumarate in Et_2O at 24·9° and 0°, catalysed by 12 amines. tert.-Amines, in agreement with theory, did not catalyse the isomerisation. The application of the mechanism to all αβ-unsaturated esters and acids is discussed. W. R. A.

Mechanism of the peroxide-catalysed polymerisation of d-sec.-butyl α-chloroacrylate. C. C. Price and R. W. Kell (*J. Amer. Chem. Soc.*, 1941, **63**, 2798—2801).—Kinetics of the polymerisation of $d \cdot CH_2 \cdot CCl \cdot CO_2Bu \cdot sec.$ catalysed by Bz_2O_2 have been investigated in dil. dioxan solution at 26°, 44°, 52°, 60°, and 68° using the polarimetric technique (cf. A., 1941, II, 84). The rate of reaction ∝ the concn. of monomeride and $[Bz_2O_2]^{\frac{1}{2}}$. Results agree with the mechanism of macro-polymerisation involving a free radical chain reaction. For Bz_2O_2 it is suggested that the chain is initiated by free radicals formed by thermal decomp. of Bz_2O_2. W. R. A.

Alcoholysis of polyvinyl acetate. L. M. Minsk, W. J. Priest, and W. O. Kenyon (*J. Amer. Chem. Soc.*, 1941, **63**, 2715—2721).—The alcoholysis of polyvinyl acetate (I) of varying mol. wt. and concn. in abs. MeOH, catalysed by HCl and NaOH in varying amount, has been studied at 10° and 30° up to 50% alcoholysis. The rate of reaction depends on (i) the concn. of the basic catalyst, (ii) the 1·22 power of the concn. of the acidic catalyst, and (iii) approx. the first power of the concn. of (I), and is independent of the mol. wt. of (I). The energy of activation is 13,000 g.-cal. for the basic and 13,200 g.-cal for the acidic catalysts. The reaction possesses apparent autocatalytic characteristics which may be due either to an autocatalytic or to a stepwise nature. The effect of moisture on the reaction is briefly discussed. The reaction is explained qualitatively as due to the degree of deacetylation of (I) rather than to external causes. W. R. A.

Mechanism of mutarotation of d-hydroxymethylenecamphor.—See A., 1942, II, 106.

Mechanism of the Friedel–Crafts reaction.—See A., 1942, II, 136.

Comparison of metallic chlorides as catalysts for the Friedel–Crafts ketone synthesis.—See A., 1942, II, 143.

Mechanism of the steam–carbon reaction. G. S. Scott (*Ind. Eng. Chem.*, 1941, **33**, 1279—1285).—Data relating to the C–H_2O reaction are reviewed. These indicate that since in the reaction between lignite char and steam at <1000° the dry gas composition of the products approaches CO_2 $33\frac{1}{3}$% and H_2 $66\frac{2}{3}$% at very brief contact time (B., 1934, 786), the initial reaction is probably $C + 2H_2O = CO_2 + 2H_2$. The total reaction at 700—1200° is approx. of second order with activation energy 26,000 g.-cal. per mol. Results with coke are more inconclusive but in general accord with those obtained with lignite char. The importance of the presence of catalytic materials in the ash of the coke is emphasised. J. W. S.

Preparation of palladium and platinum synthetic high-polymeride catalysts and relationship between particle size and rate of hydrogenation. L. D. Rampino and F. F. Nord (*J. Amer. Chem. Soc.*, 1941, **63**, 2745—2749).—Catalysts of Pd–polyvinyl alcohol (I), $-CH_2 \cdot CMe \cdot CO_2Me$ (II), –Me polyacrylate (III) and of Pt–polyvinyl alcohol (IV) have been prepared and compared with the catalysts Pd–gum arabic, –gum tragacanth, –C, and –$BaSO_4$. (I) and (IV) were studied in H_2O and aq. EtOH whilst (II) and (III) were studied in AcOH, C_6H_6, and $COMe_2$ alone and in admixture. (I), (II), (III), and (IV) were equally efficient in acid, neutral, and alkaline media, and with the exception of Pd–$BaSO_4$ were superior to the other catalysts studied. The efficiency of (I) increased with increasing degree of polymerisation of polyvinyl alcohol, (V). Comparison of Au nos. shows that whilst the Au no. of (V) is < of gum arabic. (V) is more efficient than gum arabic as a supporter. (I) was efficient for the reaction $CO + H_2O \rightarrow CO_2 + H_2$ and in the hydrogenation of castor and fish oil yields solid products, the fish oil losing the fishy odour. W. R. A.

Vapour-phase esterification of benzoic acid with ethyl alcohol. Effect of oxides on the catalytic activity of silicon carbide and alundum. A. A. Vernon and B. M. Brown (*Ind. Eng. Chem.*, 1933, **33**, 1289—1291; cf. A., 1940, I, 262).—SiC and alundum are less active than SiO_2 in catalysing esterification of BzOH with EtOH in the vapour phase, but cause less carbonisation. When metallic oxides suspended on these materials as carriers are used as catalysts their activity varies with the carrier used. TiO_2 on Al at 370°, Mn_2O_4 on SiC at 410°, and MgO on SiC at 450° show the greatest activity. The first two give decreasing yields with increasing rate of passage of the vapours through the catalyst, owing to side reactions. Life tests on TiO_2 catalysts, however, indicate that side reactions decrease and the efficiency of the esterification process increases with use. MgO on SiC is the best catalyst at low rates of flow. J. W. S.

Influence of support structure and method of preparation of platinum catalysts. T. Schoon and E. Beger (*Z. physikal. Chem.*, 1941, **A, 189**, 171—182).—The activity of Pt catalyst supported on asbestos, Al_2O_3, C, and SiO_2 gel for the decomp. of H_2O_2, hydrogenation of C_2H_4, and dehydrogenation of C_6H_6 has been investigated,

and ultramicrographs of the catalyst surfaces are reproduced. In general, fine crystal structure favours hydrogenation and conglomerates favour dehydrogenation. C. R. H.

Catalytic poisoning in liquid-phase hydrogenation. Effect of sulphur compounds of various degrees of oxidation.—See B., 1942, II, 45.

Electrodeposition of cadmium on iron.—See B., 1942, I, 151.

Anodic treatment of aluminium in the chromic acid bath.—See B., 1942, I, 160.

Effect of wetting agents on electrodeposition of nickel.—See B., 1942, I, 156.

[Applications of] porous carbon electrodes. III. Reduction of *p*-nitroaniline.—See B., 1942, II, 45.

Effects of a high-voltage discharge on the thermal decomposition of ethane. I. H. Parrill and W. G. Eversole (*Ind. Eng. Chem.*, 1941, **33**, 1316—1317).—The decomp. of C_2H_6 in a 75,000-v. discharge from an induction coil and in a 15,000-v. transformer discharge has been studied at 100—450°. The amount of H_2 and C_2H_4 formed in the transformer discharge reaches a max. at ~300°, and above this temp. the yield of CH_4 increases rapidly with rise of temp. With the coil discharge there is little increase in the % of CH_4 produced with rise of temp. J. W. S.

Mercury-photosensitised reactions of ethylene. D. J. LeRoy and E. W. R. Steacie (*J. Chem. Physics*, 1941, **9**, 829—839).—Reactions of C_2H_4 photosensitised by $^3P_1$ Hg radiation have been investigated. The products are H_2, C_2H_2, C_4H_{10}, butene, and hexenes. The variation of the rate with the pressure of C_2H_4 suggests that the following deactivation process is involved : $C_2H_4 + Hg\ (^3P_1) \rightarrow C_2H_4* + Hg\ (^1S_0)$; $C_2H_4* + C_2H_4 \rightarrow 2C_2H_4$; $C_2H_4* \rightarrow C_2H_2 + H_2$. Polymerisation results from a free radical mechanism and the formation of C_4H_{10} is considered to occur according to $H_2 + Hg\ (^3P_1) \rightarrow 2H + Hg\ (^1S_0)$; $H + C_2H_4 \rightarrow C_2H_5$; $2C_2H_5 \rightarrow C_4H_{10}$. The suggested mechanisms are consistent with the val. found for the quantum yield. W. R. A.

Photochemistry of *iso*butene. I. W. F. Kieffer and J. P. Howe (*J. Amer. Chem. Soc.*, 1942, **64**, 1—7).—When *iso*butene (I) is irradiated with 1900 A., decomp. and polymerisation occur. Near the max. rate the data are summarised by the following quantum yields : H, 0·03 ; CH_4, 0·10 ; hydrocarbon with 2·25 C per mol., 0·16 ; polymeride with 9·05 C per mol., 0·45. All observed processes can be interpreted by free radical mechanisms. At low pressures the excited (I) mol. is split into primary free radicals which recombine on the walls and in the gas phase and react with (I) mols. At higher pressures excited mols. are quenched and the radicals which are formed react with (I) to form other radicals which combine. The reaction is influenced by the nature of the wall. No $CH_2\!:\!CMe$ was found among the products. W. R. A.

Photochemical chlorination and chlorine-activated oxidation of pentachloroethane. H. J. Schumacher and W. Thürauf (*Z. physikal. Chem.*, 1941, **A, 189**, 183—199).—The rate of photochemical chlorination of $C_2HCl_5 \propto [Cl_2]$ and $I^{0\cdot5}$ (I = light quanta absorbed). The reaction is inhibited by O_2 as a result of oxidation of C_2HCl_5. This oxidation increases with increase in $[O_2]$, both $CCl_3\cdot COCl$ and $COCl_2$ being formed in the ratio ~5 : 1. Oxidation decreases with rise of temp. The kinetics of both reactions are discussed. Cl atoms, formed by light absorption, react with C_2HCl_5 to form HCl and C_2Cl_5, the latter, in absence of O_2, being chlorinated to C_2Cl_6. In presence of O_2, C_2Cl_5 forms a peroxide, $C_2Cl_5O_2$, which decomposes either to $2COCl_2 + Cl$ or to $CCl_3\cdot COCl + ClO$. ClO then reacts with an additional mol. of C_2HCl_5 to form $CCl_3\cdot COCl + HCl + Cl$. C. R. H.

Polymerisation of olefines induced by free radicals. C. J. Danby and C. N. Hinshelwood (*Proc. Roy. Soc.*, 1941, **A, 179**, 169—193).—The photolysis of aldehydes at 300° is reduced by C_2H_4, C_3H_6, or *iso*-C_4H_8 and many mols. of the olefine may be polymerised for each quantum of light absorbed by the aldehyde. A similar polymerisation is induced by photolysis of ketones. The reactions were investigated by combining pressure measurements with chemical analysis at each stage, the rates of olefine polymerisation and of aldehyde photolysis being independently determined. It is concluded that large radicals are built up by the successive addition of olefine mols. to the primary radicals from the photolysis of the aldehyde or ketone. When the polymeride radicals contain about three olefine mols. they break down, either (a) regenerating a Me radical which begins a new polymerisation chain or (b) giving inactive products. There is no marked diminution in reactivity of the alkyl radicals as the series is ascended but the polymerisation rate diminishes rapidly in the series C_2H_4, C_3H_6, *iso*-C_4H_8. G. D. P.

Photochemical decomposition of cyclic ketones. S. W. Benson and G. B. Kistiakowsky (*J. Amer. Chem. Soc.*, 1942, **64**, 80—86).—The absorption spectra and v.p. of *cyclo*-butanone (I), -pentanone (II), and -hexanone (III) have been measured. The photochemical decomp. of each has been investigated in a flow system over the temp. range 150—350° and at pressures of from 30—200 mm. and the

products have been analysed. (I) yields $C_3H_6 + CO$ (~40%) and $C_2H_4 + CH_2\!:\!CO$ (~60%) ; (II) *cyclo*butane + CO (38%) and $2C_2H_4 + CO$ (62%) ; (III) C_5H_{10} (75% *cyclo*pentane and 25% Δ^a-pentene) + CO (98%), $C_2H_4 + C_3H_6 + CO$ (2%), *cyclo*hexenyl-*cyclo*hexanone + H_2O (variable), and very small amounts of an unknown polymeride. The photolysis of (III) is much more complex than the simple reaction postulated by Norrish (A., 1938, I, 632). The ratio of the quantities of gaseous products is independent of temp. and pressure. The quantity of condensation products formed by (III) depends on both temp. and pressure. The primary process is the absorption of light involves the splitting of one bond and formation of a polymethylene biradical. Photolysis of (II) is suggested as a convenient means of synthesising *cyclo*butane. W. R. A.

Photo-synthesis in flashing light.—See A., 1942, III, 276.

Reversible photochemical processes in rigid media. Phosphorescent state.—See A., 1942, I, 82.

IX.—METHODS OF PREPARATION.

Chemical processes in which solids participate. II. G. F. Hüttig (*Kolloid-Z.*, 1941, **95**, 258—283 ; cf. A., 1942, I, 160).—Summary and bibliography. F. L. U.

Separation tube. III. Production of 2·5 litres of the pure isotopes ^{22}Ne and ^{20}Ne. G. Dickel and K. Clusius (*Z. physikal. Chem.*, 1940, **B, 48**, 50—62).—Using a 29-m. separation tube 2·5 l. of ^{22}Ne (99·7% ^{22}Ne) was obtained and on the light side ^{20}Ne (99·8%) was formed. At. wts. of both isotopes have been determined by mass spectral methods and from ρ measurements. 2 l. of Ne in which the rare isotope ^{21}Ne was enriched from 0·27% to 2·5% were obtained. W. R. A.

Oxychlorides of silicon and corresponding ethyl esters. W. C. Schumb and D. F. Holloway (*J. Amer. Chem. Soc.*, 1941, **63**, 2753—2755).—By the action of Cl_2 and O_2 (by vol. 2 : 1) on cryst. Si at dull red heat $(SiOCl_2)_4$ and the homologues $Si_nO_{n-1}Cl_{2n+2}$ ($n = 2$—7) have been prepared. The homologues are colourless, oily liquids, which hydrolyse in presence of moisture, increase in viscosity as n increases, mix with CCl_4, $CHCl_3$, CS_2, and $SiCl_4$, and yield esters ($n = 2, 3, 4, 6$) with EtOH. The esters are colourless, oily liquids, miscible with CCl_4, CS_2, and EtOH, practically incombustile in air, and are not hydrolysed even after prolonged contact with H_2O at 100°. The esters can be prepared from oxybromides by NaOEt but not from oxybromides by EtOH. The following (b.p. in parentheses) are described : $Si_2O_2Cl_6$ (76°/15 mm.), $Si_4O_3Cl_{10}$ (109—110°/15 mm.), $Si_5O_4Cl_{12}$ (130—131°/15 mm.), $Si_6O_5Cl_{14}$ (139—141°/15 mm.), $Si_7O_6Cl_{16}$ (145—147°/15 mm.), $Si_3O_2(OEt)_8$ (268—273°), $Si_4O_3(OEt)_{10}$ (290—295°), $Si_6O_5(OEt)_{14}$ (300—310°). W. R. A.

Preparation and allotropic transformation of lead monoxide. M. Petersen (*J. Amer. Chem. Soc.*, 1941, **63**, 2617—2620).—Yellow, orthorhombic PbO is obtained on dehydration of PbO_3xH_2O in a vac. at ~120° or on decomp. of PbO_3 in a vac. at ~250°. In both instances the yield is dependent on the state of the original compound and is greatest when the original compound is of small particle size. With coarse particles red, tetragonal PbO is obtained. The boundary between red and yellow stability is $489 \pm 1°$. From X-ray powder patterns the lattice dimensions of yellow PbO are : a 5·476, b 4·744, c 5·885 A. W. R. A.

Reactions of chromates at high temperatures. XIII. Decomposition of mixtures of calcium chromate with magnesium oxide. XIV. Decomposition of mixtures of strontium chromate with magnesium oxide. XV. Decomposition of mixtures of calcium chromate with calcium oxide and with calcium carbonate. XVI. Decomposition of mixtures of strontium chromate with strontium oxide and with strontium carbonate. XVII. Decomposition of mixtures of calcium chromate with ferric oxide and with chromic oxide. XVIII. Decomposition of mixtures of strontium chromate with calcium oxide and of calcium chromate with strontium oxide. XIX. Synthesis and decomposition of calcium chromate. XX. Synthesis and decomposition of strontium chromate. D. S. Datar (*J. Indian Inst. Sci.*, 1941, **23, A**, 237—250, 251—257, 258—268, 269—273, 274—282, 283—290, 291—309, 310—316; cf. A., 1940, I, 36 and previous abstracts).—XIII. A mixture of $CaCrO_4$ (1 mol.) with MgO (0·5 mol.) decomposes above 825° giving $2CaO,MgO,2CrO_3$, and then in successive stages $8CaO,4MgO,Cr_2O_3,6CrO_3$, $6CaO,3MgO,Cr_2O_3,4CrO_3$, $10CaO,5MgO,2Cr_2O_3,6CrO_3$, and $4CaO,2MgO,Cr_2O_3,2CrO_3$, at 25, 33·3, 40, and 50% decomp., respectively. The initial product is very stable and has no measurable O_2 pressure at the decomp. temp. of the corresponding basic chromate with Na_2O in place of MgO. Mixtures with a higher or lower proportion of MgO give the same products up to 50% decomp. Heats of decomp. corresponding with the several stages are calc. from the decomp. pressures.

XIV. Similar details are given for $2SrCrO_4 + MgO$ mixtures, which give analogous products at the corresponding stages.

XV. $CaCrO_4$ combines with CaO to form both $3CaO,CrO_3$ and $2CaO,CrO_3$; with $CaCO_3$ the former is the main product, but the latter is also formed to some extent.

XVI. Similar results are obtained with $SrCrO_4$ and SrO or $SrCO_2$. $2SrO,CrO_3$ decomposes completely without forming intermediate compounds. With both the Ca and Sr compounds $3MO,2CrO_3$ gives on decomp. $12MO,Cr_2O_3,6CrO_3$, $9MO,Cr_2O_3,4CrO_3$, and $15MO,2Cr_2O_3,6CrO_3$ in successive stages.

XVII. Addition of Fe_2O_3 accelerates the decomp. of $CaCrO_4$. The basic chromate formed, CaO,Fe_2O_3,CrO_3, decomposes to give $2CaO,2Fe_2O_3,Cr_2O_3$, which is the final product, without intermediate stages. Mixtures of $CaCrO_4$ with Cr_2O_3 behave similarly.

XVIII. Mixtures of $CaCrO_4$ with SrO and of $SrCrO_4$ with CaO both yield CaO,SrO,CrO_3, but whereas the second mixture gives rise to mixed basic Cr chromates of Ca and Sr, the first does not, although it can do so if $SrCO_3$ is substituted for SrO. Thermochemical data are recorded.

XIX. The oxidation of mixtures of Cr_2O_3 (1 mol.) with CaO (1, 2, 3, and 4 mols.) has been followed by measuring the O_2 absorbed and the equilibrium O_2 pressures produced at various stages. The reactions are $Cr_2O_3 + 3CaO \rightarrow 3CaO,Cr_2O_3 \rightarrow 6CaO,Cr_2O_3,2CrO_3 \rightarrow 15CaO,2Cr_2O_3,6CrO_3 \rightarrow 9CaO,Cr_2O_3,4CrO_3 \rightarrow 12CaO,Cr_2O_3,6CrO_3 \rightarrow 12CaO,8CrO_3 \rightarrow CaCrO_4$ with CaO and $2CaO,CrO_3$ if CaO was in excess, or CaO,Cr_2O_3,CrO_3 if Cr_2O_3 was in excess. The intermediate compounds, identified by their decomp. pressures, are thus identical with those occurring during the decomp. of $CaCrO_4$; variation in the proportion of CaO affects only the final product. Addition of MgO has no effect on the oxidation of Cr_2O_3 in presence of CaO. Tables of decomp. pressures and thermal effects are given. The basic chromate formed in the thermal decomp. of $CaCrO_4$ is due to a side reaction, the main reaction, $2CaCrO_4 \rightarrow 2CaO,Cr_2O_3 + 1.5O_2$, being irreversible.

XX. Oxidation of Cr_2O_3 (1 mol.) with $SrCO_3$ (3 mols.) proceeds through a series of basic Cr chromates to the final product which contains $2SrO,CrO_3$ and $3SrO,2CrO_3$. In the decomp. of $SrCrO_4$, in addition to $2SrO,Cr_2O_3$, which is formed irreversibly at 1030°, the existence of three other basic chromites is indicated. In contrast to the behaviour of $CaCrO_4$, addition of Cr_2O_3 suppresses the decomp. of $SrCrO_4$ by producing SrO,Cr_2O_3,CrO_3, which forms a stable solid solution with $3SrO,2CrO_3$. F. L. U.

Products obtained by the reducing action of metals on salts in liquid ammonia solution. VI. Reduction of nickel salts. W. M. Burgess and J. W. Eastes (*J. Amer. Chem. Soc.*, 1941, 63, 2674—2676).—When $NiCl_2$, $NiBr_2$, NiI_2, $Ni(CNS)_2$, $Ni(OAc)_2$, and $Ni(CN)_2$ are reduced by Na, K, or Ca in liquid NH_3 free Ni, in a finely-divided state, is first formed and is a very active catalyst for the reaction between Na, K, or Ca and NH_3. The Ni is pyrophoric owing to adsorbed H_2. The catalytic activity is greatest when the Ni is prepared using Ca. Small amounts of Ni amide are formed in presence of excess of Ni salt. W. R. A.

Preparation and properties of phthiocol inner complexes.—See A., 1942, II, 146.

X.—ANALYSIS.

Polarographic analysis. A. C. Coates and R. Smart (*Chem. and Ind.*, 1941, 778—784).—A review. The methods of polarographic analysis and the recording and interpretation of the polarograms are described, with particular reference to metallurgical analysis.
J. W. S.

Naming spectroscopic analytical methods. M. G. Mellon (*J. Opt. Soc. Amer.*, 1941, 31, 648—650). O. D. S.

Luminol as reagent for hydrogen peroxide, copper, iron, and cyanide. A. Steigmann (*J.S.C.I.*, 1942, 61, 36).—The glowing of solutions of luminol (o-aminophthalhydrazide) containing $Na_2S_2O_8$, which is caused by traces of H_2O_2, is a very sensitive reagent for H_2O_2 at great dilutions. This reaction may be used to detect traces of Cu, Fe··, CN′, and Cu and Fe inhibitors in gelatins etc.

Determination of small quantities of fluoride in water. Modified zirconium–alizarin method. W. L. Lamar and C. G. Seegmiller (*Ind. Eng. Chem.* [*Anal.*], 1941, 13, 901—902).—Dil. H_2SO_4 is added to the H_2O, and thereby decreases interference due to SO_4'' to an extent such that waters containing <500 p.p.m. of SO_4'' may be analysed for F′ without recourse to a correction curve. Alkalinity in the H_2O is neutralised by means of HNO_3. The Zr′′′′–alizarin indicator appears to be more stable in dil. H_2SO_4 than in HCl or in a mixture of dil. HCl and H_2SO_4. When a 100-ml. sample is used, the F′ content of waters containing <500 p.p.m. of SO_4'', 500 of HCO_3', and 10^3 of Cl′ can be determined to within ± 0.1 p.p.m. L. S. T.

Quantitative analysis of mixtures of thiosulphate and sulphite. K. G. A. Pankhurst (*Chem. and Ind.*, 1942, 74—75).—In the iodometric determination of $Na_2S_2O_3$ and Na_2SO_3, aq. $BaCl_2$ can be used to remove SO_3'' if the p_H of the solution is adjusted first to ~8·6 by means of $NaHCO_3$. L. S. T.

Rapid determination of hydrogen sulphide and mercaptan-sulphur in gases and aqueous solutions.—See B., 1942, I, 121.

Determination of pyritic sulphur in coal.—See B., 1942, I, 118.

Spectrographic analysis of iron for tellurium. R. E. Nusbaum and J. W. Hackett (*J. Opt. Soc. Amer.*, 1941, 31, 620—626).—The determination of 0·001—0·01% Te in Fe is described. O. D. S.

Determination of silicon in aluminium and its alloys.—See B., 1942, I, 159.

Determination of small quantities of sodium in aluminium metal.—See B., 1942, I, 159.

Controlling factors in the assay of silver by cupellation.—See B., 1942, I, 158.

Spectrographic studies of co-precipitation. Fourth-period elements with barium sulphate, and copper and zinc with lead sulphate. L. Waldbauer, F. W. Rolf, and H. A. Frediani (*Ind. Eng. Chem.* [*Anal.*], 1941, 13, 888—889).—Data showing the co-pptn. of Fe··, Mn··, and Cr··· with $BaSO_4$, pptd. by addition of SO_4'' to acidified aq. $BaCl_2$ + foreign ion, are recorded. The wts. of ppts. are < the theoretical, indicating that some phenomenon other than adsorption takes place. Co·· and Ni·· do not co-ppt. with $BaSO_4$ under the conditions described. Cu·· and Zn·· are co-pptd. with $PbSO_4$ obtained by adding SO_4'' to a dil. HNO_3 solution of $Pb(NO_3)_2$ + foreign ion. The data for Zn indicate the possibility of mixed crystal formation, whilst those for Cu indicate adsorption, occlusion, or post-pptn. L. S. T.

Quantitative spectrographic analysis of magnesium alloys.—See B., 1942, I, 159.

Gravimetric, colorimetric, and spectral analytical processes for the determination of small amounts of cadmium, copper, iron, and lead in zinc. W. Müller and A. Sieverts (*Spectrochim. Acta*, 1940, 1, 332—351).—A gravimetric method of determining small amounts of Cd, Cu, Fe, and Pb in Zn described involves successive separation of Fe as $Fe(OH)_3$ (determined with 8-hydroxyquinoline), Pb as $PbCrO_4$ (determined with thionalide), Cu with thionalide, and Cd by internal electrolysis, using Zn foil and Pt gauze (determination with β-naphthoquinoline and KI). Colorimetric methods for determining Fe with sulphosalicylic acid and Cu, Cd, and Pb with dithizone are detailed. Spectroscopic determinations are best made by comparison of the intensities of the Cd 2265, Cu 3247·5, Pb 2203·5, and Fe 2382 A. lines with the Zn 2064·2 or 2102·88, 3282·3, 2102·88, and 2502 A. lines, respectively. Sensitised plates are required for the determination of Cd and Pb. The results of determinations by the three methods are in satisfactory accord. J. W. S.

Rapid determination of copper in its alloys.—See B., 1942, I, 156.

Titrimetric determination of copper in mineral oils.—See B., 1942, I, 125.

Photometric determination of minute amounts of mercury. A. E. Ballard and C. D. W. Thornton (*Ind. Eng. Chem.* [*Anal.*], 1941, 13, 893—897).—Hg·· is recovered completely by passing the solution through an asbestos pad impregnated with CdS and supported on a sintered-glass disc. The dried pad containing HgS is heated in a closed system in a quartz-ended cell, and the absorption of 2537 A. measured photometrically to determine the amount of Hg present. Details of apparatus and performance are given. $0.02—0.60 \pm 0.02$ µg. of Hg·· in 150—400 c.c. of solution can be determined. Hg·· is adsorbed by glass from dil. solution. L. S. T.

Molecular spectra and fractionation of rare earths. G. Piccardi (*Spectrochim. Acta*, 1939, 1, 249—269).—A visual spectro-chemical method has been applied to the determination of rare earths. The oxides are excited in a gas flame and from the intensities of the emitted bands Sc, Y, La, Gd, Sm, and Eu can be detected and determined. During the separation of a mixture of rare-earth bromates the analytical method revealed two new band spectra, one of which was probably due to DyO. C. R. H.

Spectrochemical determination of scandium in silicate rocks. A. Kvalheim and L. W. Strock (*Spectrochim. Acta*, 1939, 1, 221—226).—The method used is a combination, by a simple procedure, of the sensitive cathode layer method and a photometric determination of photographic spectral line densities. The Sc lines 4246·83, 4320·73, and 4314·09 A., especially the first, are well suited as analysis lines. 1% of La_2O_3 is added to the standard mixture and samples so as to act as an internal intensity standard, the La line 4263·59 A. being compared with the first Sc line and the La line 4322·51 A. with the second and third Sc lines. The construction of a calibration curve is described. The Sc content of five pyroxenites and one kimberlite has been determined. C. R. H.

Spectro-analytical determination of elements in flame and spark by direct photo-electric measurement of line intensities. G. Thanheiser and J. Heyes (*Spectrochim. Acta*, 1939, 1, 270—288).—The relative advantages of flame and spark technique are discussed. An apparatus in which the light emanating from a spark is separated into two parts by a system of prisms is described. Both parts are examined by a monochromator, the intensities being measured by two photo-cells which operate two electrometers. The ratio of the charges on the electrometers at any given time ∝ the ratio of line intensities. Given the line intensity for known concns. of element, the element concn. in other cases can be calc. Results for Al containing Mn and Mg illustrate the application of the method, the accuracy of which is ~1·5%. C. R. H.

Potentiometric determination of nickel and copper in steel.—See B., 1942, I, 154.

Determination of molybdenum in alloy steels.—See B., 1942, I, 154.

Determination of tin in cast iron and plain steel.—See B., 1942, I, 150.

Determination of small amounts of antimony with rhodamine B. W. G. Fredrick (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 922—924).—The Sb dissolved in 25% H_2SO_4 is oxidised to Sb^V by means of $Ce(SO_4)_2$ in presence of Cl′ (from LiCl) and the red complex obtained with rhodamine B (**I**) is extracted with EtOH after destruction of excess of reagent by means of aq. Br. The determination is then made colorimetrically. Most acids radicals, except Cl′ and SO_4″, interfere. Metals of the dithizone (**II**) group, *e.g.*, Hg, Cu, Ni, Cd, and Zn must first be extracted with (**II**) at p_H 8·5. As and Fe also interfere. The method detects 0·1 μg. of Sb^V in 5 ml. of solution. Procedure for determining 0·1—300 μg. of Sb, and precautions to be observed in using the method, are described. The reaction of (**I**) and Sb oxidised with $NaNO_2$ in the solution could not be developed quantitatively. The 25% H_2SO_4 is preferable to 50% HCl for the colorimetric determination. The colour produced by dissolution of the Sb–(**I**) complex in EtOH follows Beer's law. Data showing the accuracy of the method are recorded.   L. S. T.

Separation of bismuth from lead with ammonium formate. S. Kallmann (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 897—900).—Benkert and Smith's basic formate method (A., 1897, ii, 435) has been investigated critically. It does not give a clear-cut separation of Bi from Pb, especially when large amounts of Pb are involved and only two formate separations are employed. A modification of the method in which close attention is paid to conditions of neutralisation, and NH_4 replace Na salts, in which basic Bi formate (**I**) is slightly sol., is described. The modified method is satisfactory even when small amounts of Bi are separated from 10—50 g. of Pb. The (**I**) obtained can be ignited to Bi_2O_3, or dissolved in HCl and the Bi pptd. as BiOCl, or dissolved in dil. H_2SO_4 and the Bi ($\div 0·7$ mg.) determined colorimetrically by means of KI. Pb is pptd. as chromate in the filtrate from (**I**). Data concerning the separations to be obtained by these methods, and the solubility of (**I**) and basic Bi carbonate in the filtrates from their respective pptns., are recorded.   L. S. T.

Photometric determination of niobium and tantalum in steel etc. —See B., 1942, I, 154.

XI.—APPARATUS ETC.

Modified heat-conduction calorimeter. W. T. Ziegler and C. E. Messer (*J. Amer. Chem. Soc.*, 1941, **63**, 2694—2700).—Constructional and operational details are given of a heat-conduction calorimeter suitable for studying the thermal properties of substances which undergo λ-type transition. KCl was used as a standard substance. Vals. of C_p from 107° to 321° κ. are given for $KClO_3$, NH_4Cl, and $(NH_4)_2SO_4$. The transition temp. for NH_4Cl is $-30·6\pm0·15°$ and for $(NH_4)_2SO_4$ $-49·9\pm0·15°$. The entropy of NH_4Cl at 298° κ. is $22·6\pm0·3$ g.-cal. per degree per mol.   W. R. A.

Two bridge-controlled thyratron thermostats. D. Bancroft (*Rev. Sci. Instr.*, 1942, **13**, 24—27).—Two circuits for the regulation of temp. by means of a bridge-controlled thyratron are described. One utilises a resistance thermometer, whilst the other controls through changes in the resistance of the furnace winding. Extreme overload in control voltage does not cause erratic behaviour.   A. A. E.

Response of sputtered thermocouples to interrupted radiation. L. Harris and A. C. Scholp (*J. Opt. Soc. Amer.*, 1940, **30**, 519—522).—The response of thin sputtered thermocouples to interrupted radiation of frequencies down to 0·75 cycle per sec. has been investigated for Bi-Sb and Bi-Te couples. The attenuation factors for different frequencies are evaluated from the voltages generated by the couples. Experimental results agree satisfactorily with theory for Bi-Sb couples, but not for Bi-Te couples, which are anomalous. Thin sputtered thermocouples when used with low-frequency amplification are more sensitive than wire thermocouples used with the most sensitive galvanometer but without mutipliers. A. J. M.

Increasing the depth of focus in photomicrography by incident light. W. Koch (*J. Roy. Microscop. Soc.*, 1941, **61**, 86—87).—Depth of focus can be increased by inserting a stop immediately above the coverslip.   E. E. H.

Automatic time-switch apparatus for spectral photographs. G. Balz and G. Reiniger (*Spectrochim. Acta*, 1940, **1**, 323—331).—The advantages of automatic control of the time the spark is allowed to pass before its spectrum is photographed and of the exposure time are discussed. An electrically operated time switch arrangement for this purpose is described.   J. W. S.

Simple device for increasing photographic plate capacity for

spectra in the technical analysis of alloys. G. Balz (*Spectrochim. Acta*, 1939, **1**, 227—228).—Half of the photographic plate is shielded so that the unused portion of the spectrum is not photographed. The plate is then reversed and the unused portion used for a subsequent analysis.   C. R. H.

Photography by luminescent screens in the extreme ultra-violet. T. Suga and M. Kamiyama (*J. Opt. Soc. Amer.*, 1941, **31**, 592—593).—An ordinary fast emulsion placed in contact with a film of $CaWO_4$, $MgWO_4$, Zn or Cd silicate, or Cd borate gives satisfactory spectrograms of the He continuum and emission lines at ~230—1000 A. The spectrograms are less sharp than those obtained with Schumann plates, and longer exposures are required. The method may be suitable for photometric measurements in the extreme ultra-violet.   A. J. E. W.

Determining chromatic aberration for photomicrographic purposes. W. Koch (*J. Opt. Soc. Amer.*, 1940, **30**, 564—565).—The simple method described enables the difference of focus of a lens for different λλ to be determined by a single test exposure. The method is based on the photographing of a stage micrometer in an oblique position in the light of different λλ and reading the difference of focus from the division marks of the micrometer. The process is best carried out with a microscope with a mechanical stage.   A. J. M.

Spectrographic analysis. Photographic aspects of the internal standard method. I. A. C. Coates and E. H. Amstein (*J.S.C.I.*, 1942, **61**, 21—29).—The method is considered in which plate calibration is carried out using metallic pencils of known composition, and the calibration curve is a log plot of concn. against the opacity ratio of the standard to the impurity line. The general equation for this calibratiou curve is derived, and from it the following are deduced : (1) the quant. effect of a difference in λ between standard and impurity lines; (2) the slope of the calibration curve; (3) the significance of the useful exposure range, and (4) the reasons for plate calibration. The photographic consts. are determined, using as a const. source a hot Hg arc, and varying the exposures. In this connexion the effect of reciprocity failure is discussed. Some practical analyses are considered in the light of the above theoretical results, using the determined photographic consts. Two processes for duralumin are compared, and as a further example the estimation of Cu and Sb in an alloy is considered.

Loss of light in spectrographs with very narrow slits. G. Milazzo and G. B. Tommasi (*Spectrochim. Acta*, 1939, **1**, 229—238).—The drop in intensity of spectral lines as the width of the slit is reduced is discussed theoretically. Loss of light may be due, among other things, to diffraction effects at the slit, optical image distortion, and the effect of emulsion graininess in the photographic plate. The effect of diffraction can be calc. from Fresnel's formulæ; the other effects must be determined experimentally. The plot of light loss against slit width has the same form irrespective of the cause of the loss.   C. R. H.

Projection comparator for spectro-chemical analysis. A. Gatterer (*Spectrochim. Acta*, 1940, **1**, 352—373).—Details are given of an improved and more convenient form of the comparator previously described (*Z. Instrumk.*, 1938, **58**, 271). The new apparatus enables enlargements of spectral photographs, taken on different plates, to be cast side by side on a screen, photographed together, or compared by means of a photo-cell.   J. W. S.

Tempering effect in spectral analysis. H. Mäder and R. Poetzelberger (*Spectrochim. Acta*, 1939, **1**, 213—220).—Several causes, *e.g.*, melting and oxidation phenomena at the metal surface, and internal state of the alloy, contribute to the delay observed in the line intensities becoming const. This is particularly noticeable in Al–Mg alloys. The behaviour on spark heating of alloys containing constituents of widely differing m.p. is discussed. The more volatile constituent of the alloy is removed rapidly, thus enriching the residual metal in the less volatile constituent.   C. R. H.

Method of spectrophotometry for solutions in liquified gases.—See A., 1942, I, 82.

Evaluation of X-ray back-reflexion pictures. H. Neerfeld (*Mitt. Kaiser-Wilh.-Inst. Eisenforsch.*, 1940, **22**, 213—216; *Bull. Iron Steel Inst.*, 1941, No. 71, 38A).—Methods of evaluation are reviewed and modifications which simplify the procedure proposed. A suggested procedure for rapidly determining the lattice const. is to project the X-ray film on to a suitable nomogram. A more accurate method is measurement of the distance between the lines with a glass rule or a comparator in the usual way and the use of a nomogram, or a special slide rule, to simplify the calculation of the lattice const.   R. B. C.

Prism and sector photo-electric photometers for determination of concentrations in gaseous or liquid systems. L. Harris, J. A. Kyger, and C. N. Sjogren (*J. Opt. Soc. Amer.*, 1941, **31**, 263—267).—Two photometers for the accurate determination of concns. from transmission measurements are described. The original monochromatic light from an at. spectral source is divided into two beams, one of which is incident on one photo-tube. The other beam passes

through the photometer and the absorption cell, and then reaches the second photo-tube. The photometer is adjusted until the two photo-tube currents are equal. A. J. M.

Microphotometer. H. B. Vincent and R. A. Sawyer (*J. Opt. Soc. Amer.*, 1941, **31**, 639—643).—A photometer suitable for routine measurement is described in detail. O. D. S.

Optical properties of the grating interferometer. J. H. Schroeder and B. P. Ramsay (*J. Opt. Soc. Amer.*, 1940, **30**, 355—361).—A grating interferometer, made by substituting gratings for mirrors in the arms of a Michelson interferometer, may be useful for the study of fine structure. The order of interference, resolving power, magnifying power, and dispersion of the arrangement are discussed. A. J. M.

Fabry–Perot interferometers in a parallel arrangement. L. Sturkey (*J. Opt. Soc. Amer.*, 1940, **30**, 351—354).—The intensity equation of an arrangement consisting of two Fabry–Perot interferometers in parallel is obtained and discussed. The arrangement may be applied to spectroscopic work. A. J. M.

Use of the interferometer in analysis of mine gases.—See B., 1942, I, 121.

Reflectometers.—See B., 1942, I, 109.

Low-reflexion evaporated fluoride coatings. G. S. Monk (*J. Opt. Soc. Amer.*, 1940, **30**, 571—572).—Low-reflecting films of fluorides on glass are in the liquid phase when first deposited, but become solid within 24 hr. When lenses are coated with low-reflecting fluoride films there is a considerable improvement in the transmission as a function of λ. A. J. M.

Field emission X-ray tube. C. M. Slack and L. F. Ehrke (*J. Appl. Physics*, 1941, **12**, 165—168).—Currents of several thousand amp. can be obtained in highly evacuated tubes by the application of high field gradients to cold metallic electrodes. This principle has been applied in the construction of a condenser discharge X-ray tube for taking radiographs of rapidly moving objects. A third electrode is placed close to the cathode and connected to the anode through a high resistance. This initiates the discharge, which is then forced, by the voltage drop across the high resistance, to transfer to the anode. If correctly shaped, the auxiliary electrode may be used to focus the electrons on the desired region of the anode. A. J. M.

Application of the microscope in forensic science.—See A., 1942, III, 279.

300-kilovolt magnetic electron microscope. V. K. Zworykin, J. Hillier, and A. W. Vance (*J. Appl. Physics*, 1941, **12**, 738—742).—A modified form of the R.C.A. commercial electron microscope is briefly described. Typical photomicrograms of blood smears, *B. megatherium*, and a cut section (1—2 μ. thick) of cockroach skin are reproduced; the last-named clearly shows internal structure. The high accelerating potential results in high penetrating power, but renders the adjustment of the apparatus very crit.; Pb screens are required to eliminate stray X-rays produced by the electron beam. A. J. E. W.

Determination of object thickness in electron microscopy. L. Marton and L. I. Schiff (*J. Appl. Physics*, 1941, **12**, 759—765).—Theory is given for a method of determining the thickness from the reduction of electron beam intensity caused by the object. With thin objects this reduction is calc. from the total cross-section for single scattering of electrons outside the aperture of the microscope objective; the cross-section for electrons of energy $\not< 10$ kv. is determined by the Born approximation. The effects of multiple scattering and of free-electron scattering in metals are discussed. Typical applications to the determination of the thickness of grains in Sb films, Na laurate curd fibres, and gelatin or collodion "casts" of metallographic specimens, are described. A. J. E. W.

Current–potential curves in ionised gas flames. T. Heumann (*Spectrochim. Acta*, 1940, **1**, 293—318).—The influence of the length, thickness, temp. and nature of the probe electrode on the variation of the current with the p.d. applied between the burner and a probe electrode has been investigated for a Bunsen flame. The form of the curve depends only on the cathode and its characteristic is attributed to the cool film on the probe electrode in which recombination of ions and combination of electrons with mols. occurs, thereby increasing the electron velocity. When two probe electrodes are introduced into the flame there is a potential fall at each electrode and no potential gradient in the main body of the flame. A Bunsen flame at 2000° K. contains 10^7—10^8 charged particles per c.c. J. W. S.

Electrode polarisation. IV. Automatic control of potential of a working electrode. A. Hickling (*Trans. Faraday Soc.*, 1942, **38**, 27—33; cf. A., 1941, I, 470).—An electrical device is described whereby the potential of a working electrode, relative to that of a reference electrode, can be maintained automatically at any desired val. If no electrode process is possible at this val. no current will pass through the cell; if some electrolytic process is possible the limiting current for that process will pass. Applications of the method are described. F. L. U.

Measurement of dielectric constants by the comparison method. Dielectric constant of carbon tetrachloride from 15° to 40°. J. G. Miller (*J. Amer. Chem. Soc.*, 1942, **64**, 117—121).—A scheme of capacity measurements at varying frequencies has been applied to the comparison method of determining dielectric const. (ϵ). Vals. of ϵ for CCl_4 at six temp. between 15° and 40° are given. W. R. A.

Method of minimising supercooling and its application in the determination of freezing points from dielectric constant measurements. T. M. Shaw (*Rev. Sci. Instr.*, 1942, **13**, 2—5).—In the study of the freezing and thawing of H_2O in soils and other colloidal materials by determination of ϵ at temp. $>$ and $<$ the f.p. supercooling prevents precision. The condenser described includes in the outer electrode a device which permits the cooling of a very restricted portion of the soil. With the procedure described, supercooling is negligible. A. A. E.

Hydrogen arc of high intensity for continuous ultra-violet radiation. A. J. Allen (*J. Opt. Soc. Amer.*, 1941, **31**, 268—270).—The construction of the apparatus is described. A. J. M.

Ion beam focussing. W. W. Buechner, E. S. Lamar, and R. J. Van de Graaff (*J. Appl. Physics*, 1941, **12**, 141—148).—The initial focussing of ions from capillary sources of the diffusion type is considered. The first lens of the focussing system was formed by a cylindrical electrode coaxial with a 90° cone, from the apex of which the ions drifted out from the source. This was followed by two other coaxial cylinders at various potentials up to 25 kv. An electric scanning method was used to examine the beams. They were also studied by a photographic method as they were made slightly luminous by traces of gas in the high-vac. region. A focussing and canal arrangement suitable for differential pumping is described, and incorporated in an ion gun assembly. A. J. M.

Photo-electric measurement of scale marks and spectrum lines. G. R. Harrison and J. P. Molnar (*J. Opt. Soc. Amer.*, 1940, **30**, 343—347).—A new type of all-electric balancing network for photometric work is described. With it a single photo-cell or electron multiplier can be used to locate accurately and rapidly the centre of a spectrum line or scale mark. The positions of 4000 lines can be recorded in <2 min. A. J. M.

Optimum liquid combinations for cloud chambers. C. Beck (*Rev. Sci. Instr.*, 1941, **12**, 602—606).—A mixture of Pr^aOH 50, $COMe_2$ 25, and H_2O 25 vol.-% has a satisfactory expansion ratio and gives excellent tracks with low background fog. Photochemical fog is caused chiefly by light of $\lambda < 3900$ A. Irradiation of pure alcohols gives no perceptible fog, but that of the above mixture produces dense fog. However, if illumination is of short duration photolytic action is small and the decay of photo-chemical nuclei is sufficiently rapid. A. A. E.

Theory of the cyclotron. R. R. Wilson (*J. Appl. Physics*, 1940, **11**, 781—796).—The formation of the initial ions in the cyclotron and the various processes leading to the loss of ions from resonance are discussed in detail. Theoretical predictions are compared with experimental data for the Berkeley 37- and 60-in. cyclotrons. It is suggested that the best form of magnetic field for the cyclotron is that in which the field decreases from the centre with const. dH/dr. Methods of obtaining such a field are described. O. D. S.

Developments in ion accelerating tubes. J. H. Manley, L. J. Haworth, and E. A. Luebke (*Rev. Sci. Instr.*, 1941, **12**, 587—590). —A stable artificial neutron source which is suitable for the production of neutron bursts of variable frequency and length is described. By the use of the D–D reaction, target currents of >200 μa. at 300 kv. give a neutron yield of 10 g. Ra–Be equiv. A. A. E.

Absolute sensitivity of Geiger counters. J. D. Craggs (*Nature*, 1941, **148**, 661).—Preliminary experiments with single β- and γ-ray counters for determining the abs. yields of some nuclear disintegration processes are described, and possible errors discussed. L. S. T.

Comparison between a Geiger–Müller counter, a secondary electron multiplier tube, and a photographic film for detecting weak X-rays. A. Eisenstein and N. S. Gingrich (*Rev. Sci. Instr.*, 1941, **12**, 582—586).—The tube has a lower resolving time than the counter, but the sensitivity of the latter is 5—10 times that of the former. The tube sensitivity increases with λ more rapidly than the counter sensitivity. A diffraction pattern of a liquid can be obtained with a counter in $\frac{1}{20}$ of the time required for a photographic exposure. A. A. E.

Circuit for self-recording Geiger–Müller counters. L. Jánossy and P. Ingleby (*J. Sci. Instr.*, 1942, **19**, 30—31).—A circuit suitable for recording which of a set of Geiger–Müller counters are discharged simultaneously with the coincidences of a set of master counters is described and figured. The resolving time of the circuit is $\sim 10^{-4}$ sec., and its efficiency to record counter discharges is $\not< 99\%$. A. A. E.

Apparatus for the direct determination of slow neutron velocity distributions. L. J. Haworth, J. H. Manley, and E. A. Luebke (*Rev. Sci. Instr.*, 1941, **12**, 591—597).—By means of the apparatus

described, with a detailed circuit diagram, a modulated source of slow neutrons can be produced and their intensity determined as a function of time. Deflexion of the deuteron beam of a high-voltage tube affords square bursts of neutrons of any desired length. After being slowed by paraffin a beam falls on a detector, pulses from which are impressed on an oscilloscope screen together with a time scale.   A. A. E.

Apparatus for analysis of 1 ml. of respiratory gas.—See A., 1942, III, 297.

Rotating bubble method for the determination of surface and interfacial tensions. B. Vonnegut (*Rev. Sci. Instr.*, 1942, **13**, 6—9). —The two phases in a closed container are rotated at a known speed about a horizontal axis. The lighter phase takes the equilibrium shape of an elongated bubble along the axis of rotation. If the length of the bubble is large in comparison with its radius, γ can be computed from the radius, the densities of the phases, and the angular velocity. A preliminary approx. determination of γ for liquid Wood's metal at the m.p. gave the val. 250 dynes per cm.   A. A. E.

Explorations toward the limit of utilisable pressures. P. W. Bridgman [with A. B. Greninger and L. A. Carapella] (*J. Appl. Physics*, 1941, **12**, 461—469).—Experiments are described in which Carboloy bosses, immersed in *iso*-C_5H_{12} at a hydrostatic pressure of 26,000 kg. per sq. cm., were subjected to additional compressive stresses $\geqslant$ 360,000 kg. per sq. cm. Although Carboloy is normally brittle, appreciable plastic flow occurs at such pressures. Total pressures (p kg. per sq. cm.) of 300,000—400,000 produced no permanent allotropic change, as shown by X-radiograms, in graphite, S, Se, black P, Tl, In, or Sn. The measurement of compressibility at $p = 100,000$—150,000 is discussed, with special reference to the choice of piston material. Carboloy (No. 905) under hydrostatic pressure has a compressive strength ($\sim$125,000 kg. per sq. cm.) > that of steel, quartz, spinel, sapphire, or tourmaline, and approx. equal to that of diamond.   A. J. E. W.

Fine fractionating column constructed entirely of glass and employing multi-chamber tubes. K. Klein, H. Stage, and G. H. Schultze (*Z. physikal. Chem.*, 1941, **A**, **189**, 163—170).—Recent types of fractionating columns are discussed and a new column employing four-chamber tubes having an efficiency equiv. to 10 theoretical plates over a height of 62 cm. is described.   C. R. H.

Filtration aids. J. Carey (*Pharm. J.*, 1942, **148**, 42).—Two simple devices for maintaining a const. level of solution in the filter funnel and also of the H_2O when washing the ppt. are described.   D. F. R.

Use of a McLeod gauge in measuring small volumes. N. B. Keevil, R. F. Errington, and L. T. Newman (*Rev. Sci. Instr.*, 1941, **12**, 609—611).—Precautions necessary for accurate vol. measurements are discussed. Vals. of the capillary depression of Hg, determined as the intercept on the p' axis of the plot of the apparent pressure difference p' against the reciprocal of the length of the gas column, are not const. Hence vals. of He contents of rocks and meteorites, based on the assumption of a const. depression, need review.   A. A. E.

Electrical capacitance diaphragm manometer.—See A., 1942, III, 296.

Two improved pressure-regulation devices. J. H. Thelin (*Ind. Eng. Chem.* [*Anal.*], 1941, **13**, 908—910).—The regulators described and illustrated give sensitive pressure control over the ranges 1—200 and 1—350 mm., respectively. They have been designed for experiments on the v.p. of binary mixtures.   L. S. T.

Preparation of thin potassium foils. J. B. Platt and D. H. Tomboulian (*Rev. Sci. Instr.*, 1941, **12**, 612—613).—Protected K films, $\sim$8 × 10^{-4} cm. thick, were made by evaporating Al on to a cleaned Kodapak surface, then evaporating K on to the Al from an externally heated crucible (using C_6H_6 instead of kerosene for protection), and finally evaporating ceresin wax on to the K. No change was observed for 10 min. after removal from the vac. system. After transfer in $\frac{1}{2}$ hr. to an X-ray spectrometer $\geqslant$1% of the surface had deteriorated; at forevac. pressure the absorbers kept indefinitely without further change.   A. A. E.

Sample carrier for organic liquids. F. O. Green (*Ind. Eng. Chem.* [*Anal.*], 1941, **13**, 911).—The carrier is blown from Pyrex tubing, and has a small opening at one end. It is suitable for liquids of intermediate b.p. Loss by evaporation is eliminated, and the disadvantages of sealed bulbs are avoided.   L. S. T.

Disposal of acid fumes in wet assaying. E. J. Poth and G. A. Elliott (*Ind. Eng. Chem.* [*Anal.*], 1941, **13**, 910).—Fumes are rapidly and completely removed by passing the fume-laden gases over zeolite sand covered with H_2O. Large vols. of gas can be dealt with, and removal of acid fumes is so effective that any type of pump can be used with the exhaust open to the laboratory. Application of the procedure to micro-Kjeldahl digestion is illustrated.   L. S. T.

Chromatography of solutions containing a single solute. H. G. Cassidy and S. E. Wood (*J. Amer. Chem. Soc.*, 1941, **63**, 2628—

2630).—The chromatography of lauric acid on a C column is in satisfactory agreement with Wilson's theory (A., 1940, I, 370).   W. R. A.

New form of chromatogram employing two liquid phases. I. Theory of chromatography. II. Application to micro-determination of higher monoamino-acids in proteins. A. J. P. Martin and R. L. M. Synge (*Biochem. J.*, 1941, **35**, 1358—1368).—I. A theory of chromatography, based on the theoretical plate concept and applicable to substances with linear distribution isotherms, is advanced. Chromatography is thus related to fractional distillation etc.

II. A new chromatogram, depending on partition of solutes between two liquid phases, is described. A SiO_2 gel column is thoroughly mixed with an aq. solution of Me-orange, and the substances for analysis are dissolved in $CHCl_3$ containing 0·5—1·0% of BuOH and poured on to the top. The position of the acids is revealed by the indicator, which turns from yellow through orange to pink. The NH_2-acids occurring in Merino wool hydrolysates are separated into three groups (as their Ac derivatives) from amounts of material corresponding with 30 mg. of protein, and the results agree well with those obtained by other methods.   P. G. M.

XII.—LECTURE EXPERIMENTS AND HISTORICAL.

Chemical processes in which solids participate. I. Historical foundations. G. F. Hüttig (*Kolloid-Z.*, 1941, **94**, 137—147).—A survey.   F. L. U.

XIII.—GEOCHEMISTRY.

Changes taking place in sea-water during storage. H. W. Harvey (*J. Marine Biol. Assoc.*, 1941, **25**, 225—233).—Evidence is obtained that when a glass or SiO_2 capillary tube is dipped into sea-H_2O containing a trace of casein or peptone the org. matter is adsorbed on the tube at the meniscus. This supports the view that the rapid growth of bacteria when sea-H_2O is stored in glass vessels is brought about by concn. of food by adsorption. In the presence of glucose and an NH_4 salt the P consumed by bacteria is regenerated as PO_4''' after their death. Bacteria in sea-H_2O liberate PO_4''' readily from nucleic acid and casein but not from glycerophosphate.
        J. W. S.

Concentrated saline water from the Sturgeon River gold mines. E. L. Bruce (*Trans. Roy. Soc. Canada*, 1941, [iii], **35**, IV, 25—29). —The H_2O appears to have been impounded in the rocks; it is not H_2O that has seeped down from the surface. The salts consist of $CaCl_2$ (81·6%) and NaCl (18·4%) with traces of K·, Mg··, and SO_4''.
        L. S. T.

Piezo quartz. A. W. G. Wilson (*Canad. Chem.*, 1941, **26**, 10—14, 45).—An account of applications, properties, and occurrence in Canada.

Petrographic province of Central Montana. E. S. Larsen (*Bull. Geol. Soc. Amer.*, 1940, **51**, 887—948).—Variation diagrams for the various sub-provinces are reproduced and discussed. Chemical composition of the rocks is outlined. The parent magmas of the various provinces are represented probably by the mafic rocks, and were derived probably from a basaltic magma by the removal of crystals of calcic plagioclase and hypersthene in depth.   L. S. T.

Origin of the hæmatite deposits at Steeprock Lake, Ontario. T. L. Tanton (*Trans. Roy. Soc. Canada*, 1941, [iii], **35**, IV, 131—140).— Glacially-transported boulders show that the hæmatite (I) is an integral part of a jaspilite-(I) deposit with the chemical and mineralogical composition of Fe formation such as characterises all Fe ranges in the Lake Superior region. The Steeprock (I)-bearing deposits appear to have emanated from an igneous source in a manner and by processes common to Fe formation, and to have risen through rock channels as in conduits.   L. S. T.

Rock alterations by hydrothermal solutions in certain Canadian localities. E. L. Bruce (*Trans. Roy. Soc. Canada*, 1941, [iii], **35**, IV, 31—37).—Diagrams showing the alterations in chemical composition of porphyry, syenite, and lamprophyre from Kirkland Lake, Ontario, of granite from Orphan Mine, Sturgeon River area, Ontario, of basic lavas from Hollinger Mine, Porcupine, Ontario, and of basic lava to produce Fe formation, Goudreau, Ontario, are reproduced and discussed. Chemical analyses are recorded.
        L. S. T.

Crystalline morphology of microlite. J. D. H. Donnay (*Trans. Roy. Soc. Canada*, 1941, [iii], **35**, IV, 51—56).—Microlite (I) from Morefield mine, Amelia, Virginia, has morphology Fd^{**}, space-group O_h^7—Fd3m. (I) from Maine has $a_{0calc.}$ 10·3 A. and $a_{0obs.}$ 10·4 A.   L. S. T.

"Lead-ratio" method for determining the age of the Deccan Traps. A. S. Kalapesi, S. K. Chhapgar, and R. N. Sukheswala (*Current Sci.*, 1941, **10**, 526—528).—The amounts of U, Th, and Pb in fresh specimens of igneous rocks from the Deccan Traps have been determined, and the age of the rocks has been calc. by the formula, age = (% Pb)/(% U + 0·36 × % Th) × 7600 × 10^6 years.
        A. J. M.

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