

# BRITISH CHEMICAL AND PHYSIOLOGICAL ABSTRACTS

## A., I.—General, Physical, and Inorganic Chemistry

MARCH, 1941.

### I.—SUB-ATOMICS.

**Relative intensities of  $1S \rightarrow 3P$  and  $1S \rightarrow 1P$  transitions in Mg.** (Miss) P. J. Rubenstein (*Physical Rev.*, 1940, [ii], 58, 1007).—Mathematical. The val. of the parameter suggested by King and Van Vleck (cf. A., 1939, I, 594) to reconcile theoretical with experimental relative intensities is discussed.

N. M. B.

**Satellite lines in atomic spectra and the excitation of electrons from closed shells.** T. Y. Wu (*Physical Rev.*, 1940, [ii], 58, 1114—1115).—A discussion, based on variational wave-mechanical calculations of energy states, of the explanation of groups of weak lines in the spectra of C v and C vi reported by Edlén (cf. A., 1939, I, 439).

N. M. B.

**Broadening, asymmetry, and shift of rubidium resonance lines under different pressures of helium and argon up to 100 atmospheres.** S. Y. Ch'en (*Physical Rev.*, 1940, [ii], 58, 1051—1058; cf. A., 1938, I, 53).—Using an improved pressure-tight absorption tube with MgO windows, the effects on Rb resonance lines of He and A up to 100 atm. and H<sub>2</sub> up to 20 atm. were investigated. Up to relative density 46 the broadening  $\propto$  the concn. of He or A. The slopes of the half-width-relative density curves are 0.735 and 0.594 cm.<sup>-1</sup> per unit relative density of He for  $2P_{3/2}$  and  $2P_{1/2}$  components, respectively, and correspondingly 0.855 and 0.627 cm.<sup>-1</sup> for A. He produces a violet and A a red asymmetry, the degree increasing with the concn. of He or A, and comparatively much greater for A. For A the asymmetry of the  $2P_{3/2}$  component is  $>$  that of the  $2P_{1/2}$  component; for He the reverse is true. A produces a greater shift (strong red) than that by He (violet). For both gases the shift of the  $2P_{1/2}$  component is  $>$  that of the  $2P_{3/2}$  component. For He the shift appears to be  $\propto$  the relative density, and the shift of the longer- $\lambda$  component is  $\sim$  twice that of the shorter- $\lambda$  component; for A the shifts are quite close, and the relation between shifts and relative densities obeys in general the  $\frac{1}{2}$ -power relation. Optical collision diameters calc. from half-width data are 13.37 (Rb-A) and 7.753 Å. (Rb-He). Transition probabilities and  $f$  vals. are evaluated.

N. M. B.

**Pressure effects of hydrogen and nitrogen on the second doublet of Rb principal series.** S. Y. Ch'en and C. S. Pao (*Physical Rev.*, 1940, [ii], 58, 1058—1061; cf. A., 1938, I, 53).—At pressures up to 13 atm. for both H<sub>2</sub> and N<sub>2</sub> the  $2P_{3/2}$  broadens more markedly than the  $2P_{1/2}$  component, and the half-width-relative density relation is linear. N<sub>2</sub> produces a red shift for both components, and H<sub>2</sub> gives a weaker red shift for  $2P_{3/2}$  and a stronger violet shift for  $2P_{1/2}$ . There is a departure from a linear relationship between shift and density of the perturbing gases. Study of the line contours shows marked asymmetry, towards the red for N<sub>2</sub> and slightly towards the violet for H<sub>2</sub>. The relation between half-width and shift is discussed.

N. M. B.

**Hyperfine structure in the arc spectrum of bromine.** S. Tolansky and S. A. Trivedi (*Nature*, 1940, 146, 687—688).—A correction (cf. A., 1940, I, 335).

L. S. T.

**Spectroscopically pure mercury ( $^{198}\text{Hg}$ ).** J. Wiens and L. W. Alvarez (*Physical Rev.*, 1940, [ii], 58, 1005).—With a view of obtaining a monochromatic line of an even Hg isotope as a  $\lambda$  standard, the bombardment of Au with slow neutrons from a cyclotron is described. Slow-neutron capture gives radioactive  $^{198}\text{Au}$  which emits  $\beta$ -rays (2.7 days) giving  $^{198}\text{Hg}$ . A microphotometer trace of the Fabry-Perot spectrogram of the  $\lambda$  4047 line of this transmutation product shows absence of hyperfine components.

N. M. B.

**Hyperfine structure and intensities of the forbidden lines of Pb r.** S. Mrozowski (*Physical Rev.*, 1940, [ii], 58, 1086—1093).—The lines investigated, in order to establish intensity rules, are those arising from transitions between the levels of the  $6p^2$  configuration. They are excited intensely by 3-m. standing waves in He at  $\sim 5$  mm. pressure, containing saturated Pb vapour at 800°. For the quadrupole line  $\lambda$  5313, the intensity ratio (3:2) and the ratio of the distances from the centre of gravity agree with the Rubinowicz formulae transcribed for hyperfine structure (selection rule  $\Delta F = 0, \pm 1, \pm 2$ ). For the magnetic dipole line  $\lambda$  4618, these ratios agree with the rules for electric dipole transitions (2:1). For  $\lambda$  7330 (of mixed type) the intensities are approx. those for ordinary electric dipole transitions, showing that the line is mostly magnetic dipole radiation for which the rule  $\Delta F = 0, \pm 1$  holds. The measured relative intensities of these lines and of  $\lambda$  4659 and a new line  $\lambda$  9250 ( $3P_2 \rightarrow 1D_2$ ) are  $I_{4618} : I_{5313} = 5.0 \pm 0.3$ , and  $I_{4659} : I_{7330} : I_{9250} = 0.023 \pm 0.006 : 1 : 0.84 \pm 0.07$ . These ratios are approx. independent of furnace temp.

N. M. B.

**Zeeman effect of krypton.** J. B. Green, D. W. Bowman, and E. H. Hurlburt (*Physical Rev.*, 1940, [ii], 58, 1094—1098).—Full data on the Zeeman effect of  $\sim 130$  lines in the spectrum of neutral Kr are tabulated, and yield a large additional no. of  $g$  vals. The  $g$  sum rule is verified for  $4p^6 5s, 4p^6 5p$ , and for  $J = 2$  of  $4p^6 6p$ . Anomalies in the  $g$  vals. are discussed.

N. M. B.

**Copper K-absorption spectrum of aluminium-copper alloys and the problem of their improvement.** S. Kokubo and T. Hayasi (*Sci. Rep. Tôhoku*, 1940, 29, 384—390; cf. A., 1937, I, 159).—The fine structure of the Cu K-absorption edge in Al-Cu alloys containing 5% Cu has been correlated with the heat-treatment of the alloys and compared with that of the compound CuAl<sub>2</sub>. The structures are similar for CuAl<sub>2</sub> and for the alloy after 30 min. heating at 545° followed by slow cooling. The structures of the K-edge for alloy samples heated at 545° for 30 min. and then quenched in cold H<sub>2</sub>O are similar before and after annealing for 6 hr. at 200°, but differ from that for CuAl<sub>2</sub>. The significance of these results for the hardening process in Cu-Al alloys is discussed.

O. D. S.

**Mobilities in hydrogen at high current densities.** W. H. Bennett (*Physical Rev.*, 1940, [ii], 58, 992—997).—In an investigation of the silent electric discharge from sharp points and fine wires in H<sub>2</sub> at atm. pressure the conditions are such that the discharge itself purified the gas from electron-attaching impurities, and favour free electron conduction. Measurements are reported of the generalised coeff. of mobility for the drift of free electrons in H<sub>2</sub> and of the mobility of H<sub>3</sub><sup>+</sup> in H<sub>2</sub> (cf. Bradbury, A., 1936, 540).

N. M. B.

**Double scattering of high-speed electrons by a gold and an aluminium target. Magnetic spectra of doubly scattered electrons.** K. Kikuchi (*Sci. Rep. Tôhoku*, 1940, 29, 423—429, 430—439).—I. The magnetic spectrum of 42—86-kv. electrons scattered from a Au (polarising) and an Al (analysing) target has been investigated. The spectrum shows no asymmetry comparable with that previously observed (*Proc. Phys.-Math. Soc. Japan*, 1940, 22, No. 10) for double scattering from two Au targets. This agrees with Mott's theory (A., 1932, 441). The asymmetry for two Au targets is in numerical agreement with the theory.

II. The shapes of the magnetic spectra of electrons doubly scattered from a Au and an Al target or from two targets are compared with those of Wagner for single scattering by Au (A., 1930, 269). It is concluded that elastic single scattering is relatively frequent for targets having thicknesses satisfying Wentzel's criterion. With increasing target thickness the



tail of the elastic peak at first becomes more marked but rapidly reaches a const. val. The thickness of the Au targets used by Dymond (A., 1932, 789) does not satisfy Wentzel's criterion and, therefore, the observed asymmetry of doubly scattered electrons does not correspond with that predicted by Mott (*ibid.*). O. D. S.

**Secondary electron emission of nickel at the Curie point.** P. S. Varadachari (*Proc. Indian Acad. Sci.*, 1940, 12, A, 381—390).—Secondary electron emission from Ni has been investigated at various applied potentials from 30° to 470°. At the Curie point (358°) the secondary electron current does not suddenly alter; this is contrary to existing results of Tartakowsky *et al.* (A., 1932, 553) and Hayakawa (A., 1934, 233). W. R. A.

**Decrease in ionisation of the  $F_2$  region during solar eclipse.** J. A. Pierce, A. J. Higgs, and E. C. Halliday (*Physical Rev.*, 1940, [ii], 58, 1119, and *Nature*, 1940, 146, 747).—During the total eclipse of 1 Oct., 1940, ionospheric observations at 3 points in South Africa showed a marked ultra-violet light effect in the  $F_2$  region; the max. electron density decreased by ~20% to a min. ~30 min. after totality. There was no evidence for corpuscular effects. N. M. B.

**Recombination and electron attachment in the  $F$  layers of the ionosphere.** F. L. Mohler (*J. Res. Nat. Bur. Stand.*, 1940, 25, 507—518).—Observations at Washington indicate that the rate of recombination of electrons in the ionosphere at night is approx.  $\propto c^2$  ( $c$  = electron concn.), but the apparent recombination coeff.  $\alpha'$  tends to increase with decreasing  $c$  over the half period of a sunspot cycle. This, and the variation of  $\alpha'$  with height, indicate that electrons disappear both through recombination and through negative ion formation. The daily variation of  $c$  indicates that the  $F_2$  layer is above, and the  $F_1$  layer is near, the level at which the rate of production of electrons is a max. in midsummer. It is assumed that both layers arise through ionisation of at. O. The calc. val. of the pressure ( $p$ ) of max.  $c$ , and the ratio  $p/p_0$  ( $p_0$  = pressure at the  $F_1$  level), are in accord with the theory of recombination. Seasonal variations in  $p/p_0$  and in  $c$  are explained. The effective collision area for electron attachment to at. O is  $6 \times 10^{-21}$  cm.<sup>2</sup> J. W. S.

**High-velocity atomic beams.** I. Amdur and H. Pearlman (*J. Chem. Physics*, 1940, 8, 998).—A correction (cf. A., 1940, I, 89). J. W. S.

**$^{12}\text{C}_2$ — $^{14}\text{N}$  mass difference.** E. B. Jordan (*Physical Rev.*, 1940, [ii], 58, 1009—1010).—Using a new type of mass spectrograph of very high resolving power and dispersion, preliminary measurements give an average mass difference of  $0.01256 \pm 0.000015$ . N. M. B.

**Search for element 85.** E. B. Andersen (*Kgl. Danske Vidensk. Selsk., Mat.-fys. Medd.*, 1938, 16, No. 5, 18 pp.; *Chem. Zentr.*, 1938, ii, 3663).—A review compiled from notebooks of U. Keel. Attempts to extract a radioactive analogue of I from thorite, Ra-D, stibnite, antimonite, other sulphide minerals, etc. have failed. The methods of separation and purification are described in detail. A. J. E. W.

**Velocity spectrum of  $\alpha$ -particles.** R. Ringo (*Physical Rev.*, 1940, [ii], 58, 942—948).—A 60° magnetic  $\alpha$ -particle spectrograph and its use on a no. of natural  $\alpha$ -particle emitters, with photographic plates to detect the particles, are described. The energy of the main group of Pa  $\alpha$ -particles was found to be  $5.053 \pm 0.007$  Me.v. With the thinnest sources of Po, Th-C, and Th-C'  $\alpha$ -particles, as many as 10% of the particles had energies <5% below the energy of the max. in any one group. N. M. B.

**Neutron-proton scattering at high energies.** C. F. Powell, H. Heitler, and F. C. Champion (*Nature*, 1940, 146, 716—717).—The scattering of 8-Me.v. neutrons from B + D by protons has been investigated. The experimental curve for angular scattering agrees with that obtained by assuming scattering to be isotropical about the centre of mass of the colliding particles. L. S. T.

**Electrostatic deflexion studies of  $\alpha$ -particles; the  $\alpha$ -particles from  $^6\text{Li}$  ( $p, \alpha$ )  $^3\text{He}$ .** L. C. Miller (*Physical Rev.*, 1940, [ii], 58, 935—942).—A technique is described for studying nuclear reactions in which short-range  $\alpha$ -particles are produced with too small a yield for direct application of the electrostatic deflector (cf. Allison, A., 1938, I, 489). A strong Po source is used to supply to the deflector  $\alpha$ -particles; a group of these,

homogeneous in energy, passes through and enters a variable-pressure absorption cell and ionisation chamber. Cut-off pressures, determined for various  $\alpha$ -particle energies, result in a calibrated cell which can be used to determine the  $\alpha$ -particle energies in nuclear disintegration. Application to  $^6\text{Li}$  ( $p, \alpha$ )  $^3\text{He}$  gives a  $Q$  val. of  $3.94 \pm 0.08$  Me.v. The calibration for 1—1.8-Me.v.  $\alpha$ -particle energy is also used to determine the slope of the range-energy curve. Its average val. for this region is 200 kv. per mm. range. N. M. B.

**Possible scheme for the assignment and prediction of radio-active periods.** G. R. Dickson and E. J. Konopinski (*Physical Rev.*, 1940, [ii], 58, 949—951; cf. Wigner, A., 1937, I, 110).—Families of odd nuclei differing from each other only by  $\alpha$ -units show some evidence of a type of regularity in their stability against  $\beta$ -processes. The assumption of a similar regularity for all such families permits the unique assignment to the correct isotope of many known radioactive periods and the prediction of many yet unknown lifetimes. Results for 21 and 52 cases, respectively, are tabulated. N. M. B.

**Scattering of 20° neutrons in  $o$ - and  $p$ -hydrogen.** L. W. Alvarez and K. S. Pitzer (*Physical Rev.*, 1940, [ii], 58, 1003—1004).—Measurements with improved apparatus are reported. The true scattering cross-sections are  $\sigma_o = (100 \pm 3) \times 10^{-24}$  and  $\sigma_p = (5.2 \pm 0.6) \times 10^{-24}$  sq. cm.; hence  $\sigma_o/\sigma_p = 19$ , compared with 2—5 from earlier work, the low val. being due probably to excess scattering of faster neutrons in  $p$ -H<sub>2</sub> (cf. Libby, A., 1939, I, 232). N. M. B.

**Neutron scattering in  $o$ - and  $p$ -hydrogen and the range of nuclear forces.** J. Schwinger (*Physical Rev.*, 1940, [ii], 58, 1004—1005).—Mathematical. The results of scattering measurements (cf. preceding abstract) cannot be reconciled with calc. singlet and triplet scattering amplitudes, the corresponding cross-sections, and the force range, based on present theory. N. M. B.

**Ground states of  $^{10}\text{Be}$  and  $^{10}\text{C}$ .** E. P. Cooper and E. C. Nelson (*Physical Rev.*, 1940, [ii], 58, 1117).—Considerations based on energy relations in the anomalous decay of  $^{10}\text{Be}$  (~10<sup>6</sup> years) into stable  $^{10}\text{B} + 550$ -ke.v.  $\beta$ -particles and the contrasting decay of  $^{10}\text{C}$  (9 sec.) into  $^{10}\text{B} + 3.36$ -Me.v. positrons lead to the conclusion either that the level spacing given by the Hartree approximation is in error by > an order of magnitude, or that some asymmetry other than the known electromagnetic forces must appear in nuclear interactions. N. M. B.

**Thresholds for the proton-neutron reactions of lithium, beryllium, boron, and carbon.** R. O. Haxby, W. E. Shouppe, W. E. Stephens, and W. H. Wells (*Physical Rev.*, 1940, [ii], 58, 1035—1042).—Energy thresholds for neutron production by bombardment of targets with high-energy protons from a pressure electrostatic generator, measured with a BF<sub>3</sub> ionisation chamber surrounded with paraffin, as a neutron detector, are:  $^7\text{Li}$ , 1.86;  $^9\text{Be}$ , 2.03;  $^{11}\text{B}$ , 2.97; and  $^{12}\text{C}$ , 3.20 Me.v. From these vals. the calc. mass differences are:  $^7\text{Be}$ — $^7\text{Li}$ , 0.87;  $^9\text{B}$ — $^9\text{Be}$ , 1.08;  $^{11}\text{C}$ — $^{11}\text{B}$ , 1.97; and  $^{13}\text{N}$ — $^{13}\text{C}$ , 2.22 Me.v.  $^9\text{B}$  is shown to be unstable with respect to disintegration into  $^8\text{Be} + ^1\text{H}$ . The  $^{13}\text{N}$ — $^{13}\text{C}$  difference agrees closely with the max. positron energy from  $^{13}\text{N}$ . N. M. B.

(A) **Protons from carbon and aluminium bombarded by deuterons.** H. L. Schultz, W. L. Davidson, jun., and L. H. Ott. (B) **Protons from separated isotopes of carbon and neon under deuteron bombardment.** H. L. Schultz and W. W. Watson (*Physical Rev.*, 1940, [ii], 58, 1043—1047, 1047—1050).—(A) To overcome difficulties arising from the use of proportional counters and ionisation chambers, a special moving-diaphragm type cloud chamber was used to study the protons from bombardment of C and Al with 3.2-Me.v. deuterons from a cyclotron. The group corresponding with the ground state of  $^{13}\text{C}$  appears to be single. The general distribution of protons from  $^{27}\text{Al}$  accords with the findings of McMillan (cf. A., 1935, 559), but the large no. of closely spaced groups renders analysis into groups difficult. Curves are given from which any group structure can be inferred. As tested by scattering from thin Au foil, the deuteron beam is homogeneous to within 0.15 Me.v.

(B) A cloud-chamber study of the protons arising from the bombardment by 2.54-Me.v. deuterons of CH<sub>4</sub> gas enriched in  $^{13}\text{C}$  and Ne enriched in  $^{20}\text{Ne}$  shows that the yield of long-range protons from the  $^{13}\text{C}$  ( $d, p$ )  $^{14}\text{C}$  reaction is <4% of the yield of shorter-range protons from the  $^{12}\text{C}$  ( $d, p$ )  $^{13}\text{C}$  reaction at



this deuteron energy. This indicates that the half-life of  $^{14}\text{C}$  is  $\sim 100$  years compared with 1000 years as estimated by Ruben (cf. A., 1940, I, 186). In Ne the longest range group of protons (cf. Pollard, A., 1940, I, 340) is complex, with an indicated doublet width of the ground state of  $^{21}\text{Ne}$  of 0.44 Me.v. The only proton group definitely indicated for the  $^{22}\text{Ne}$  bombardment occurs at  $\sim 30$  cm. range. N. M. B.

**Artificial radioactivity of caesium induced by neutrons.** E. Rona and H. Scheichenberger (*Anz. Akad. Wiss. Wien, math.-nat. Kl.*, 1938, 56; *Chem. Zentr.*, 1938, ii, 3653).—Irradiation of  $\text{CsNO}_3$  with slow neutrons from 250–550-millicurie Ra-Be and Rn-Be sources induces  $\beta$ -activity with a half-life of several months; the half-val. thickness of Al for the  $\beta$ -radiation is 0.16 mm. Other short-lived activities (cf. Latimer *et al.*, A., 1935, 678) have not been observed.

A. J. E. W.

**Proton-induced radioactivity of manganese.** A. Hemmendinger (*Physical Rev.*, 1940, [ii], 58, 929–934).—The reaction  $^{52}\text{Cr}(p, n)^{52}\text{Mn}$  at 6.6 Me.v. proton energy produces isomerides with periods 21.3 min. and 6.5 days (cf. Livingood, A., 1938, I, 594). These are positron emitters with max. positron energy 2.2 and 0.77 Me.v., respectively. The 21-min. activity emits 2  $\gamma$ -rays per positron. The  $\gamma$ -radiation in the 6.5-day activity is so intense that 95% of these disintegrations must be due to K-electron capture; this is followed by emission of probably 2  $\gamma$ -rays. In the remaining 5% the positron emission is followed by 3  $\gamma$ -rays. For the 21-min. and 6.5-day activities the yields are  $0.40 \times 10^{-6}$  and  $0.68 \times 10^{-6}$ , and the thresholds 6.2 and  $\sim 6.2$  Me.v., respectively. N. M. B.

**$\gamma$ -Radiation from rhenium.** E. Creutz, W. H. Barkas, and N. H. Furman (*Physical Rev.*, 1940, [ii], 58, 1008).—Proton bombardment of W produced the long-period isotope obtained by Fajans (cf. A., 1940, I, 384) by W ( $D, n$ ) and Re ( $n, 2n$ ), and assigned to  $^{184}\text{Re}$ . The half-life found is  $54 \pm 2$  days. The 90-hr. and 30-min. periods were also produced by proton bombardment. Absorption measurements of the radiation from the 54-day product showed negative electrons of ranges corresponding with  $\sim 0.1$ , 0.22, and 0.86 Me.v., and  $\gamma$ -radiation of  $\sim 1$  Me.v. The highest-energy group may be conversion electrons from this  $\gamma$ -ray. A long exposure showed a line at 0.096 Me.v. If these are K-conversion electrons there must be a  $\gamma$ -ray from the 54-day isotope of  $0.096 \pm 0.071$  (Re K edge) = 0.17 Me.v. N. M. B.

**Counter studies on cosmic rays at sea level.** G. O. Altmann, H. N. Walker, and V. F. Hess (*Physical Rev.*, 1940, [ii], 58, 1011–1017).—Extensive studies of Rossi transition curves for Pb up to 400 g. per sq. cm. showed no evidence of a second max. (cf. Bothe, A., 1939, I, 190). Coincidence counter recordings of time variations of cosmic rays with temp. and pressure, and of various non-periodic changes in intensity due to the passage of cold and warm fronts, barometric depressions, and magnetic storms are reported and discussed. N. M. B.

**Genetic relation between the electronic and mesotronic components of cosmic rays near and above sea level.** G. Bernardini, B. N. Cacciapuoti, B. Ferretti, O. Piccioni, and G. C. Wick (*Physical Rev.*, 1940, [ii], 58, 1017–1026; cf. A., 1940, I, 309).—The hypothesis that cosmic-ray electrons observed at sea level are mostly due to mesotron disintegration was tested by comparing the ratio soft/hard component, at sea level in free air, with the same ratio at 2050 m. under a dense absorbing layer; by comparing Rossi curves for small showers under the same conditions; and by a detailed study of the increase of the soft component with altitude. Results indicate that the proper lifetime of the mesotron is  $< 4 \mu$ -sec. and that the soft radiation observed at sea level is not entirely due to secondary processes of the mesotron. N. M. B.

**Cosmic rays and comets.** V. Rojansky (*Physical Rev.*, 1940, [ii], 58, 1010).—A discussion of methods and opportune conditions for testing the conjecture that comets are contraterrene bodies (composed of hypothetical atoms consisting of negatively charged nuclei surrounded by positrons). Among the products of mutual annihilation of terrene (ordinary) and contraterrene matter there may be free mesons. This suggests that the continual release of mesons at the top of the earth's atm. may be caused by contraterrene matter from interstellar space impinging on the atm., and that non-ionising particles which release mesons deeper in the atm.

may be contraterrene neutrons set free in the earlier stages of the annihilation of the impinging contraterrene at. nuclei. N. M. B.

**Production and absorption of mesotrons in the substratosphere.** M. Schein, E. O. Wollan, and G. Groetzinger (*Physical Rev.*, 1940, [ii], 58, 1027–1031; cf. A., 1940, I, 308).—Coincidence-counter attempts, at altitudes up to 9.3 km., to observe mesotron production in an 8-cm. Pb block by some non-ionising radiation other than photons indicate that the no. of mesotrons so created is  $\sim 5\%$  of the total no. of mesotrons at this altitude. From data for mesotron absorption in Pb as a function of altitude, an energy spectrum of mesotrons at 6.7 km. is constructed. At 6.7 km.  $\sim 33\%$  of the mesotrons have energies  $< 5.2 \times 10^8$  e.v., and at sea level only a very small fraction of the mesotrons have energies in this range, in agreement with the observations of Herzog (cf. *ibid.*, 188). N. M. B.

**Vertical shift of the meso-formation layer.** H. Arakawa (*Physical Rev.*, 1940, [ii], 58, 1118–1119; cf. Loughridge, A., 1940, I, 54).—Mathematical. An expression in conformity with aerological standards is deduced for vertical shift due to temp. or pressure. N. M. B.

**Existence and magnitude of electronic charges.** A. Landé (*J. Franklin Inst.*, 1940, 229, 767–774).—Mathematical. For the quantisation of Dirac's classical point electron Einstein's classical equation is supplemented with a reciprocal classical equation. A transcendental equation is obtained for the eigen-val.  $\mu$ , which is the product of the fine structure const.  $\alpha$  and the factor  $\gamma$  in Dirac's signal radius  $\gamma e^2/mc^2$ , giving  $\mu_{\text{min.}} = 0.0299$ . W. J.

**Electromagnetic properties of mesotrons.** H. C. Corben and J. Schwinger (*Physical Rev.*, 1940, [ii], 58, 953–968).—Mathematical. A general theory describing particles of unit spin and arbitrary magnetic moment is developed and applied to the motion of such particles in a Coulomb field. The exact equations for the radial components of the wave functions are discussed both for particles with a magnetic moment unity (Proca theory) and for those with a magnetic moment of two meson magnetons. N. M. B.

**Mesons in a Coulomb field.** I. Tamm (*Physical Rev.*, 1940, [ii], 58, 952).—Mathematical. The regular solutions of the Proca equations in a field of a point charge do not form a complete set of functions and the problem of the Coulomb scattering of mesons has no solution. This breakdown of theory arises from neglect of the finite size of elementary particles. N. M. B.

**Nature of nuclear forces.** L. Landau and I. Tamm (*Physical Rev.*, 1940, [ii], 58, 1006; cf. preceding abstract).—Mathematical. Considerations lead to the view that nuclear forces originate from the electrical interaction of the nuclear particles by means of the mesotrons, and are connected with the peculiar properties of the equations of motion of the mesotrons. N. M. B.

**Theory of mesons.** C. Møller (*Physical Rev.*, 1940, [ii], 58, 1118).—A discussion and amplification of the theory of meson fields previously reported (cf. *Kgl. Danske Vidensk. Selsk., Mat.-fys. Medd.*, 1940, 17, 8). N. M. B.

**"Radius" of the elementary particle.** L. Landau (*Physical Rev.*, 1940, [ii], 58, 1006–1007).—Mathematical. There are no reasons to assume that the limits of applicability of the electrodynamic conceptions in quantum mechanics are given by  $e^2/mc^2$ . A simple method is developed to find, in quantum theory, the limit beyond which the theory comes into contradiction with itself because of the neglect of the reaction of the field. N. M. B.

**Magnetic resonance method of determining nuclear moments.** A. F. Stevenson (*Physical Rev.*, 1940, [ii], 58, 1061–1067).—Mathematical. A quant. examination of refinements of the theory of the method, as given by a correction for the use of an oscillating rather than a rotating field, and by taking into account the "end effect" (cf. Millman, A., 1939, I, 297). N. M. B.

**Scattering matrix of radioactive states.** G. Breit (*Physical Rev.*, 1940, [ii], 58, 1068–1074; cf. A., 1940, I, 428).—Mathematical. The method of complex eigen-val. is generalised to many-dimensional problems by means of the scattering matrix (cf. Wheeler, A., 1938, I, 57). N. M. B.



Possible rôle of neutrinos in stellar evolutions. G. Gamow and M. Schoenberg (*Physical Rev.*, 1940, [ii], 58, 1117).—In progressively contracting stars, when the density and temp. in the interior become high enough to permit the penetration of free electrons into different nuclei with formation of unstable isobars of smaller at. no., the neutrinos produced cannot be held back by gaseous walls surrounding the central region. Thus no thermodynamic equilibrium is possible, and the matter rapidly loses its extra heat content through the neutrino emission. Under such conditions the slow contraction will give place to a rapid collapse. N. M. B.

## II.—MOLECULAR STRUCTURE.

Intensity changes in Cameron bands of carbon monoxide excited by electron impact. G. E. Hansche (*Physical Rev.*, 1940, [ii], 58, 1075—1077).—Relative intensities of the  $^3\Pi$ — $^2\Sigma$  Cameron bands and the  $^1\Pi$ — $^2\Sigma$  fourth positive bands of CO excited by impact of electrons of various energies at various pressures indicate that intense Cameron bands can be obtained at pressures up to 0.025 mm. in contrast with an upper limit of 0.005 mm. in electrodeless-discharge experiments (cf. A., 1940, I, 192), and that the excitation function of the Cameron bands has two max., as in the case of a  $^3P$ — $^1S$  at. transition. N. M. B.

Visible fluorescence bands of cadmium vapour. A. Kotecki (*Acta phys. polon.*, 1937, 6, 144—149; *Chem. Zentr.*, 1938, ii, 3653—3654).—The intensity distribution of the bands, which depends on the temp. of the vapour and the  $\lambda$  of the exciting light, is studied, and conclusions concerning the  $2^3P_1$  state of the Cd<sub>2</sub> mol. are recorded. A. J. E. W.

Frequencies  $\nu_2$  and  $\nu_1$  in the infra-red spectra of SiH<sub>4</sub> and GeH<sub>4</sub>. J. W. Straley, C. H. Tindal, and H. H. Nielsen (*Physical Rev.*, 1940, [ii], 58, 1002; cf. A., 1940, I, 60).—Suggested interpretations are discussed. A re-examination of the spectra under higher resolving power confirms available data, and, in the case of SiH<sub>4</sub>, shows the secondary peak near 10.3  $\mu$ . as a Q branch of a weaker band extending to 9.0  $\mu$ . The bands at 11.0 and 10.3  $\mu$ . are identified with frequencies  $\nu_4$  and  $\nu_2$ , respectively. For GeH<sub>4</sub>, there exists at longer  $\lambda$  a region of more intense absorption. Measurements and almost complete resolution were obtained for 9—13  $\mu$ .; they reveal a convergence towards higher frequencies in the band  $\nu_4$  and towards lower frequencies in the band  $\nu_2$ . N. M. B.

Absorption of light in solid and liquid ammonia. I. Absorption spectrum from (I) 5000 to 2000 Å., (II) 10.140 to 5000 Å. A. Prichotko (*Acta Physicochim. U.R.S.S.*, 1940, 12, 559—564, 565—572).—I. The absorption spectrum of the liquid and the cryst. solid was measured for layers 1—28 mm. thick at temp. very near the m.p. The absorption is continuous; the low-frequency end begins at  $\lambda$  2345 Å. for the liquid and 2116 Å. for the solid, compared with 2430 for the gas. The large displacements observed are ascribed to changes in the electronic shell caused by mol. association.

II. The infra-red spectra of liquid and solid NH<sub>3</sub> are similar to one another but entirely different from that of the gas. Three of the bands in the liquid become doublets in the solid. A provisional interpretation is offered. F. L. U.

Absorption spectra of europium ion in some hydrated salts. F. H. Spedding, C. C. Moss, and R. C. Waller (*J. Chem. Phys.*, 1940, 8, 908—918).—The absorption spectra of cryst. EuCl<sub>3</sub>·6H<sub>2</sub>O, EuBr<sub>3</sub>·6H<sub>2</sub>O, and Eu<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>·8H<sub>2</sub>O have been measured over the  $\lambda$  range 6150—2900 Å. at 78° and 298° K. Evidence is obtained for the existence of 300, 385, 938, and 970 cm.<sup>-1</sup> energy levels, and for the possibility of an energy level at 435 cm.<sup>-1</sup>. Decrease of temp. from 298° to 78° K. shifts the lines  $\sim$ 10 cm.<sup>-1</sup>. Certain smaller frequency intervals are attributed to vibrational and oscillational frequencies superimposed on the electronic frequency. J. W. S.

Infra-red spectrum and internal torsion of dimethyl sulphide. H. W. Thompson (*Trans. Faraday Soc.*, 1941, 37, 38—45).—Absorption spectra of Me<sub>2</sub>S at various pressures have been measured in the range 1—16  $\mu$ . The data differ from those of Fonteyne (A., 1940, I, 95) in two significant ways. The total entropy calc. on the basis of the present frequency assignments is 69.20, against the measured val. 69.35. F. L. U.

Absorption spectra of co-ordination compounds. IV. Ethylenediamine cobaltic complexes. H. Kuroya and R. Tsuchida (*Bull. Chem. Soc. Japan*, 1940, 15, 427—439; cf. A., 1938, I, 385, 432, 493).—The absorption spectra of a no. of complexes of Co<sup>III</sup> with (CH<sub>3</sub>NH<sub>2</sub>)<sub>2</sub> (I) are recorded in curves and tables. Generally the first, second, and third absorption bands are shifted towards shorter  $\lambda$ , and the extinction coeffs. are increased, as compared with those of the corresponding NH<sub>3</sub> complexes. In analogous Co and Cr complexes, the first band of the Co compound is displaced to longer  $\lambda$ , and the second band is displaced to shorter  $\lambda$ , as compared with the corresponding bands of the Cr compound. These results accord with the view that the second band, but not the first, is an index of the stability of the complex, being due to the co-ordination electrons. The greater stability of (I) complexes is explained on structural grounds. J. W. S.

Spectral investigation of chemical processes in organic compounds at low temperatures. I. A. Terenin (*Acta Physicochim. U.R.S.S.*, 1940, 12, 617—636).—The fluorescence spectra of PhCHO (I) and some related substances in thin films ( $\sim$ 0.1  $\mu$ . by vac. condensation) at  $-180^\circ$  have been studied. For (I), the spectrum is shifted towards longer  $\lambda$ , and the vibrational frequency of the carbonyl group ( $\Delta\nu$ ) is 1560 cm.<sup>-1</sup>, instead of 1730 cm.<sup>-1</sup> as compared with the gas phase. Thin films of dil. solutions of (I) in H<sub>2</sub>O, EtOH, C<sub>6</sub>H<sub>6</sub>, and COMe<sub>2</sub>, obtained by vac. condensation of the solvent in presence of traces of (I), give spectra at  $-180^\circ$  in which  $\Delta\nu$  is 1600—1620 cm.<sup>-1</sup>; this val. is considered to be characteristic of the isolated (I) mol. at  $-180^\circ$ . With increasing dipole moment of the solvent the max. become more diffuse, although their position is unchanged. This is ascribed to electrostatic interaction. The val. 1560 cm.<sup>-1</sup> in the solid film is considered to indicate association to double mols. by H bond formation. When the film of (I) is quickly warmed to  $-20^\circ$  and again cooled the fluorescence changes to an intense green with a max. at 5300 Å., suggesting the formation of benzoin. Fluorescence spectra under similar conditions are also recorded for CPhMe, (CH<sub>2</sub>Ph)<sub>2</sub>, BzOH, CH<sub>2</sub>Ph·OH, and hydrobenzoin. F. J. G.

Raman effect of oxonium compounds. A. R. Gantmacher, M. W. Wolkenstein, and J. K. Sirkin (*Acta Physicochim. U.R.S.S.*, 1940, 12, 786—792).—Raman spectra for systems Me<sub>2</sub>O + nHCl (n = 1, 2, 3) between  $-80^\circ$  and  $20^\circ$  are recorded. With increasing [HCl] and falling temp. a new line at  $\Delta\nu \sim 500$  cm.<sup>-1</sup> and a new diffuse band at  $\Delta\nu \sim 2400$  cm.<sup>-1</sup> appear. The latter is attributed to strongly deformed HCl in a structure Me<sub>2</sub>O···H—Cl···H—Cl, stabilised by resonance with Me<sub>2</sub>OH<sup>+</sup>Cl<sup>-</sup>···HCl, analogous to the HF<sub>2</sub><sup>+</sup> ion. The line  $\sim 500$  cm.<sup>-1</sup> would correspond with the hindered rotation of the second Cl atom. Reasons based on energetics are given for rejecting structures with 4-covalent O. F. J. G.

Absorption spectra of metallic complex salts of 2:2'-di-pyridyl. IV. K. Yamasaki (*Bull. Chem. Soc. Japan*, 1940, 15, 461—465; cf. A., 1940, I, 344).—Absorption curves (200—700 m $\mu$ .) are recorded for [FeR<sub>2</sub>]Cl<sub>2</sub>, [FeR<sub>2</sub>(CN)<sub>2</sub>], [Fe(CN)<sub>4</sub>]K<sub>2</sub>, and [FeR<sub>2</sub>]Cl<sub>3</sub> (R = 2:2'-di-pyridyl).  $\epsilon$  for the band  $\sim 295$  m $\mu$ . is approx.  $\propto$  the no. of R mols. in the complex. Replacement of R by CN causes a progressive shift towards the violet. F. J. G.

Structural interpretations of flavone spectra. S. Aronoff (*J. Org. Chem.*, 1940, 5, 561—571).—The ultra-violet spectrum of flavone shows two well-defined bands at 3000 and 2500 Å. (with a further band at 2000 Å.). C<sub>6</sub>H<sub>6</sub> and pyrene show max. at 2000 and 2500 Å. but annelation of the two mols. produces a new band. Substitution of Ph at C<sub>2</sub> does not shift basically any of the absorption bands and thus does not, *per se*, affect the nucleus. Flavanone (I) shows two bands beyond 2000 Å., one at 2500 and another at 3200. Disruption of the quinoidal structure of the pyrone in benzopyrone shifts one of the bands to the red, so that this structure is not in itself responsible for the two bands beyond 2000 Å. Since  $\alpha$ -hydroxybenzylacetophenone has an absorption spectrum similar to that of (I), even a chromone structure is not necessary to produce the "characteristic" flavone spectrum. What appears requisite is O on the phenone to complete (either directly or by chelation) a two-ringed system or, more explicitly, to give *o*- or *p*-resonance (*m*-resonance is negligible with the large bond distances involved). In monohydroxyflavones OH at C<sub>4</sub>(<sub>1</sub>), C<sub>7</sub>(<sub>1</sub>), or C<sub>8</sub>(<sub>2</sub>) causes a shift of the 3000 Å. band, the order (as given) being



$\alpha$  the length of the conjugation chain. OH at  $C_{(6)}$  or  $C_{(3)}$  produces no shift, whereas OH at  $C_{(3)}$  creates a new band beyond 2500 and 3000 Å. without altering the 2500 Å. band (3000 Å. band doubtful). 5- and 6-Hydroxyflavone shift the 2500 Å. band, the former also shifting the 3000 Å. band. The connected resonances are described. It is concluded that owing to restriction of the normal resonance of the pyrylium nucleus by ketonic O, the additional resonances caused by substitutions follow a path through this O resulting in a red-shift of one band. Where such resonances cannot occur, either the resonance is identical with flavone or a tautomerism involving much more energy predominates. An exception is made with substitution of OH at  $C_{(3)}$  where, although a resonance form similar to 7-OH exists, a rearrangement to a ketonic (I) occurs most readily. Among polyhydroxyflavones, except where additional resonance forms may exist, the resultant  $\lambda$  of the absorption bands lie on the max. position of each band with regard to the substituted OH. In most cases, however, especially those involving OH at  $C_{(3)}$ , there is a large shift indicating that the additional resonance involves a still larger energy absorption. Since the chain length is greatest through 4', the shift is also proportionately greater with compounds of this derivative. This applies also to  $(OH)_3$ - and  $(OH)_4$ -substitutions. H. W.

**Infra-red absorption of proteins in the 3  $\mu$ . region. XII.** A. M. Buswell, K. F. Krebs, and W. H. Rodebush (*J. Physical Chem.*, 1940, **44**, 1126—1137).—Absorption bands of 16 proteins and 11 related compounds are tabulated. All the proteins show peaks at 3.00, 3.22, and  $\sim 3.4 \mu$ , whilst salmine shows additional absorption at 3.09  $\mu$ . Absorption at 3.00  $\mu$  is due to a single NH $\cdot$ O bond and at 3.22  $\mu$  to double NH $\cdot$ O bonds in a ring-dimeride structure (two peptide links bonded NH to O). The band due to the latter linking is relatively strong for gelatin and peptone but is much less pronounced for natural proteins, especially if the method of isolating the protein has not been drastic. It is suggested that in natural proteins excess H $_2$ O attaches to half of the hydrophilic groups, thus preventing ring formation. Drastic dehydration irreversibly removes this H $_2$ O and permits ring formation. Absorption at  $\sim 3.4 \mu$  is due to C-H bonding, and the additional absorption shown by salmine is attributed to excess NH $_2$ . C. R. H.

**Raman spectra of esters of dicarboxylic acids. Oxalyl chloride, ethyl and methyl oxalates, ethyl malonate, fumarate, and maleate, and oxalic acid.** B. D. Saksena (*Proc. Indian Acad. Sci.*, 1940, **12**, A, 416—426).—Raman spectra and the polarisation of the lines have been investigated. All these compounds possess free rotation around the C-C linking and are capable of occurring as *cis*- or *trans*-isomerides which, by virtue of different symmetry, exhibit different spectroscopic characteristics. Frequencies for H $_2$ C $_2$ O $_4$  and (COCl) $_2$  and their polarisation characteristics have been calc. on the *trans* model and agree with ascertained data. Me $_2$ C $_2$ O $_4$  shows striking changes in passing from the solid to the liquid state. This is attributed to the transformation from  $\text{—C}\begin{array}{c} \diagup \text{O} \\ \diagdown \text{O} \end{array}\text{—R}$  to



W. R. A.

**Triboluminescence of sugars.** (Miss) F. G. Wick (*J. Opt. Soc. Amer.*, 1940, **30**, 302—306; cf. A., 1937, I, 599).—Sucrose, maltose, and lactose crystals phosphoresce after exposure to an Fe spark at room temp.; at liquid air temp. this phosphorescence and triboluminescence are much more intense. Addition to the sugar of oils or dyes which are excited to fluorescence by the Fe spark also increases the triboluminescence intensity, and the intensities of triboluminescence and fluorescence are max. in similar temp. ranges; oils which increase the phosphorescence but not the fluorescence of the sugar have no effect. Amorphous carbohydrates (including caramelised sucrose) are phosphorescent, particularly at low temp., but not triboluminescent. These experiments confirm that triboluminescence is partly due to fluorescence excited by an electric discharge caused by fracture of the crystals. Triboluminescence which is increased in intensity by fluorescent materials is also produced in sugars by sudden cooling to or heating from liquid air temp. At liquid air temp. ice is phosphorescent and triboluminescent, and the triboluminescence intensity is increased by previous irradiation with the Fe spark. A. J. E. W.

**Mechanism of spark discharge in air at atmospheric pressure. II.** L. B. Loeb and J. M. Meek (*J. Appl. Physics*, 1940, **11**, 459—474; cf. A., 1940, I, 276).—There are two possible mechanisms of spark discharge, that due to Townsend and Holst, which holds for vals. of  $p\delta$  ( $p$  = pressure,  $\delta$  = spark gap) from < min. sparking potential up to  $\sim 100$ , and that due to Meek, based on positive-ion space-charge streamer formation, which holds for vals. of  $p\delta > 100$ . An approx. expression for the tip-field of the positive space-charge in the streamer, if the streamer is to be propagated, is worked out, and applied to spark breakdown at atm. pressure. Results worked out from the theory give a small deviation from Paschen's law. The equation has been tested for H $_2$  and other gases with satisfactory results. The theory gives results deviating from experiment at vals. of  $p\delta$  where streamer formation ceases to be possible, and the Townsend-Holst theory becomes applicable. The effect of illumination of the cathode with ultra-violet light on the spark potential is discussed, and shown not to affect the streamer theory. The conditions necessary for streamer and avalanche propagation are discussed. For long sparks, the Meek criterion for sparking no longer applies, but sparks progress by avalanche advance and retrograde streamers. The Townsend mechanism also does not apply. The mechanism of the lightning discharge is discussed. A. J. M.

**Electrical conductivity.** G. Calcagni (*Separate, Genoa*, 1940, 56 pp.).—A theory of electrical conduction in metals and electrolytes is proposed and discussed, in which the occurrence of electrical phenomena is attributed to the action of various forms of energy on the interat. and intermol. forces in matter. O. J. W.

**Formulae for the natural dispersion of some organic liquids.** W. J. C. Beynon (*Phil. Mag.*, 1941, [vii], **31**, 1—12).—The dispersions of MeOH, EtOH, Pr $^n$ OH, Bu $^n$ OH, and CH $_3$ CH $_2$ CH $_2$ OH over the range 3000—20,000 Å. can be represented by  $n^2 - 1 = b_0 + \sum b_r/(\lambda^2 - \lambda_r^2) - b_\infty \lambda^2/(\lambda_\infty^2 - \lambda^2)$ , where  $n$  is the refractive index for wave-length  $\lambda$ , and  $b_0$ ,  $b_r$ ,  $b_\infty$ ,  $\lambda_r$ , and  $\lambda_\infty$  are consts. The consts.  $\lambda_r$  are identified with the absorption bands of the substances in the vapour state in the extreme ultra-violet region, and  $\lambda_\infty$  is the wave-length of the infra-red absorption band at  $\sim 3.2 \mu$ . From the consts. of these formulae and those of the corresponding magneto-optical dispersion formulae (A., 1938, I, 226) the val. of  $e/m$  for the resonator responsible for the dispersion is calc. as  $0.93 - 1.14 \times 10^{-17}$  e.m.u., the val. increasing with increasing  $\nu$  and generally with increasing mol. wt. The vals., however, are all < the accepted vals. for the electron. J. W. S.

**Complex rotatory dispersion of optically active tetrahydrofuryl-2-carbinol.** M. P. Balfe, M. Irwin, and J. Kenyon (*Nature*, 1940, **146**, 686).—The *d*- and *l*-rotatory forms of tetrahydrofuryl-2-carbinol, obtained by crystallisation of the brucine salt of its H phthalate, show complex rotatory dispersion. The carbinol from the (–)-H phthalate has  $\alpha_{D}^{20} -2.23^\circ$ ,  $\alpha_{438}^{20} -2.36^\circ$ ,  $\alpha_{403}^{20} +0.56^\circ$ ,  $\alpha_{392}^{20} +5.69^\circ$ , and  $\alpha_{382}^{20} +28.4^\circ$  ( $l = 1$ ). The sp. rotations at increasing dilutions in H $_2$ O give a family of curves of which the inflexions, max., and reversals of sign are displaced towards the ultra-violet as dilution increases. A similar family of curves is given by 5% solutions in aliphatic alcohols, the characteristic features of the curves being moved towards the longer  $\lambda$  as the mol. wt. of the solvent is increased. In dioxan, the sp. rotatory power in the visible spectrum is practically independent of concn. L. S. T.

**Structure of hydrides of boron. III. Structure and properties of ammoniates of boron hydrides.** L. E. Agromonov (*J. Gen. Chem. Russ.*, 1940, **10**, 1120—1140; cf. A., 1939, I, 599).—Structural and electronic formulae based on the tervalency of B are proposed. R. T.

**Energy of aliphatic carbon linkings.** E. C. Baughan and M. Polanyi (*Nature*, 1940, **146**, 685).—Linking energies for C-I, C-Br, C-H, C-Me, and C-OH in various alkyl compounds are tabulated and discussed. L. S. T.

**Normal vibrations of molecules of the tetramethylmethane type.** S. Silver (*J. Chem. Physics*, 1940, **8**, 919—933).—For fixed orientations of the Me groups, there are two configurations (eclipsed and staggered, respectively) in which the mol. as a whole possesses the  $T_d$  symmetry group. The group-theory analysis has been applied to the eclipsed form and, by



means of Redlich's theorem, the symmetry co-ordinates are derived. Using a simple valency potential, the secular equations for the totally symmetrical and doubly degenerate modes have been developed. Assuming the force constants of the Me groups to be the same as in  $C_2H_6$ , the frequencies calc. for  $CMe_4$ ,  $SiMe_4$ , and  $NMe_4^+$  are in accord with those observed in the Raman spectra. J. W. S.

**Diamagnetic anisotropy and electronic structure of aromatic molecules.** H. Brooks (*J. Chem. Physics*, 1940, 8, 939–949).—Anisotropy is treated from the viewpoint of the Heitler–London–Pauling–Slater approximation by inclusion of ionic terms in the secular equation. Correlation effects tend to reduce the diamagnetic susceptibility, the effect being relatively greater in complex mols. than in  $C_6H_6$ . The contribution of higher order permutation integrals is negligible. The variation of the anisotropy of  $C_6H_6$  through intermediate stages of approximation is discussed by means of a more exact model. J. W. S.

**Conjugated systems and "resonance."** A. Burawoy (*Chem. and Ind.*, 1940, 594–596).—Vals. of the heats of combustion and hydrogenation for a no. of pairs of isomeric org. compounds show that these consts. afford no conclusive evidence for the occurrence of resonance in conjugated systems. Shortening of the C–C linking and reduction of the linking energy by adjacent multiple linkings is not confined to such systems; these effects, which show an approx. parallelism, depend on the general arrangement of linkings in the mol. and are not due to conjugation. The expected lengthening of multiple linkings by resonance is not observed. Evidence for resonance in conjugated systems based on linking energies and interat. distances is therefore invalid. A. J. E. W.

**Light absorption, resonance, and electron isomerism.** A. Burawoy (*Chem. and Ind.*, 1940, 855–861; cf. preceding abstract).—A review and discussion, largely of the author's work, in which absorption data for org. compounds containing conjugated linkings are shown to be inconsistent with the view that such compounds are resonance hybrids, but consistent with the existence of electron isomeric mols. in equilibrium. A. J. E. W.

**Modern development of the concept of co-ordination. II. Constitution of  $ClO_3^-$  ion.** G. B. Bonino (*Gazzetta*, 1940, 70, 217–227; cf. A., 1940, I, 198).—The  $ClO_3^-$  ion contains an excited Cl atom of the  $3s^2 3p^3 3d^4$  or  $3s^2 3p^3 3d^2$  type, and has a pyramidal symmetry,  $C_{3v}$ . This is supported by Raman and infra-red data. O. J. W.

**Field dependence of the intrinsic domain magnetisation of a ferromagnet.** T. Holstein and H. Primakoff (*Physical Rev.*, 1940, [ii], 58, 1098–1113).—Mathematical. The basis of the treatment is the exchange interaction model amplified by explicit consideration of the dipole–dipole interaction between the at. magnets. At room temp. and for fields of  $\sim 4000$  gauss the vol. susceptibility is  $\sim 10^{-4}$ . Results are in satisfactory agreement with experiment. N. M. B.

**Benzene formula—"resonance and mesomerism."** A. G. Byard (*Chem. and Ind.*, 1940, 593–594).—Graphical methods of representing the C atom and the  $C_6H_6$  mol. are discussed. A. J. E. W.

**Coupling of molecules in liquids.** A. Piekara (*Acta phys. polon.*, 1937, 6, 130–143; *Chem. Zentr.*, 1938, ii, 3657; cf. A., 1938, I, 178).—Two types of coupling force are distinguished: (a) Debye forces between neighbouring mols. in ordered arrangement; (b) association forces between mols. situated fortuitously in close proximity. In liquids having similar polarisation properties to  $PhNO_2$  type (b) forces are of predominant importance. The proposed coupling mechanism prohibits a sharp distinction between associated and non-associated liquids. Calc. vals. of the reduction factor,  $R$ , are in accord with polarisation data for alcohols,  $n-C_6H_{14}$ – $PhNO_2$  mixtures, and solutions of fatty acids in  $n-C_6H_{14}$ . A. J. E. W.

**Molecular forces involved in surface formation. I. Surface energies of pure liquids.** J. W. Belton and M. G. Evans (*Trans. Faraday Soc.*, 1941, 37, 1–15).—Partition functions of the liquid, surface, and vapour phases of a pure substance are used to calculate the surface free energy ( $\gamma$ ), heat of vaporisation ( $L$ ), and v.p. of the liquid. A quasi-lattice structure is assumed for the liquid, and the potential energy change on moving a mol. from the bulk to the surface is calc. for both cubical and hexagonal close-packing. For He, Ne, Ar,  $H_2$ ,  $O_2$ ,

$N_2$ ,  $Cl_2$ , and CO the calc. and observed vals. of  $\gamma$  and of its temp. coeff. agree well, as do also, apart from  $O_2$  and  $Cl_2$ , the corresponding vals. of  $L$ . Calc. v.p. are of the right order of magnitude. F. L. U.

### III.—CRYSTAL STRUCTURE.

**Classical and quantum reflexions of X-rays in crystals.** (Sir) C. V. Raman and P. Nilakantam (*Nature*, 1940, 146, 686).—A reply to criticism (cf. A., 1940, I, 348, 375).

L. S. T.  
**Modified reflexions of Cu K $\alpha$  X-rays from rock-salt.** G. E. M. Jauncey and O. J. Baltzer (*Physical Rev.*, 1940, [ii], 58, 1116; cf. Raman, A., 1940, I, 431).—Photographs taken when a narrow primary beam fell at various vals. of the glancing angle  $i$  on the (100) face of a thick crystal showed Bragg or  $B$  spots and Laue or  $L$  spots. A  $B$  spot lights up only for a certain val. of  $i$ , whereas when  $i$  is changed by  $\Delta$  the  $L$  spots in the equatorial plane move by  $2\Delta$ . An  $L_{hkl}$  spot or a  $B_{hkl}$  spot is produced by reflexion from the  $hkl$  planes. As an  $L_{h'k'o}$  spot is made to approach a  $B_{hko}$  spot a modified spot appears if  $h', k' = h, k$ . The modified spot is therefore associated with  $B_{hko}$  and designated by  $mB_{hko}$ . Results are discussed in relation to available formulæ (cf. Zachariasen, A., 1940, I, 285). N. M. B.

**Graphical method for selecting suitable targets for precision determination of cubic lattice constants and for solving cubic powder constants.** L. A. Carapella (*J. Appl. Physics*, 1940, 11, 510–514).—Charts connecting the lattice parameter  $a_0$ ,  $\lambda$  of radiation, and diffraction angle  $\theta$  of cubic lattices are given. By their use  $a_0$  may be determined directly from  $\theta$  to within 1%, and, in particular, suitable  $\lambda\lambda$  for accurate determination of an approx. known  $a_0$  may be selected. O. D. S.

**Mechanical and X-ray measurement of the torsional modulus of iron.** R. Glocker and O. Schaaber (*Ergebn. tech. Röntgenk.*, 1938, 6, 34–42; *Chem. Zentr.*, 1938, ii, 3656).—Measurements on a tool steel (C 0.6%) with a yield point of 35 kg. per sq. mm. are described. The X-ray and mechanical methods give  $8300 \pm 250$  and  $8140 \pm 30$  kg. per sq. mm., respectively, as the torsional modulus. The concordance of the two vals. shows that mechanical elasticity consts. are valid for X-ray measurements of two-dimensional stresses. A. J. E. W.

**Bending and mosaic of single-crystals in the wide-angle [X-ray] diagram.** H. Seemann (*Ergebn. tech. Röntgenk.*, 1938, 6, 186–209; *Chem. Zentr.*, 1938, ii, 3656).—A review of the use and advantages of wide-angle diagrams for the study of lattice defects in crystals. A. J. E. W.

**Crystal structures of some heterocyclic organic compounds of analogous constitution. I. Thianthren and selanthren.** R. G. Wood and J. E. Crackston. II. Phenanthiazine, phenoxthionine, phenoxselenine, and phenoxtellurine. R. G. Wood, C. H. McCale, and G. Williams (*Phil. Mag.*, 1941, [vi], 31, 62–70, 71–80).—I. Crystallographic and X-ray measurements indicate that thianthren and selanthren crystallise from  $COMe_2$  in monoclinic holohedra, with  $a$  14.4 and 14.5,  $b$  6.11 and 6.24,  $c$  11.9 and 12.1 Å., and  $\beta$   $110^\circ 0'$  and  $110^\circ 20'$ , respectively, the unit cell in each case containing 4 mols. The space-group is  $P2_1/a$  ( $C_{2h}^2$ ). The optical properties of the crystals are recorded and possible structures of the mols are discussed.

II. Crystallographic and X-ray measurements indicate that phenanthiazine, phenoxthionine, phenoxselenine, and phenoxtellurine crystallise from EtOH in an orthorhombic form, with  $a$  5.91, 5.94, 5.93, and 5.97,  $b$  7.90, 7.76, 7.85, and 8.15, and  $c$  21.0, 20.5, 20.5, and 20.5 Å., respectively, the unit cell in each case containing 4 mols. Definite conclusions concerning the space-groups could not be drawn. The optical properties of the crystals are recorded and the possible structures of the mols. are discussed. J. W. S.

**Electric fields in vibrating polar crystals.** R. H. Lyddane, K. F. Herzfeld, and R. G. Sachs (*Physical Rev.*, 1940, [ii], 58, 1008–1009).—Mathematical. The polarisation  $P$ , associated with the displacements of the ions in a vibrating crystal, causes electric forces  $F$  giving rise to an electric field  $E$  and an electric displacement  $D$ . If the vibrational  $\lambda$  is short compared with the size of the crystal, but long compared with the lattice distance, then for longitudinal displacement,  $E = -4\pi P$  and  $D = 0$  (cf. A., 1939, I, 63). Calcul-



ations confirm that, for transverse vibrations,  $E = 0$  and  $D = 4\pi P$  (cf. Fröhlich, *ibid.*, 554). These formulae lead to the Lorentz-Lorenz force for both types of vibration; i.e.,  $F = E + (4\pi/3)P$ . N. M. B.

**Rotatory power of nickel sulphate at low temperatures.** P. Rudnick, F. G. Slack, and J. O'Connor (*Physical Rev.*, 1940, [ii], 58, 1003).—Visual measurements reported for cryst.  $\alpha$ -NiSO<sub>4</sub>·6H<sub>2</sub>O at  $\lambda\lambda$  4358, 5461, and 5780 at liquid air temp. agree with previous photographic measurements (cf. A., 1940, I, 350), and are compared with corresponding room temp. data (cf. A., 1938, I, 563). Natural rotations are displaced in the negative (abnormal) direction at low temp. The magnetic rotations, although in the positive (diamagnetic) direction, are increased at low temp. The Verdet const. at 5461 Å. is represented by  $V = 0.018 + 2.3/T$ . N. M. B.

**Torsional frequencies of crystal specimens.** W. F. Brown, jun. (*Physical Rev.*, 1940, [ii], 58, 998–1001).—The interpretation of twisting and bending of cylindrical specimens under a harmonically varying twisting moment is examined and results are applied to available experimental data (cf. Siegel, A., 1940, I, 250). N. M. B.

#### IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

**Change of electric conductivity of water in supersonic field.** S. S. Tumanski and M. S. Schulman (*Kolloid. Shurn.*, 1939, 5, 961–964).—Supersonic field produced by a piezo-quartz increases the conductivity of H<sub>2</sub>O at 20°, e.g., by  $3 \times 10^{-6}$  ohm<sup>-1</sup> cm.<sup>-1</sup> within 15 min. When CO<sub>2</sub> passes over H<sub>2</sub>O this increase may be  $4 \times 10^{-5}$ . The effect of the field is due to additional dissolution of CO<sub>2</sub> from the air. J. J. B.

**Magnetic properties of the iron group anhydrous chlorides at low temperatures.** I. Experimental. C. Starr, F. Bitter, and A. R. Kaufmann. II. Theoretical. C. Starr (*Physical Rev.*, 1940, [ii], 58, 977–983, 984–992).—I. The susceptibility  $\chi$  of the anhyd. chlorides of Fe, Ni, Co, Mn, Cr, V, Ti, and Cu was studied as a function of field strength up to 32,000 gauss and of temp. down to 13.9° K. None of the compounds showed any dependence of  $\chi$  on field strength at temp.  $> 63^\circ$  K. NiCl<sub>2</sub>, CoCl<sub>2</sub>, FeCl<sub>2</sub>, and CrCl<sub>3</sub>, which have positive Curie temp. at room temp., show a field strength dependence of  $\chi$  at 13.9° and 20.4° K. The first three have an S-type magnetisation curve characterised by a small initial  $\chi$  which decreases with falling temp., followed by a very large  $\chi$  and eventual approach to saturation, both increasing with falling temp. CrCl<sub>3</sub> (Curie point 16.8° K.) shows a field dependence of  $\chi$  above and below this temp., and a large initial  $\chi$  increasing with falling temp. The  $\chi$  of many of the compounds reaches a max. at temp. which do not appear to be correlated with field dependence, but these temp. correspond with the temp. of known sp. heat anomalies.

II. The predictions of paramagnetic theory are compared with the room temp. results and an attempt is made to explain departures from theory in terms of the cryst. field. The low-temp. anomalies require a theory of metamagnetism. It is assumed that at temp. below the Curie point neighbouring atoms behave as groups, which are spontaneously formed at the Curie point. The at. magnetic moments within each group are assumed to be either parallel or antiparallel to each other, the latter arrangement having the lowest energy. The resulting theory satisfactorily explains the behaviour of the metamagnetic chlorides (CrCl<sub>3</sub>, FeCl<sub>2</sub>, CoCl<sub>2</sub>, and NiCl<sub>2</sub>), and qualitatively explains the behaviour of the other chlorides. N. M. B.

**Effect of temperature on the ultrasonic velocity in liquids.** V. Suryaprakasam (*Proc. Indian Acad. Sci.*, 1940, 12, A, 341–349).—Ultrasonic velocities ( $v$ ) and adiabatic compressibilities have been measured throughout the temp. range 30–120° for C<sub>6</sub>H<sub>6</sub>, Pr<sup>3</sup>OH, CCl<sub>4</sub>, CH<sub>3</sub>Ph·OAc, PhCl, PhBr, *o*- and *m*-C<sub>6</sub>H<sub>4</sub>MG·NO<sub>2</sub>, COPhMe, and cyclo-hexane and hexanone. For all these substances  $v$  diminishes with temp. at approx. 3–5 m. per sec. per degree. The rate of decrease in  $v$  for *o*- > *m*-C<sub>6</sub>H<sub>4</sub>Me·NO<sub>2</sub>, and for PhCl > PhBr. C<sub>6</sub>H<sub>6</sub> shows the greatest rate of fall and Pr<sup>3</sup>OH exhibits a point of inflexion at  $\sim 55^\circ$ . The results agree with existing data. W. R. A.

**Diamagnetism of phosphorus.** S. R. Rao and S. Aravamudachari (*Proc. Indian Acad. Sci.*, 1940, 12, A, 361–366).—Employing the Gouy method  $\chi$  ( $\times 10^{-6}$ ) for white P is  $-0.840$ , and for CS<sub>2</sub>  $-0.538$ . 25 solutions of P<sub>4</sub> in CS<sub>2</sub> (% com-

position  $> 25\%$ ) have been examined. Observed  $\chi$  is  $>$  calc.  $\chi$  for all solutions. This may be due to (a) solid white P containing complexes higher than P<sub>4</sub> which break down to P<sub>4</sub> on dissolution, or (b) the tetrahedral mol. of solid P not being completely non-polar and thus possessing intermol. interaction forces which cease to function on dissolution. Alternative (b) is preferred. W. R. A.

**Low-temperature gaseous heat capacities of certain C<sub>3</sub> hydrocarbons.** G. B. Kistiakowsky, J. R. Lacher, and W. W. Ransom (*J. Chem. Physics*, 1940, 8, 970–977; cf. A., 1939, I, 362).—The thermal conductivities of CH<sub>3</sub>:C:CH<sub>2</sub>, CH<sub>2</sub>:CHMe, CH<sub>3</sub>CMe, and cyclopropane have been measured at low pressures and at 150–340° K. by the method described previously (A., 1938, I, 184). The heat capacities deduced from these measurements are compared with those determined by other methods, and support the bracketing method of determining these vals. The heats of reaction of H<sub>2</sub> with C<sub>3</sub>H<sub>2</sub>, C<sub>3</sub>H<sub>4</sub>, and CH<sub>2</sub>:CHMe at 0° K. and the non-vibrating state, calc. from measurements at higher temp., show the same regularities as the experimental vals. for 355° K., indicating that the dependence of the heat change of a reaction on other groups present in the mol. is a fundamental phenomenon, due to a change in the bonding strength within the mol. J. W. S.

**Heat capacities of some organic compounds containing nitrogen, and the atomic heat of nitrogen.** S. Satoh and T. Sogabe (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, 19, 1348–1352).—Thermal data for org. compounds differing in mol. formula by NH<sub>3</sub>, C<sub>2</sub>H<sub>2</sub>, and CH<sub>2</sub>N<sub>2</sub> are reviewed, and the heat capacities of these mols. are obtained. Using the known mean at. heats of C and H, that of N can be found. The at. heat of N is usually lower in aliphatic compounds than in aromatic. The average val. is 4.46. A. J. M.

**Gaseous heat capacity and restricted internal rotation of diborane.** F. Stitt (*J. Chem. Physics*, 1940, 8, 981–986).—Using the low-temp. thermal-conductivity method (A., 1938, I, 184; 1939, I, 362) with C<sub>2</sub>H<sub>2</sub>, C<sub>2</sub>H<sub>4</sub>, and C<sub>2</sub>H<sub>6</sub> as comparison gases, the heat capacity of gaseous B<sub>2</sub>H<sub>6</sub> has been measured at 95–324° K. The val. at 95° K. ( $C_p = 6.35 \pm 0.20$  g.-cal. per g.-mol. per degree) indicates that internal rotation in the B<sub>2</sub>H<sub>6</sub> mol. is restricted by a potential barrier, the height of which is probably 4000–6000 g.-cal. per g.-mol. if the barrier is assumed to be a sinusoidal function of the angle of internal rotation. J. W. S.

**Critical constants and van der Waals' equation.** G. N. Copley (*Chem. and Ind.*, 1941, 48).—Methods of calculating van der Waals' const.  $b$  are discussed. If van der Waals' equation is valid at the crit. point,  $RT_c/p_{c,v_c} + 8p_{c,v_c}/RT_c = h = 5.67$ . Data for 31 substances give a mean  $h$  val. of 5.85, and show that  $h$  is more nearly const. than  $RT_c/p_{c,v_c}$ . A. J. E. W.

**Compressibility of ammonia at high temperatures and pressures.** J. S. Kasarnovski (*Acta Physicochim. U.R.S.S.*, 1940, 12, 513–522).— $P$ - $V$  vals. are given for 25° intervals from 200° to 300° and for pressures 100–1629 atm. The vals. are correct to 0.5%. F. L. U.

**Influence of high-frequency electric field on the velocity of crystallisation of undercooled salol.** R. J. Berlaga and K. K. Demidov (*Acta Physicochim. U.R.S.S.*, 1940, 12, 609–616).—In an alternating electric field of frequency  $3.5$ – $9 \times 10^7$  cycles per sec. the linear crystallisation velocity of salol at room temp. is reduced to an extent corresponding with a rise of temp. of 6–7°, whilst the max. rise produced by the field under the same conditions in solid or liquid salol was 2.5°. F. L. U.

**Growth conditions for single and optically mosaic crystals of zinc.** C. A. Cinnamon and A. B. Martin (*J. Appl. Physics*, 1940, 11, 487–490).—The conditions of growth of single crystals of Zn (99.99+ %) have been studied by a modified Kapitza method. The ratio of temp. gradient across the interfacial boundary between liquid and solid phases to the rate of growth of the crystal must be maintained within an optimum range of vals. which depends on the angle of orientation. Crystals of high orientation can be grown over a much greater range of vals. of the above ratio than those of lower orientation, and optically mosaic crystals show no preferred region of growth. A. J. M.

**Viscosities of several common gases between 90° K. and room temperature.** H. L. Johnstone and K. E. McCloskey



(*J. Physical Chem.*, 1940, **44**, 1038—1058).—Using the oscillating-disc method the  $\eta$  (relative to air at 296.1° K.) of  $H_2$ , air,  $O_2$ ,  $NO$ ,  $N_2O$ ,  $CO_2$ , and  $CH_4$  have been determined and are recorded at  $\sim 10$ — $15^\circ$  intervals. The results, which are believed accurate to 0.3% at 300° K. and to 0.7—0.8% at the lower temp., generally agree with previously published data, but the present vals. are consistently > those of Sutherland and Maass (cf. A., 1932, 685) who used a somewhat similar apparatus. Inaccurate temp. measurement in the earlier experiments is suggested as a cause of the observed differences. C. R. H.

## V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

**Properties of hydrogen mixtures.** A. W. Brunot (*Trans. Amer. Soc. Mech. Eng.*, 1940, **62**, 613—619).—The properties ( $d$ , sp. heat,  $\eta$ , and thermal conductivity) of binary mixtures of  $H_2$  with small amounts of air,  $N_2$ , or  $CO_2$  are summarised. R. B. C.

**Proposed standardisation of osmotic pressure as a term.** W. H. Hall (*Science*, 1940, **92**, 334).—Suggestions concerning the definition of osmotic pressure are made. L. S. T.

**Determination of the vapour pressure of aqueous solutions.** Z. P. Tschesheva and K. N. Oseledko (*Kolloid. Shurn.*, 1939, **5**, 875—882).—Through the stopper of a flask a Ni test-tube is inserted. The flask contains the aq. solution, and the test-tube  $Et_2O$  and a thermometer.  $Et_2O$  evaporates, and the temp. at which dew appears on the tube is read. The results are consistent within 0.03 mm. Hg. Within this limit the v.p. of mol. solutions of NaCl, KCl,  $CaCl_2$ ,  $BaCl_2$ , and mannitol agree with older data. The v.p. of 1M-sucrose at 25° is 23.27—23.29 mm. Hg, showing that sucrose binds 6—8 mols. of  $H_2O$ . 0.7% of starch does not affect the v.p. of salt or mannitol solutions. J. J. B.

**"Re-formation" process in the study of changes of state in metals [alloys].** H. Auer and H. Schröder (*Ann. Physik*, 1940, [v], **37**, 137—154).—A detailed discussion of the physical basis of methods involving heat-treatment of alloys during the progress of changes of state. The conditions necessary for a reversal of the direction of a change by increase of temp. are outlined, and the formation, temp. hysteresis, uniformity of at. forces, and thermal energy relationships of transitional states are discussed. Deductions concerning the execution of "re-formation analyses" find complete confirmation in data for Al-Cu alloys obtained by magnetic susceptibility measurements. A. J. E. W.

**X-Ray analysis of gold-aluminium alloys.** O. E. Ullner (*Arkiv Kemi, Min., Geol.*, 1940, **14**, A, No. 3, 20 pp.; cf. Coffinberry et al., A., 1938, I, 132).—X-Ray analysis of the Au-Al system by the powder method shows the existence of 6 intermediate phases below 500°. The  $\alpha$ -phase is a solid solution of Al in Au, the saturation limit at 500° being approx. 12.4 at.-% of Al. The phase retains the face-centred cubic lattice of Au. The first intermediate phase,  $Au_4Al$  (the Y-phase of Heycock and Neville), exists only over a narrow range, and is obtained pure only in alloys which have been melted, allowed to cool to 400—500°, and then quenched. The lattice is simple cubic, parameter 6.902 Å. at 510°; unit cell contains 20 atoms. The co-ordination no. of the Al atom is 6. The X-ray photograph is very similar to that obtained for  $\beta$ -Mn, but the structure of  $Au_4Al$  is not completely identical with that of  $\beta$ -Mn. A  $\delta$ -phase, of which the exact composition could not be determined, was also detected. The D-, E-, and X-phases of Heycock and Neville could not be obtained pure, and exist only over narrow ranges. The formulae assigned to them ( $Au_5Al_2$  or  $Au_4Al_3$ ,  $Au_3Al$ , and  $AuAl$ , respectively) by Heycock and Neville are probably correct. A. J. M.

**Aluminium-magnesium alloys.**—See B., 1941, I, 75.

**Constitution of the magnesium-rich alloys in the systems magnesium-lead, magnesium-tin, magnesium-germanium, and magnesium-silicon.** G. V. Raynor (*J. Inst. Metals*, 1940, **66**, 403—426).—The systems have been examined by thermal, micrographic, and X-ray methods from the Mg end up to the eutectic. The solubility of Pb in Mg falls from 7.75 at.-% at the eutectic temp. (465°) to 5.2 at 400°, 2.3 at 300°, and 0.5 at.-% at 200°, and that of Sn in Mg from 3.35 at.-% at the eutectic temp. (560.6°) to <0.2 at.-% at 250°. Mg

dissolves  $\sim 0.003$  at.-% of Ge and Si at 600° but both these elements are practically insol. in Mg at room temp. The eutectic points of these systems are: Pb 19.0 at.-%, 465°; Sn 10.7 at.-%, 560.6°; Ge 1.15 at.-%, 634.7°; Si 1.16 at.-%, 637.6°. The liquidus curves for the four systems form a clear valency group; other regularities between the systems are pointed out. A. R. P.

**Neutron studies of order in iron-nickel alloys.** F. C. Nix, H. G. Beyer, and J. R. Dunning (*Physical Rev.*, 1940, [ii], **58**, 1031—1034; cf. Whitaker, A., 1939, I, 396; 1940, I, 307).—The difference in neutron transmission between fully annealed and quenched alloys plotted against Ni content shows a broad peak near  $Ni_3Fe$  and falls to vanishingly small vals. near 35 at.-% of Ni and pure Ni. The higher is the degree of order the greater is the transmission. Substitution of 2.3 at.-% of Mo or 4.1 at.-% of Cr for Fe in the annealed 78 at.-% Fe-Ni alloy causes a relative transmission decrease of 15.6 and 21.2%, respectively. Cold-working (known to produce disorder) of an annealed 75 at.-% Ni alloy causes a decrease of 20.6% in neutron transmission. Results demonstrate the use of neutron technique in studying order in the solid state. N. M. B.

**Regular solutions of gases in liquids.** M. Gonikberg (*Acta Physicochim. U.R.S.S.*, 1940, **12**, 489—500).—Hildebrand's equation (cf. A., 1935, 818) is applied to the calculation of the solubilities of  $H_2$  and  $N_2$  in various solvents at several temp. Approx. formulae for vals. of the internal pressure needed for the calculation are given. Henry's coeff., for low concns. and pressures, can also be deduced from the theory. F. L. U.

**Solubility of gases in liquids at low temperatures and high pressures. III. Solubility of hydrogen in liquid methane.** V. Fastovski and M. Gonikberg (*Acta Physicochim. U.R.S.S.*, 1940, **12**, 485—488).—The distribution of  $H_2$  between liquid  $CH_4$  and the vapour phase was determined at 90.3°, 110.0°, 122.0°, and 127.0° K. over the pressure range 180—230 atm., under which conditions the system behaves in accordance with Kritschewski's equation for dil. solutions. Vals. of Henry's coeff. and the partial mol. vol. of the dissolved  $H_2$  are calc. F. L. U.

**Solubility curves.** E. I. Achumov (*J. Gen. Chem. Russ.*, 1940, **10**, 670—672).—Where solvates are formed it is more convenient to express concns. as g.-mols. of solvent per g.-mol. of solute. R. T.

**Partition of sulphur dioxide between water and some immiscible solvent.** H. Suzuki (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, **19**, 1360—1363).—The distribution of  $SO_2$  between  $H_2O$  and  $CHCl_3$ ,  $C_6H_6$ , and  $CCl_4$  has been investigated at 25°. The following coeffs. were obtained:  $C_{CHCl_3}/C_{H_2O} = 1.40$ ;  $C_{C_6H_6}/C_{H_2O} = 2.03$ ;  $C_{CCl_4}/C_{H_2O} = 0.516$ . A. J. M.

**Exchange of uni- and multi-valent ions in soils and glauconite.**—See B., 1941, III, 30.

**Sorption by clays.**—See B., 1941, III, 30.

**Surface activity. V. Surface activity and osmotic pressure in inorganic salts.** A. Giacalone (*Gazzetta*, 1940, **70**, 274—283; cf. A., 1940, I, 203).—The surface tension  $\gamma$  of equiv. solutions of various chlorides is the same. The deviation of the lowering of the f.p. from the theoretical val. increases with concn. above a certain concn. This increase is the greater the higher is the valency of the cation. Increase in  $\gamma$  and depression of f.p. are related. O. J. W.

**Surface ageing of solutions.** A. E. Alexander (*Trans. Faraday Soc.*, 1941, **37**, 15—25).—The course of adsorption at the air- $H_2O$  interface of  $Ph\cdot[CH_2]_2\cdot CO_2H$  (I),  $C_{12}H_{25}\cdot O\cdot SO_3Na$ ,  $C_{16}H_{33}\cdot SO_3H$ , and  $C_8H_5N\cdot C_{16}H_{33}Br$  has been studied by measurements of surface and interfacial tension and of surface potential. All these substances are adsorbed at a rate  $\ll$  that calc. from their diffusion rates. The time lag is completely eliminated by the presence of a monolayer of a "piston" oil ( $Et$  dodecoate, oleic acid), and is considerably reduced by addition of capillary-active substances such as  $PrOH$  or  $EtOAc$ ; with (I) it is eliminated by the formation of the Na salt. The rate-determining step is considered to be the penetration and reorientation in the surface layer of the hydrophobic part of the mol. F. L. U.

**Nomograph for surface tension of ethyl alcohol-water mixtures [from 15° to 90°].** D. S. Davis (*Ind. Eng. Chem.*, 1940, **32**, 1587). S. M.



**Electrocapillary curves of alloys in fused salts.** S. Karpatschov and A. Stromberg (*Acta Physicochim. U.R.S.S.*, 1940, 12, 523—530).—Electrocapillary curves for Sn-Zn and Mg-Tl alloys in KCl-LiCl and KI-LiI mixtures were determined at 430°. In the Tl alloys the potential corresponding with max.  $\gamma$  becomes more positive with increase in [Tl] up to ~20%, above which it remains const. This behaviour, which closely resembles that in aq. solutions, is attributed to adsorption of Tl at the interface with the electrolyte. Surface concns. are calc. by Gibbs' equation. F. L. U.

**Study of foam stability. Effect of acids on syneresis of saponin foam.** K. N. Arbuzov (*Kolloid. Shurn.*, 1939, 5, 867—874).—The foam was produced by passing air through saponin (I) solution in a sintered glass crucible. The rate of drainage of foam from solutions in H<sub>2</sub>O is a max. when 0.4—0.5 of the foam is drained away. It is lowered by addition of HCl or AcOH when the concn. of (I) is 0.4%, and by HCl when it is 1.2%; 0.1N-AcOH reduces, and 1—2N-AcOH increases, the rate in 1.2% (I). The lowering of the rate by 0.1N-HCl is > by more conc. acids, the least lowering being observed in 1N-HCl. The rate in AcOH increases with concn. up to 2N. Presumably acids have a physical effect common to all acids, and a chemical effect different in HCl and AcOH; the relative importance of the chemical effect increases with degree of drainage. J. J. B.

**Emulsions. I. Mechanism of emulsification of a standard emulsion in sodium oleate solution and nature of adsorption at the interface. II. Partial coagulation of a standard emulsion in sodium oleate solution by salts of bi- and multivalent metals.** A. R. Martin and R. N. Hermann (*Trans. Faraday Soc.*, 1941, 37, 25—29, 30—38).—I. "Standard" emulsions contained 60 vol.-% of oil and were made by intermittent shaking of 0.033N-Na oleate. Some of the substances emulsified formed emulsions of the H<sub>2</sub>O-in-oil type, and this tendency increased with increasing interfacial tension of the liquid against H<sub>2</sub>O. Such liquids could be made to give emulsions of the oil-in-H<sub>2</sub>O type by increasing the periods of rest between successive shakings. An explanation of this behaviour is offered. From measurements of the mean size of the droplets it is calc. that the interfacial film is in no case > unimol. In paraffin and C<sub>6</sub>H<sub>6</sub> emulsions it consists of acid soap. The viscosity of emulsions of C<sub>11</sub>H<sub>23</sub>OH is abnormally high.

II. The vols. of oil separated from "standard" emulsions by the addition of salts of Zn, Mg, Ca, Sr, Ba, Cu, Co<sup>III</sup>, Al, Th, and hexol in amounts < those required to react with the whole of the Na oleate have been measured. The effects are sp., and valency is unimportant, HCl being more effective than any of the salts used. The most important factor is the withdrawal from the stabilising film of oleic acid which is attached to the metal oleate formed. Thus CuSO<sub>4</sub> and Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, which are very effective coagulants, form oleates containing a large excess of acid, whilst ZnSO<sub>4</sub>, which is relatively ineffective, forms a nearly normal oleate.

F. L. U.

**Dependence of the law of size distribution of crystals on kinetics of crystallisation. I. Dispersion statistics for free growth.** S. Roginski and O. Todes (*Acta Physicochim. U.R.S.S.*, 1940, 12, 531—558).—On the basis of kinetic equations for the free growth of crystals (cf. A., 1939, I, 616) expressions are derived for the size distribution, according to radius, surface, or vol., of primary cryst. particles. Except for the case where nucleus formation and growth are affected by decreasing concn., the distribution curves in general exhibit no max., and differ completely from those for a Gaussian distribution. The occurrence of the latter in some actual systems is due to secondary processes such as aggregation of primary particles. F. L. U.

**Science of rheology.** V. G. W. Harrison (*Nature*, 1940, 146, 580—582).—A review. L. S. T.

**Determination of surface area of powders.**—See B., 1941, I, 46.

**Stabilisation of suspensions, and adsorption layers in disperse systems.**—See B., 1941, II, 57.

**Aluminium hydroxide sol prepared by autoclave treatment.** T. Katsurai and T. Kita (*Bull. Chem. Soc. Japan*, 1940, 15, 458—459).—A stable Al(OH)<sub>3</sub> sol is obtained by heating a washed suspension of the ordinary ppt. in an autoclave at 190° for 1 hr. The ppt. should be washed until free from alkali but still containing a trace of chloride. F. J. G.

**Stabilisation of suspensions by adsorption layers. XX. Stabilisation of suspensions of titanium dioxide in hydrocarbon media by soaps of multivalent metals.** L. R. Soloveva (*Kolloid. Shurn.*, 1939, 5, 883—897; cf. A., 1938, I, 511).—From sedimentometric curves the largest, smallest, and most probable apparent diameter ( $\bar{d}$ ) of 2% suspensions of TiO<sub>2</sub> in dry C<sub>6</sub>H<sub>6</sub> are calc. to be respectively 60—80  $\mu$ , 30—60  $\mu$ , and 44—68  $\mu$ . The val. of  $\bar{d}$  is reduced by 2/3 by addition to the C<sub>6</sub>H<sub>6</sub> of 5% of oleic acid, or of 1% of Mg oleate, Al oleate, or Ca stearate, or of 0.1% of Ca oleate, or of 0.05% of Al stearate. No connexion with the surface activity of the soaps is observed. J. J. B.

**Surface of colloidal particles in titanium dioxide sols.** V. V. Kisseleva and V. A. Kargin (*Acta Physicochim. U.R.S.S.*, 1940, 12, 589—608).—Erythrosin, methylene-blue, and thionine-blue were added to dialysed sols of TiO<sub>2</sub> in amounts such that adsorption of the dye was complete irrespective of the sign of the charge on the colloid. The resulting changes in the absorption spectrum of the dyes are independent of the  $p_H$  of the intermicellar liquid and are determined solely by the composition of the adsorption layer. The observations are interpreted in terms of ionic exchange. F. L. U.

**Base-binding capacities of hydrogen-clays.**—See B., 1941, III, 30.

**Electron diffraction study of hydrous oxides amorphous to X-rays.** H. B. Weiser and W. O. Milligan (*J. Physical Chem.*, 1940, 44, 1081—1094).—Freshly formed gels of hydrous oxides which are amorphous to X-rays fall into two classes: those which give electron diffraction patterns characteristic of crystals, e.g.,  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>,  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> [from Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>],  $\alpha$ -Ga<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, and probably BeO, and those which give patterns of the amorphous type, e.g., Cr<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, Nb<sub>2</sub>O<sub>5</sub>, and Ta<sub>2</sub>O<sub>5</sub>. The gels of the first class are composed of very fine crystals which give diffuse patterns. The gels of the second class are amorphous, the atoms being arranged in a network which lacks periodicity and symmetry. C. R. H.

**Study of amorphous films by electron diffraction. III.** S. Yamaguchi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1940, 38, 100—105; cf. A., 1940, I, 199).—Electron diffraction shows that a colloidal substance of definite structure, approx. cubic, appears just before a film of saturated aq. ZnBr<sub>2</sub> crystallises to ZnBr<sub>2</sub>·2H<sub>2</sub>O, and when saturated aq. ZnCl<sub>2</sub> crystallises. The size of these colloidal particles is 30—50 Å. A. J. M.

**Time of set of silica gels. V. Effect of alcohols and  $p_H$  on the "heat of activation."** L. A. Munro and J. A. Pearce (*J. Physical Chem.*, 1940, 44, 1024—1033).—Using the technique previously described (cf. A., 1937, I, 564 and subsequently), the time of set of SiO<sub>2</sub> gels over the range 0—50° and  $p_H$  range ~5.5—10.5 and in presence of MeOH, PrOH, (CH<sub>3</sub>OH)<sub>2</sub>, glycerol, and mannitol has been determined. Those added substances which most affect the time of set are affected most by temp. changes. In alkaline media all added substances become less sp. in their effects with rise in temp.; MeOH and PrOH have an accelerating action at high and a slightly retarding action at low  $p_H$ , the  $p_H$  of reversal being ~7. With all additions there is a lack of specificity at  $p_H$  ~7, suggesting that the dielectric const. of the added substance has little effect on the time of set. C. R. H.

**Influence of the solvent of the formation of micelles in colloidal electrolytes. I. Electrical conductivities of sodium dodecyl sulphate in ethyl alcohol-water mixtures.** A. F. H. Ward (*Proc. Roy. Soc.*, 1940, A, 176, 412—427).—In very dil. aq. solution Na dodecyl sulphate behaves as a completely dissociated electrolyte. Above a crit. concn. the equiv. conductance falls and micelles are formed. The variation of conductance with concn. was measured for a series of mixtures of H<sub>2</sub>O and EtOH and the curves show a gradual transition from the type associated with micelle formation to that characteristic of strong electrolytes. Micelles are not formed at concn. >40% of EtOH, and the crit. concn. at first falls and then rises with increasing addition of EtOH. The effects are interpreted by considering the radius of the micelle to be equal to the length of the paraffin chain and thus to be independent of concn. and nature of solvent. The energy changes involved in micelle formation are calc. and it is shown that the EtOH mols. are adsorbed on the micelle surfaces. G. D. P.



**Systems of sodium palmitate in organic liquids.** R. D. Vold, C. W. Leggett, and J. W. McBain (*J. Physical Chem.*, 1940, **44**, 1058—1071).—The solubility ( $s$ ) of Na palmitate (I) in glycerol, diethylene glycol, medicinal paraffin,  $n$ -C<sub>12</sub>H<sub>26</sub>, PrOH, palmitic acid (II), and CCl<sub>4</sub> over the range 0–300° has been determined. At temp. <50°  $s$  is very low in all the solvents but at higher temp. considerable differences are observed. In general  $s$  increases with increasing polarity of the solvent, (II) and CCl<sub>4</sub> being the exceptions, but the formation of acid soaps with (II) and chemical reaction between (I) and CCl<sub>4</sub> at high temp. adequately account for their abnormal behaviour. In five of the solvents  $s$  bears no relation to the m.p. of (I), the so-called Krafft point, and this would appear to rob the Krafft point of much of its significance.  $s$  curves of (I) in H<sub>2</sub>O, (II), and (CH<sub>2</sub>-OH)<sub>2</sub> each indicate the presence of supernat soap phases of approx. equal thermal stability. These phases have possibly a micellar structure with solvent filling the interstices between soap aggregates. No phase analogous to middle soap was found. C. R. H.

**Soap gels in pinene.** M. Prasad and C. V. Viswanath (*Current Sci.*, 1940, **9**, 459; cf. A., 1940, I, 293).—Transparent gels formed by K oleate, Na palmitate (I), and Na stearate in pinene resemble those of Na oleate (II). The rate of syneresis of these gels is greatest with (II), least with (I). F. R. G.

**Viscosity of starches of various sorts in sodium salicylate.** M. I. Kniaginitshev (*Kolloid. Shurn.*, 1939, **5**, 899–906).—0.2 g. of starch is pasted with 1 c.c. of H<sub>2</sub>O and then dissolved in 99 c.c. of 30% or 55% aq. Na salicylate. The  $\eta$  of solutions in 30% salicylate was at 20° 1.2–1.3 (H<sub>2</sub>O = 1); it is almost independent of the plant (wheat, rye, barley, rice, pea, bean, potato, *Vigna sinensis*). Small granules give smaller  $\eta$  vals. than large granules of the same plant, presumably since small granules contain relatively more skin which is insol. in salicylate solutions. The relative  $\eta$  of *Solanum andigenum* is 2 although its skin is as thick as that of other kinds of potato. EtOH ppts. from these solutions a substance which gives a blue reaction with I but gives no paste with H<sub>2</sub>O. The  $\eta$  of 1% starch solutions in 30% salicylate solution is 5. J. J. B.

**Electric moments and relaxation times of protein molecules.** J. L. Oncly (*J. Physical Chem.*, 1940, **44**, 1103–1113).—The electric moments of horse serum-albumin (I) and serum pseudo-globulin- $\gamma$  (II) and of edestin (III) from hemp seed are respectively 380, 1200, and 1400 Debye units. In the case of (I) and (III) relaxation times and at. shapes calc. from dielectric dispersion data compare favourably with those calc. from ultracentrifuge, dispersion, and  $\eta$  measurements, but it is necessary to assume hydration to the extent of ~0.4 g. of H<sub>2</sub>O per g. of protein in the case of (II). C. R. H.

**Properties of thixotropic gels containing ovalbumin as the disperse phase.** W. G. Myers and W. G. France (*J. Physical Chem.*, 1940, **44**, 1113–1126).—Theories of protein structure and of thixotropy are reviewed. The emptying time ( $t_E$ ) of a viscometer containing a 1% solution of ovalbumin in presence of 30 vol.-% of AcOH, and NaCl, Na<sub>2</sub>SO<sub>4</sub>, or Na<sub>4</sub>Fe(CN)<sub>6</sub> has been determined at 27°, and at various times ( $t_M$ ) up to 1 hr. after mixing of the components.  $t_E$  increases with increase in  $t_M$ , the increase becoming more pronounced as [NaCl] increases. The systems containing 0.006–0.02N-NaCl show increasing thixotropic gel structure. If AcOH is replaced by H<sub>2</sub>SO<sub>4</sub> to give the same [H<sup>+</sup>]  $t_E$  remains const. as  $t_M$  increases. This difference in the behaviour of a weak and a strong acid cannot be accounted for on the basis of differences in the no. of salt bridges neutralised, since in each case [H<sup>+</sup>] is sufficient to neutralise all the salt bridges. It is more probable that AcOH in such concn., in addition to forming albumin acetate, solvates (through H bonds) the loose ends of the salt bridges after neutralisation has allowed them to separate. These solvate mols. are in turn solvated by H<sub>2</sub>O or by other solvated mols. until a huge lyosphere is built having a more or less extended polypeptide chain as its central strut. The interlocking of such lyospheres tends to increase  $\eta$ . Neutralisation of salt bridges permits the slow unwinding of the polypeptide chain which can then be solvated. Neutralisation of the salt bridges by H<sub>2</sub>SO<sub>4</sub> may also result in the unwinding of the polypeptide chain, but since the amount of H<sub>2</sub>SO<sub>4</sub> is small solvation of the chain has a correspondingly smaller effect. Added salts decrease the repulsion between the like-charged highly solvated particles

of the disperse phase. The salts then decrease the repulsion which normally exists between the lyospheres and cause them to cohere. Salts having multivalent ions are more effective in this than those having univalent ions. C. R. H.

## VI.—KINETIC THEORY. THERMODYNAMICS.

**Factors determining electrolytic dissociation. II. Free energies of dissociation of salt molecules in aqueous solution.** W. J. C. Orr (*Phil. Mag.*, 1941, [vii], **31**, 51–61; cf. A., 1934, 1307).—Theoretical. Methods of calculating the total heat, entropy, and free energy changes during the dissolution of salt mols. in H<sub>2</sub>O are derived, and applied to the calculation of these functions for KF, KCl, KBr, KI, LiCl, NaCl, RbCl, AgCl, TlCl, ZnCl<sub>2</sub>, CdCl<sub>2</sub>, and HgCl<sub>2</sub>. J. W. S.

**Pictures of acid-base reactions.** T. H. Hazlehurst, jun. (*J. Chem. Educ.*, 1940, **17**, 374–376).—The unique behaviour of H<sup>+</sup> and its marked difference from other ions in size is emphasised by using charts of "electron density" to represent mols. and ions containing H. Diagrams illustrating reactions between H<sub>2</sub>O and HCl, NH<sub>3</sub>, and O<sup>2-</sup>, and between OH<sub>3</sub><sup>+</sup> and NH<sub>3</sub>, are reproduced. L. S. T.

**Review of the interpretation of  $p_H$ .** M. Gorman (*J. Chem. Educ.*, 1940, **17**, 343–345). L. S. T.

**Effect of ethyl alcohol on  $p_H$  values determined by the glass electrode, and the association of ions in alcoholic hydrochloric acid.** N. Yui (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, **19**, 1353–1359).—The potentials of H and glass electrodes were compared by measuring the e.m.f. of the following cells at 25° (Hg<sub>2</sub>Cl<sub>2</sub> in saturated KCl): H<sub>2</sub>[HCl (aq. 0.01N.)|Hg<sub>2</sub>Cl<sub>2</sub>; H<sub>2</sub>[HCl (0.01N.), EtOH (x%)|Hg<sub>2</sub>Cl<sub>2</sub>; H<sub>2</sub>[HCl (aq. 0.01N.)|glass|HCl (0.01N.), EtOH (x%)|Hg<sub>2</sub>Cl<sub>2</sub>. [HCl] was maintained at 0.01N., whilst [EtOH] was increased up to 50% by wt. The difference of potential of the H electrode with increase in [EtOH] is not  $\propto$  [EtOH], and is very small, not exceeding 2.5 mv. If great accuracy is not required the glass electrode can be used satisfactorily for the determination of  $p_H$  in EtOH solutions, up to 50% concn., although results are not always reproducible. The  $p_H$  of HCl solutions increases linearly with [EtOH] up to 30%. Above this an abrupt increase in  $p_H$  was observed, which may be explained by assuming an association of Cl<sup>-</sup> and H<sup>+</sup>. A. J. M.

**Phosphatides and inorganic salts.**—See A., 1941, III, 133.

**Thermal dissociation of bismuth sulphide. II.** I. J. Gerasimov (*J. Gen. Chem. Russ.*, 1940, **10**, 1069–1072; cf. A., 1937, I, 463).—The temp.-dissociation pressure curve is given for Bi<sub>2</sub>S<sub>3</sub>, for the interval 650–750°. The vapour phase consists exclusively of S; lower sulphides are not found in the residue. R. T.

**Phase-rule study of the system sodium stearate-water.** J. W. McBain, R. D. Vold, and (Miss) M. Frick (*J. Physical Chem.*, 1940, **44**, 1013–1024).—A phase diagram of the system Na stearate (I)–H<sub>2</sub>O has been constructed from data obtained over the range 62–288°, and is compared with similar diagrams for Na oleate, palmitate, and laurate. The phase behaviours are comparable except at high concns. of (I). Two max. in the curve correspond with middle and supernat soap. The min. temp. of existence of isotropic liquid between middle soap and soap-boiler's neat soap and between neat soap and supernat soap are 145° and 262°, respectively. The numerous phases observed can be divided into five groups solely on the basis of the difference between the appearance at 100° and at room temp. The appearance of the curd at room temp. depends to some extent on the phase from which it is formed. C. R. H.

**Phase diagrams for moist gases.** A. Stradelli (*Riv. Fræddo*, 1938, **24**, 293–299; *Chem. Zentr.*, 1938, ii, 3662).—A discussion of the construction and interpretation of phase diagrams for gas mixtures containing appreciable quantities of condensable constituents. A. J. E. W.

**Two-phase equilibrium in binary and ternary systems. IV. Thermodynamic properties of propane.** J. H. Burgoyne (*Proc. Roy. Soc.*, 1940, **A**, 176, 280–294).—Existing thermal data have been summarised and some new determinations of the  $p$ - $v$ - $T$  relationships for the liquid at low temp. have been made. The entropy and enthalpy have been calc. from –80° to 200° at pressures from 0.1 to 200 atm. The results are tabulated and presented graphically. G. D. P.



**Liquid-vapour equilibrium in the system ammonia-methane-nitrogen at high pressures.** P. E. Bolschakov and E. S. Lebedeva (*Acta Physicochim. U.R.S.S.*, 1940, 12, 501—512).—Equilibrium compositions of liquid and vapour in  $\text{NH}_3\text{--CH}_4\text{--N}_2$  mixtures ( $\text{N}_2:\text{CH}_4\sim 1:4$ ) were determined at  $-20^\circ$ ,  $0^\circ$ ,  $25^\circ$ , and  $50^\circ$  over the pressure range 50—560 atm. From the experimental data the solubility of pure  $\text{CH}_4$  in liquid  $\text{NH}_3$  is calc. The electrostatic theory of solutions (cf. Kritschevski and Chazanov, A., 1939, I, 605) is used to calculate the content of  $\text{NH}_3$  in compressed  $\text{CH}_4$  over the same temp. and pressure range. F. L. U.

**System lime-ferrie oxide-silica.** M. D. Burdick (*J. Res. Nat. Bur. Stand.*, 1940, 25, 475—488).—The equilibrium diagram for the portion of the system  $\text{CaO--Fe}_2\text{O}_3\text{--SiO}_2$  containing 15—65% of  $\text{CaO}$  and  $>65\%$  of  $\text{Fe}_2\text{O}_3$  has been studied. Comparison with the system  $\text{CaO--Al}_2\text{O}_3\text{--SiO}_2$  shows that  $\text{Fe}_2\text{O}_3$  extends the range of stability of the Ca silicates and lowers the liquidus and eutectic temp. Thermal analysis and X-ray investigations indicate the existence of a limited series of solid solutions of  $\text{Fe}_2\text{O}_3$  in  $2\text{CaO}\cdot\text{SiO}_2$  containing  $>0.5\%$  of  $\text{Fe}_2\text{O}_3$ . No ternary compounds were detected. The application of the results to cements of high  $\text{Fe}_2\text{O}_3$  content is discussed. J. W. S.

**Equilibria in the system  $\text{NaCl--PtCl}_4\text{--H}_2\text{O}$ .** N. S. Kurnakov and E. A. Nikitina (*J. Gen. Chem. Russ.*, 1940, 10, 577—588).—The solid phases in equilibrium with saturated solutions are  $\text{PtCl}_4\cdot 5\text{H}_2\text{O}$  and  $\text{Na}_2\text{PtCl}_6\cdot 6\text{H}_2\text{O}$  (I) at  $40^\circ$ ,  $\text{PtCl}_4\cdot 4\text{H}_2\text{O}$  and (I) at  $60^\circ$ , and  $\text{PtCl}_4\cdot 3\text{H}_2\text{O}$ ,  $\text{NaCl}$ , and (I) at  $80^\circ$ ,  $90^\circ$ , and  $98^\circ$ .  $\text{PtCl}_4$  exists in two forms, yellow and red crystals. The  $\eta$  of solutions of the latter is anomalously high. R. T.

## VII.—ELECTROCHEMISTRY.

**Maximum specific conductivity.** M. Usanovitch (*J. Gen. Chem. Russ.*, 1940, 10, 959—961).—Where conductance is due to formation of a dissociated complex from the components of a system, max. sp. conductivity  $\chi$  is found at that concn. of the latter for which the concn. of electrolytic complex is max., in accordance with the law of mass action. In other cases  $\chi$  is the resultant of the opposing effects of increasing concn. and increasing  $\eta$ . R. T.

**Effect of apolar compounds on the conductivity of halides of aluminium in nitrobenzene and ethyl bromide.** E. J. Gorenbein and I. M. Slavutzkaja (*J. Gen. Chem. Russ.*, 1940, 10, 1144—1150).—Addition of  $\text{SnCl}_4$ ,  $\text{SnBr}_4$ , or  $\text{CCl}_4$  depresses sp. conductivity in the systems  $\text{AlBr}_3\text{--EtBr}$ ,  $\text{AlBr}_3\text{--PhNO}_2$ , and  $\text{AlCl}_3\text{--PhNO}_2$ . R. T.

**Anomalous concentration cell.** Constitution of solutions of stannous chloride in water and in hydrochloric acid. L. R. Allison, E. J. Hartung, and E. Heymann (*J. Physical Chem.*, 1940, 44, 1033—1037).—The anomalous cell  $\text{Sn}^{+2}|\text{25\% SnCl}_2, 2.33\text{N-HCl}|2.5\% \text{ SnCl}_2, 0.233\text{N-HCl}|\text{Sn}^{+2}$  shows an e.m.f. of  $-70$  mv., but with  $2.33\text{N-HCl}$  in each cell the e.m.f. is  $30.9$  mv. Measurements made in absence and in presence of  $\text{HCl}$  show that the anomaly is due to the difference in  $[\text{HCl}]$ . With increase in  $[\text{HCl}]$  there is an increase in the amount of complex ions  $\text{SnCl}_4^{2-}$  and  $\text{SnCl}_5^{-}$  with a corresponding reduction in the amount of  $\text{Sn}^{+2}$ , accompanied by a reduction in e.m.f. At high  $[\text{HCl}]$  the complex is so stable that its degree of dissociation is only slightly affected by the total  $[\text{SnCl}_2]$ . The activity of  $\text{Sn}^{+2}$  which determines the e.m.f. is then approx.  $\propto [\text{SnCl}_2]$ . C. R. H.

**Overvoltage theory of H. Eyring.** A. Frumkin (*Acta Physicochim. U.R.S.S.*, 1940, 12, 481—484).—The theory (cf. A., 1940, I, 75) is criticised. F. L. U.

**Electro-acoustic chemical effects.** V. Reception of sound by platinum electrodes and by mercury electrodes covered with colloidal membranes. L. V. Nikitin (*J. Gen. Chem. Russ.*, 1940, 10, 636—640).—The range of wave-lengths of sound registered by a polarised Pt electrode in  $0.1\text{N-HCl}$  increases with rising c.d. to a max., above which it again falls. Similar effects are obtained with Hg electrodes contained in semi-permeable membranes. (Cf. A., 1940, I, 414.) R. T.

## VIII.—REACTIONS.

**Oxidation and inflammation of gas oils.**—See B., 1941, I, 58.

**Heat of reaction of sulphur monochloride with methyl and ethyl alcohol.** A. C. Batalin and N. A. Schtscherbakov (*J. Gen. Chem. Russ.*, 1940, 10, 730—732).—The heat of reaction of  $\text{S}_2\text{Cl}_2$  with  $\text{MeOH}$  is 28.24555 and with  $\text{EtOH}$  23.1622 kg.-cal. per g.-mol. The velocity coeffs. correspond with those of reactions of the first order. R. T.

**Formation of carbon disulphide.** H. Tominaga and M. Narita (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, 19, 1370—1376).—The kinetics of the reaction between S and C have been investigated. A. J. M.

**Reactivity of carbon.** H. Tominaga and M. Narita (*Bull. Inst. Phys. Chem. Res. Japan*, 1940, 19, 1364—1369).—The kinetics of the oxidation of various kinds of C with different previous treatment have been studied, and the relationship between the data and the structure of the C has been examined. A. J. M.

**Interpretation of the effect of diluting ozone on its action as an oxidation catalyst.** E. Briner (*Arch. Sci. phys. nat.*, 1940, [v], 22, Suppl., 59—61).—The no. of mols. of  $\text{O}_3$  activated for oxidation by a mol. of  $\text{O}_2$  increases markedly with dilution of the  $\text{O}_2$  in the gas (air or  $\text{O}_2$ ) over the solution oxidised. This is explained by assuming that oxidation occurs in the superficial layers of the solution and depends on the law of adsorption. Data obtained previously (A., 1940, I, 297) show that Freundlich's law holds. L. S. T.

**Hydrolysis of methyl acetate in relation to the activities of hydrogen ion and water in concentrated solutions of hydrochloric acid alone and in presence of chlorides.** M. Duboux and A. de Sousa (*Helv. Chim. Acta*, 1940, 23, 1381—1398).—From hydrolysis measurements at  $25^\circ$  vals. of  $\alpha$  and  $\beta$  in  $\log k/m = \alpha + \beta m$  ( $k$  = velocity coeff.,  $m$  = molarity of  $\text{HCl}$ ) have been evaluated. In absence of chloride  $\beta$  is positive. In presence of chloride and with const. total  $[\text{Cl}^-]$   $\beta$  is negative, i.e.,  $k$  increases less rapidly than  $m$ , the chloride effect increasing in the order  $[\text{NH}_4\text{Cl}] < [\text{NaCl}] < [\text{MgCl}_2]$ .  $k/a_{\text{H}^+}$  ( $a_{\text{H}^+}$  =  $\text{H}^+$  activity) is reasonably const. in presence of  $\text{MgCl}_2$ , especially when total  $[\text{Cl}^-]$  is low. In presence of  $\text{NaCl}$  and  $\text{NH}_4\text{Cl}$   $k/a_{\text{H}^+}$  decreases as  $m$  increases. The influence of the activity of  $\text{H}_2\text{O}$  ( $a_{\text{H}_2\text{O}}$ ) can best be illustrated by finding what val. of  $q$  will give const. vals. for  $k/a_{\text{H}^+}\cdot a_{\text{H}_2\text{O}}^q$ . For pure  $\text{HCl}$  and for  $\text{HCl--MgCl}_2$  mixtures  $q = 7$ . In similar experiments on the inversion of sucrose  $q \sim 1$ , but in other respects a common mechanism can be applied to both reactions. C. R. H.

**Effect of copper on oxidation of vitamin-C.**—See A., 1941, III, 211.

**Aerogel catalysts.**—See B., 1941, II, 29.

**Electrodeposition of bright copper.**—See B., 1941, I, 74.

**Electrodeposition of indium from sulphate baths.**—See B., 1941, I, 75.

**Production of formaldehyde by means of the electric arc at high and low frequencies.** E. Briner and H. Høffer (*Arch. Sci. phys. nat.*, 1940, [v], 22, Suppl., 82—84).—In mixtures of  $\text{CO} + \text{H}_2$  the high-frequency arc, although more effective than the low-frequency arc, gives only a relatively small yield of  $\text{CH}_2\text{O}$ . On the other hand, in presence of  $\text{CH}_4$  the yield is much increased. Data showing the increase in yield with an increase in  $\nu$  are recorded. The increased  $\nu$  and the consequent reduction of pressure reduces or even suppresses entirely the deposition of C on the electrodes. L. S. T.

**Wave-lengths of ultra-violet radiations capable of producing ozone and the influence of pressure on this production.** E. Briner and E. Perrotet (*Helv. Chim. Acta*, 1940, 23, 1480—1490).—At ordinary pressures the most effective  $\lambda$  range of continuous radiation for  $\text{O}_3$  formation is 1800—2300 Å. As the pressure is increased the optimum  $\lambda$  range moves to higher vals. Higher  $\text{O}_3$  yields are obtained if the illumination is intermittent. As a result of the heat produced by the absorption of radiation  $\text{O}_3$  decomp. proceeds concurrently with  $\text{O}_3$  formation. Decomp. increases with increase in pressure, resulting in a reduced net yield of  $\text{O}_3$  for a given radiation. Several theories are reviewed but the data support Wulff's mechanism, viz., decomp. of polymerised  $\text{O}_2$  mols. which are present in low concn. at ordinary pressure. C. R. H.

**Chemical effect of ultrasonic waves.** S. S. Urazovskii and I. G. Polotzki (*J. Gen. Chem. Russ.*, 1940, 10, 812—818).—Exposure to ultrasonic waves has no effect on the reactions of decomp. of  $\text{CCl}_3\text{CO}_2\text{H}$  in  $\text{NH}_2\text{Ph}$ , or of isomerisation of fused  $\text{NH}_4\text{CNS}$  to  $\text{CS}(\text{NH}_2)_2$ . R. T.



## IX.—METHODS OF PREPARATION.

**Reducing power of sodium hydrogen sulphite.** R. N. Costeanu (*Bul. Fac. Științe Cernăuți*, 1938, 11, 269—270; *Chem. Zentr.*, 1938, ii, 3720).—0.1% aq.  $\text{AgNO}_3$  is rapidly and quantitatively reduced to Ag by freshly prepared aq.  $\text{NaHSO}_3$  (20 mg. per c.c.). If the aq.  $\text{NaHSO}_3$  is kept for ~3 days the  $\text{AgNO}_3$  is reduced to Ag and  $\text{Ag}_2\text{O}$ , and after longer keeping the reduction product is almost entirely  $\text{Ag}_2\text{O}$ ; the ppt. changes colour (yellow-red-brown-black) during the reaction, which becomes slower as the age of the  $\text{NaHSO}_3$  solution increases. Cu, Pb, and Hg salt solutions give similar colour changes with  $\text{NaHSO}_3$ . In all cases reduction is complete at 100°. A. J. E. W.

**Electron diffraction study of the corroded state of metals.**  
**II. Corrosion of potassium, sodium, lithium, calcium, and magnesium by water.** S. Yamaguchi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1940, 38, 106—114; cf. A., 1940, I, 287).—When K is corroded by  $\text{H}_2\text{O}$ , KOH is probably first formed, but at once reacts with  $\text{CO}_2$  forming  $\text{KHCO}_3$ . A similar result is obtained with Na, but there is some unchanged NaOH. In the case of Li, the surface layer consists of much  $\text{Li}_2\text{O}$  with little LiOH.  $\text{CO}_2$  plays no part in the corrosion of Li. With Ca, the corrosion film consists of  $\text{CaO}$  and  $\text{Ca(OH)}_2$ . The film found on Mg after immersion for 10 hr. in  $\text{H}_2\text{O}$  at 20—25° consists of much  $\text{Mg(OH)}_2$  with some  $\text{MgO}$ , and protects the underlying metal from further action. In  $\text{H}_2\text{O}$  containing Cl<sup>-</sup> the corrosion was much more rapid, but the film was again  $\text{Mg(OH)}_2$  and  $\text{MgO}$ . The Cl<sup>-</sup> catalyses the corrosion. A. J. M.

**Chromatographic filtration of alkaline solutions of copper [complexes].** O. Erämetsä (*Suomen Kem.*, 1940, 13, A, 37—38).— $[\text{Cu}(\text{NH}_3)_4]^{2+}$  and Cu<sup>+</sup>-tartrate complexes are adsorbed much more strongly on filter-paper than  $[\text{SnO}_3]^{2-}$  and  $[\text{PbO}_2]^{2-}$ . M. A. M. A.

**Titanium sulphate.** III. Preparation. IV. Hydrolysis. B. E. Boguslavskaja and O. M. Ottamanovskaja (*J. Gen. Chem. Russ.*, 1940, 10, 673—676, 677—682; cf. A., 1939, I, 622).—III.  $\text{TiO}_2$  (1 part) is added to 4 parts of 50—60%  $\text{H}_2\text{SO}_4$  at 95—100°, when a clear solution is obtained within 30 min. The temp. is maintained at 95—100° for 3 hr., when  $\text{TiOSO}_4 \cdot 2\text{H}_2\text{O}$  separates in 94—98% yield.

IV. The velocity of hydrolysis of  $\text{TiOSO}_4$  is practically unaffected by varying the  $[\text{SO}_4]/[\text{TiO}_2]$  of the solution from 1.15 to 2.5, or by varying the  $[\text{TiO}_2]$  from 13 to 16%. R. T.

**Action of hydrogen chloride on titanate and uranic anhydrides.** G. P. Lutschinski (*J. Gen. Chem. Russ.*, 1940, 10, 769—772).— $\text{TiO}_2$  or  $\text{UO}_3$  and liquid HCl, or HCl at 200°, yield  $\text{TiCl}_3(\text{OH})_2$  or  $\text{UO}_2\text{Cl}(\text{OH})$ . R. T.

**Complex germanium compounds.** B. N. Ivanov-Emin (*J. Gen. Chem. Russ.*, 1940, 10, 826—830).—Aq.  $\text{NH}_4$  paramolybdate and  $\text{NH}_4\text{VO}_3$  were added to a solution of  $\text{GeO}_2$  in NaOH, the solution was boiled to complete elimination of  $\text{NH}_3$ , cooled, made acid with  $\text{H}_2\text{SO}_4$ , and shaken with  $\text{Et}_2\text{O}$ , and the lowest of the three layers formed was collected and shaken with a small amount of  $\text{H}_2\text{O}$ . After evaporation of the  $\text{Et}_2\text{O}$  the acid  $\text{H}_4[\text{Ge}(\text{Mo}_2\text{O}_7)_3(\text{V}_2\text{O}_6)_2] \cdot 28\text{H}_2\text{O}$  [ $\text{Rb}_2$ , +1.5 $\text{H}_2\text{O}$ ,  $\text{Cs}_2$ , +1.5 $\text{H}_2\text{O}$ ,  $(\text{C}_6\text{H}_5\text{N})_4$ , and guanidine salts] was obtained. R. T.

(A) Reaction of niobium pentoxide with hydrogen chloride. (B) Chlorination of niobium and its derivatives. V. I. Spitzin and N. A. Preobrashenski (*J. Gen. Chem. Russ.*, 1940, 10, 655—666, 785—798).—(A) HCl was passed over  $\text{Nb}_2\text{O}_5$  (600—700°). The fumes condense in the order  $\text{Nb}_2\text{O}_5$  (600—400°),  $\text{NbO}_2\text{Cl}$  (300°), "white sublimate" (<300°). "White sublimate" is chiefly  $\text{Nb}_2\text{O}_5$  with adsorbed HCl and  $\text{H}_2\text{O}$ .

(B) The following reactions are described (temp. in parentheses are those of initiation of the reactions):  $2\text{Nb} + 5\text{Cl}_2 \rightarrow 2\text{NbCl}_5$  (180°);  $2\text{Nb} + 8\text{HCl} \rightarrow \text{NbCl}_5 + \text{NbCl}_3 + 4\text{H}_2$  (300°);  $\text{Nb}_2\text{O}_5 + 6\text{Cl}_2 \rightleftharpoons 4\text{NbOCl}_3 + 3\text{O}_2$  (400°);  $\text{NbOCl}_3 + \text{Cl}_2 \rightarrow \text{NbCl}_5 + \text{O}$ ;  $\text{Nb}_2\text{O}_4 + 6\text{Cl}_2 \rightarrow 4\text{NbOCl}_3 + \text{O}_2$  (350°);  $\text{Nb}_2\text{O}_5 + 5\text{Cl}_2 + 5\text{C} \rightarrow 2\text{NbCl}_5 + 5\text{CO}$  (400°);  $2\text{NaNbO}_3 + \text{Cl}_2 \rightarrow 2\text{NaCl} + \text{Nb}_2\text{O}_5 + \text{O}$  (700°);  $2\text{NaNbO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{Nb}_2\text{O}_5 + \text{H}_2\text{O}$  (300°);  $\text{Nb}_2\text{O}_5 + 6\text{HCl} \rightleftharpoons 2\text{NbOCl}_3 + 3\text{H}_2\text{O}$  (400°);  $\text{Nb}_2\text{O}_4 + 6\text{HCl} \rightarrow \text{NbOCl}_3 + \text{H}_2\text{O} + \text{H}$  (300°). R. T.

**Decahydrate of chromic perchlorate, and the double hydrate of chromic perchlorate and perchloric acid.** V. Biber and I. Neiman (*J. Gen. Chem. Russ.*, 1940, 10, 723—729).—The salts

$\text{Cr}(\text{ClO}_4)_3 \cdot 10\text{H}_2\text{O}$ ,  $\text{Cr}_2\text{H}(\text{ClO}_4)_7 \cdot 21\text{H}_2\text{O}$ , and  $\text{Cr}(\text{ClO}_4)_3 \cdot 9\text{H}_2\text{O}$  are prepared and described. The following co-ordination formulæ are assigned, from consideration of ionisation data:  $[\text{Cr}(\text{H}_2\text{O})_6(\text{OH}_2, \text{H}_2\text{O})_2][\text{ClO}_4(\text{H}_2\text{O})]_3$ ,  $[\text{Cr}(\text{H}_2\text{O})_5\text{ClO}_4, \text{Cr}(\text{OH}_2)_4, \text{ClO}_4, \text{H}_2\text{O}][\text{ClO}_4(\text{H}_2\text{O})]_2$ , and  $[\text{Cr}(\text{H}_2\text{O})_4(\text{H}_2\text{O})_4][\text{ClO}_4(\text{H}_2\text{O})]_2$ . R. T.

**Highly substituted sodium salts of phosphotungstic acid.** E. A. Nikitina (*J. Gen. Chem. Russ.*, 1940, 10, 779—784).—The  $\text{Na}_4$ ,  $\text{Na}_5$ ,  $\text{Na}_6$ , and  $\text{Na}_7$  salts of  $\text{H}_7[\text{P}(\text{W}_2\text{O}_7)_6]$  have been prepared and described. R. T.

**Action of iodine on potassium ferricyanide solution.** A. A. Bombelli (*Anal. Asoc. Quim. Argentina*, 1940, 28, 123—128).—I with a solution of  $\text{K}_3\text{Fe}(\text{CN})_6$  yields  $\text{Fe}(\text{CN})_6^{4-}$ ,  $\text{CN}^-$ , and  $\text{CN}^+$  with intermediate formation of  $\text{Fe}(\text{CN})_6^{5-}$ . F. R. G.

## X.—ANALYSIS.

**Determination of hydrogen-ion concentration.** Anon. (*Engineering*, 1941, 151, 21—23, 64—65).—A review of modern methods and apparatus.

**Determination of purity of steam.**—See B., 1941, I, 45, 46.

**Micro-manometric determination of sulphate and phosphate.**—See A., 1941, III, 236.

**Nitrosolignin colorimetric test for [determining] sulphite [pulp] waste liquor in sea-water.**—See B., 1941, III, 59.

**Joint determination of nitrogen, hydrogen, carbon monoxide, carbon dioxide, methane, ethylene, and acetylene.**—See B., 1941, I, 63.

**Determination of ammonia in condensed steam.**—See B., 1941, I, 46.

**Iodometric determination of alkali: investigation of G. S. Smith's method.** J. Haslam and R. F. Roberts (*Analyst*, 1940, 65, 399—403).—Smith's method (A., 1937, I, 531) gives low vals. because the  $\text{IO}_3^-$  and  $\text{I}^-$  are not present in the reaction product in the theoretical proportions. By determining the total I present after the removal of excess of I by a modification of Kolthoff and Yutzy's method (A., 1937, I, 197) satisfactory vals. were obtained. The modified method is useful for the determination of alkali in dark-coloured deposits and sludges and in washing mixtures containing added dye where titration with the use of indicators is not practicable. E. C. B. S.

**Determination of alkalis in felspars.**—See B., 1941, I, 63.

**Micro-manometric determination of magnesium.**—See A., 1941, III, 152.

**Determination of copper.**—See A., 1941, I, 92.

**Determination of copper in high-duty cast iron containing molybdenum.**—See B., 1941, I, 71.

**Colorimetric determination of copper in food products.**—See B., 1941, III, 50.

**Determination of mercury in complex ions [in pharmaceutical preparations].**—See B., 1941, III, 55.

**Determination of mercury in mercurochrome.**—See B., 1941, III, 55.

**Effect of  $p_{\text{H}}$  on the precipitation of indium with hydrogen sulphide.** O. Erämetsä (*Suomen Kem.*, 1940, 13, A, 29—30).—The apparent wide variation in  $p_{\text{H}}$  vals. at which  $\text{In}_2\text{S}_3$  is pptd. is due to preliminary formation of colloidal  $\text{In}_2\text{S}_3$ , which is invisible until coagulated. M. H. M. A.

**Separation of indium from tin by means of sodium hydroxide.** O. Erämetsä (*Suomen Kem.*, 1940, 13, B, 17—18).— $\text{In}(\text{OH})_3$  pptd. from 2N-NaOH solutions of In-Sn mixtures by heating at 60° contained about 1%  $\text{Sn}(\text{OH})_2$ , which was not diminished by repeating the process. The residual  $\text{Na}_2\text{SnO}_3$  solution contained only 0.001% In. M. H. M. A.

**Determination of iron in aluminium etc. with 8-hydroxyquinoline.**—See B., 1941, I, 75.

**Identification of small quantities of vanadium.** Sensitivity of the method of Montequi and Gallego. J. M. Bach (*Anal. Asoc. Quim. Argentina*, 1940, 28, 108—110).—If the complex of 8-hydroxyquinoline and V formed in the Montequi-Gallego reaction (A., 1935, 464) is extracted with isoamyl alcohol



instead of  $\text{CHCl}_3$  the sensitivity is increased to permit the detection of 5.6  $\mu\text{g}$ . of V per 100 ml. or 0.084  $\mu\text{g}$ . per ml.

F. R. G.

**Determination of vanadium in water.** J. M. Bach and R. A. Trelles (*Anal. Asoc. Quim. Argentina*, 1940, 28, 111–122).—The qual. method of Bach (preceding abstract) can be used for the colorimetric determination of V if Fe is previously removed by aq.  $\text{NH}_3$ . Excess of org. matter must be removed by boiling with  $\text{HNO}_3$ , free acid being neutralised with  $\text{NH}_3$ . The intensity of colour for 0.10–0.50 mg. of V per l. follows Beer's law. The method is not invalidated by <0.2 mg. of Cu per l., whilst Ti can be eliminated by NaF.

F. R. G.

## XI.—APPARATUS ETC.

**Calibration of thermocouples at low temperatures.** R. B. Scott (*J. Res. Nat. Bur. Stand.*, 1940, 25, 459–474).—A cryostat for use at 0° to  $-170^\circ$  comprises two coaxial Dewar vessels, the outer vessel containing liquid air or liquid  $\text{O}_2$ , whilst the refrigerating effect is varied by changing the air pressure between the walls of the inner Dewar vessel. The latter contains a heating coil and Pt resistance thermometer thermoregulator, immersed in the cryostat liquid ( $\text{CCl}_4$  +  $\text{CHCl}_3$ ,  $\text{CHCl}_3$  +  $\text{CH}_2\text{Cl}_2$  +  $\text{EtBr}$  + *trans*- $\text{C}_2\text{H}_2\text{Cl}_2$  +  $\text{C}_2\text{HCl}_3$ , or  $\text{C}_2\text{H}_6$ , according to the temp. required). Temp.-e.m.f. relations for a Cu-constantan thermocouple are given in tables. Deviation curves for a no. of these thermocouples indicate that fairly good calibration may be effected by means of the  $\text{CO}_2$  sublimation temp. ( $-78.51^\circ$ ) and the b.p. of  $\text{O}_2$  ( $-182.97^\circ$ ). Methods of determining these points are described.

J. W. S.

**Quantitative spark-spectrography of solutions.** W. D. Treadwell and R. Walti (*Helv. Chim. Acta*, 1940, 23, 1446–1456).—A simple apparatus for the sparking of solutions of metal sulphates with pure C electrodes is described. The determination of one metal (A) in presence of a large amount of another metal (B) is possible by measuring the relative intensities (I) of the spectral lines from each metal. The slope of the straight line obtained by plotting  $\log I_B/I_A$  against  $\log$  concn. of A is characteristic of A. The slopes obtained when  $B = \text{Al}$  and  $A = \text{Mg, Mn, Cu, Fe, Ni, and Si}$  have been determined and successfully applied to the determination of these elements in Al alloys.

C. R. H.

**Technical requirements in the determination of absorption spectra by the ultra-violet microscope.** P. A. Cole and F. S. Brackett (*Rev. Sci. Instr.*, 1940, 11, 419–427).—The requirements on the monochromatic illuminating system determined by the spectral properties of the source and the optical properties of the microscope are analysed and tabulated. An improved method of quant. densitometry is described.

D. F. R.

**Improved high-speed recording spectrophotometer.** G. R. Harrison and E. P. Bentley (*J. Opt. Soc. Amer.*, 1940, 30, 290–294).—With the instrument described density or transmission curves for the  $\lambda$  range 3400–9800 Å. are traced automatically on a linear  $\lambda$  scale, with an accuracy of  $\sim 1\%$  in 70 sec.; with a high-pressure Hg arc as light source the range 2300–3400 Å. can also be covered in a few min. A spectral band 0.5–10 Å. in width is obtained from a 10-ft. concave-grating monochromator with fixed slits, and the intensity of the beam after passing through the specimen is balanced against that of the same beam after traversing a photometric disc. The balancing and recording processes are effected  $\sim 20$  times per sec. by an 11-stage electron multiplier and an electric "memory" device. Typical curves for transformer oils are shown.

A. J. E. W.

**Correlation method for elimination of errors due to unstable excitation conditions in quantitative spectrum analysis.** S. Levy (*J. Appl. Physics*, 1940, 11, 480–487).—Difficulties in spectrochemical analysis arise chiefly from variability of the light source, but the radiation of all sources is determined by either the gas temp. or the electron temp. The excitation energy is therefore distributed among the excited states of the atoms statistically, the no. of atoms in the various energy levels being determined uniquely by the electron or gas temp. The intensity ratio of two lines is thus related to the intensity ratio of two others. These considerations form the basis of a correlation method by which the effect of change of electric parameters, shape of electrodes, or distance between them,

etc., is eliminated. Measurements are made on two pairs of lines, the working pair and the fixation pair, the former consisting of one line from the main substance and one from the impurity, and the latter of two lines from the main substance which react differently when one of the excitation conditions is changed. The correlation between the intensity ratios of the two pairs can be found by deliberately altering one of the conditions. A reduction curve is obtained, by the aid of which the concn. of impurity is determined. The method may also be used under standard conditions to improve accuracy.

A. J. M.

**Spectrophotometers.**—See B., 1941, I, 47.

**Rapid-operating colorimeter.**—See B., 1941, I, 47.

**Quantitative capillary luminescence analysis.** F. E. E. Germann and J. W. Hensley (*J. Physical Chem.*, 1940, 44, 1071–1081).—Using a direct vision fluorometer the possibility of determining the concn. of various fluorescent substances in org. solvents by measuring the fluorescence intensity along filter-paper strips dipped in the solutions has been investigated. The most reliable measure of concn. is the total fluorescence energy along the strip rather than the width or the height above the liquid of the strongest fluorescence band. The concns. investigated ranged from 0.003 to 0.8% according to the solute and solvent. At high concns. the formation of large crystals lowers the accuracy of the method since fluorescence energy is then not  $\propto$  concn.

C. R. H.

**Polarimeter [analyser] with penumbra.** E. Perucca (*Nuovo Cim.*, 1940, 17, 1–4).—A cheap and sensitive apparatus which can be used with any light source, even monochromatic, is described. With a monochromatic point source the apparatus is more sensitive than that of Lippich.

O. J. W.

**Sterilamp [mercury arc lamp].**—See B., 1941, I, 47.

**Multi-purpose photo-electric reflectometer.** R. S. Hunter (*J. Res. Nat. Bur. Stand.*, 1940, 25, 581–618).—In the reflectometer two separate beams from a single source are directed to two carefully matched barrier-layer photo-cells. One beam is reflected specularly from one specimen, whilst the other is reflected diffusely from the other specimen before incidence on the photo-cells. The distance of one photo-cell can be adjusted along a calibrated scale until a galvanometer indicates that the cells generate equal currents. In measurements one beam is used as comparison beam and the other as the test beam. Various applications of the instrument are discussed.

J. W. S.

**Mounting "global" for researches in the infra-red.** A. Levialdi (*Rev. Sci. Instr.*, 1940, 11, 429).—The carborundum rod (diameter 1 cm.) is surrounded by a mirror in the form of a coaxial cylinder (diameter 4 cm.) 6 cm. long with a longitudinal slit 1.2 cm. broad. The required high temp. is thus obtained over the comparatively short length of rod within the mirror.

D. F. R.

**Increasing the life of Nernst glowers.** E. S. Ebers and H. H. Nielsen (*Rev. Sci. Instr.*, 1940, 11, 429–430).—The usual Pt terminal is replaced by a Pt globule, melted down from 8 in. of No. 30 wire and welded to the filament. The radiation from the globule is sufficient to keep it from melting.

D. F. R.

**Anomalies in mass-spectrography.** H. Lichtblau (*Anz. Akad. Wiss. Wien, math.-nat. Kl.*, 1938, 23–24; *Chem. Zentr.*, 1938, ii, 3719).—The occurrence of "ghosts," bands, and line broadening in spectra obtained with mass-spectrographs of the Mattauch type is explained.

A. J. E. W.

**A.c.-operated d.c. amplifier with large current output.** S. N. Treviño and F. Offner (*Rev. Sci. Instr.*, 1940, 11, 412–415).—A d.c. phase inverter using cathode in phase degeneration drives the push-pull output stage. The output is linear over a range of 160 ma.

D. F. R.

**Shielded glass electrode.** J. Adler (*Science*, 1940, 92, 385–386).—The aq. KCl, which ends in a fluid junction and completely surrounds the stem of the electrode and the lead to the measuring apparatus, forms the shield.

L. S. T.

**Calibration of Neher-Harper counter circuit for accurate comparison of  $\beta$ - or  $\gamma$ -ray sources.** D. E. Hull (*Rev. Sci. Instr.*, 1940, 11, 404–411).—Accurate control of the plate voltage and grid bias of the quenching valve is essential for reproducible results, and a method of maintaining them to



within 0.01 and 0.2%, respectively, is described. At counting rates  $>100$  per sec. an upward drift in the rate is observed, but this error,  $\sim 5\%$ , may be reduced by "warming up" the counter at a rate  $<$  that used in the measurement and then measuring the various sources in order of decreasing counting rate. A new method of calibration, using a sample of Rn, is described. Rates of 30–200 per sec. may be measured with an accuracy of 0.2–0.3%. D. F. R.

**Double-acceleration high-voltage electron gun.** H. Moss (*J. Sci. Instr.*, 1941, 18, 8–9).—In the electron gun described, the electrons are generated in a low-voltage, cold-cathode tube, and are accelerated in a relatively high vac. The apparatus is suitable for generating an electron beam of 40–100 kv. energy at beam currents of a few  $\mu$ a. A suitable self-contained high-voltage exciter unit, with protective devices, is also described. The apparatus has the advantage over other types of electron gun of producing a relatively const. electron beam, and in the fact that all pumps are maintained at earth potential. A. J. M.

**Device for accurate delivery of small amounts of fluid.** J. Vondrak (*Science*, 1940, 92, 410).—A spring clip is attached to the barrel and plunger of a syringe and controls the amount of fluid delivered. L. S. T.

**Optimal dimensions of a Clusius-Dickel isotope separator.** W. Krasny-Ergen (*Physical Rev.*, 1940, [ii], 58, 1078–1085).—A treatment of the theory of Furry (cf. A., 1939, I, 395) concerning the choice of dimensions of a single-stage apparatus to obtain a given concn. of isotope, small compared with unity, at a min. operating cost. Formulae for distance between the tubes, mean circumference of the annular space between them, length of tubes, and min. cost are deduced, and the problem is extended to an "ideal" multi-stage apparatus. Data are illustrated numerically for production of  $^{13}\text{C}$ . N. M. B.

**Electrically driven magnetically supported vacuum type ultracentrifuge.** C. Skarstrom and J. W. Beams (*Rev. Sci. Instr.*, 1940, 11, 398–403; cf. A., 1939, I, 224).—Rotation is effected through a transitor oscillator and amplifier operating a two-phase salient pole stator and solid steel armature, producing at 1188 cycles per sec. and 1 kw. motor input a torque of 600 g.-sec. throughout the starting period up to 10% slip. The  $\frac{7}{8}$ -lb. rotor is supported magnetically and may be accelerated to 60,000 r.p.m. in 18 min. On reaching the desired speed a slip speed control actuated by a coaxial magnetic pickup sharply reduces the power input and holds the speed const. to within 0.05%. D. F. R.

**Gas detection apparatus for qualitative microchemistry.** C. L. Wilson (*Analyst*, 1940, 65, 407–408).—The test chamber of the apparatus contains a series of test filter-paper discs. When two gases are released the first is removed by the first few filter discs whilst the second is detected by its reaction on the later test discs. The apparatus has been used successfully for the detection of  $\text{AsH}_3$  and  $\text{SbH}_3$  in presence of  $\text{H}_2\text{S}$ . E. C. B. S.

**Systematic qualitative organic micro-analysis. Determinations of specific gravity.**—See A., 1941, II, 79.

**Fluorescent medium for use on surface plates.** H. D. Griffith and A. M. Fraser (*J. Sci. Instr.*, 1941, 18, 9–10).—A suspension of powdered anthracene in medicinal paraffin is spread on the surface plate and the work pressed on it. The high spots, where the anthracene has been picked up, are rendered visible with an ultra-violet lamp, as intensely green fluorescent patches. The contrast is  $\gg$  with the Prussian-blue technique. A. J. M.

**Cryolite films on glass surfaces.** J. W. French (*Nature*, 1940, 146, 687).—The explanation of the increased transmission of light resulting from the cryolite treatment of optical surfaces is discussed. L. S. T.

**pH nomograph for industrial alkalis.**—See B., 1941, I, 62.

**Materials for preparation of vertebrate fossils. Analysis of their effectiveness.** H. A. Lepper, jun., and G. E. Lewis (*Amer. J. Sci.*, 1941, 239, 17–24).—Tests of plaster of Paris beams impregnated with various binders, made to evaluate the relative merits of these materials as strengthening agents for the prep. of vertebrate fossil specimens, are recorded. Gum arabic weakens the plaster specimens, and Duco cement gives a slight increase in strength but covers the specimens

with a tough film. Shellac, Egyptian cement, Alvar, and Catalin, in the order given, improve strength. The relative advantages of these materials with regard to cost, colour, and ease of use are also discussed. L. S. T.

### XIII.—GEOCHEMISTRY.

**Copper, lead, and zinc content of the hot springs of Japan. [Determination of copper.]** K. Kuroda (*Bull. Chem. Soc. Japan*, 1940, 15, 439–441).—For the determination of Cu in mineral  $\text{H}_2\text{O}$  the sample (500 c.c.) is boiled with  $\text{HNO}_3$  to oxidise the Fe, which is then pptd. by the addition of excess of  $\text{NH}_3$  and  $(\text{NH}_4)_2\text{CO}_3$ . After redissolution and repptn. of the Fe, the combined filtrates are acidified with  $\text{HNO}_3$  and evaporated to dryness. The residue is dissolved in  $\text{HNO}_3$ , adjusted to pH 3, and titrated with a  $\text{CCl}_4$  solution of dithizone. Ag is extracted from the  $\text{CCl}_4$  until this layer turns from orange-yellow to reddish-violet, and the vol. of reagent required between this colour change and the change to a permanent green is determined and gives a measure of the [Cu]. Various Japanese springs contain Cu 0.06–68, Pb 0.000–0.033, and Zn 0.008–0.027 mg. per l. J. W. S.

**Titanium. XVI. Transition of anatase into rutile structure.** A. V. Pamfilov and E. G. Ivantscheva (*J. Gen. Chem. Russ.*, 1940, 10, 736–744).—Transition of anatase to rutile structure of  $\text{TiO}_2$  takes place at 800–900°. The process is retarded by  $\text{TiOSO}_4$  and other impurities. R. T.

**Metamorphic, ore-bearing, radioactive rocks from Feldbach (Binnen valley).** E. Hugli and H. Hirschi (*Schweiz. min. petr. Mitt.*, 1938, 18, 12–39; *Chem. Zentr.*, 1938, ii, 3670).—Micaceous rocks containing haloes due to radioactivity are described. A. J. E. W.

**Potassium-rich alkali rocks from Bulgaria. Eruptive rocks from Svidnja (western Balkans).** S. Dimitrow (*Ann. Univ. Sofia, Fac. phys.-math.*, III, *Sci. nat.*, 1937, 33, 291–344; *Chem. Zentr.*, 1938, ii, 3669).—Occurrences of shonkinite, K-quartz syenite, and quartz tinguaita are described. A. J. E. W.

**Geological-petrological study of the Grand Combin zone of the Val d'Illemon (Aosta Province, Italy).** E. A. Diehl (*Schweiz. min. petr. Mitt.*, 1938, 18, 214–403; *Chem. Zentr.*, 1938, ii, 3669). A. J. E. W.

**Geological-petrological studies in the lower Valpellina, Aosta Province (Italy).** R. Masson (*Schweiz. min. petr. Mitt.*, 1938, 18, 54–213; *Chem. Zentr.*, 1938, ii, 3669).—Analyses of the deposits are included. A. J. E. W.

**Willemite morphology and paragenesis at Balmat, N.Y.** F. H. Pough (*Amer. Min.*, 1940, 25, 488–496).—The occurrence and morphology of supergene willemite (I) of the St. Joseph Lead Company mine at Balmat are described. Paragenesis is discussed. The (I) is of high purity and non-fluorescent. L. S. T.

**Distinction between calcite and dolomite on polished surfaces.** J. Rodgers (*Amer. J. Sci.*, 1940, 238, 788–798).—A crit. examination of existing methods shows that staining of calcite by means of aq.  $\text{Cu}(\text{NO}_3)_2$  followed by fixation with aq.  $\text{NH}_3$  is the most satisfactory. A standard procedure is detailed. L. S. T.

**Optical properties and chemical composition of two micas from Westland, South Island, New Zealand.** C. O. Hutton (*New Zealand J. Sci. Tech.*, 1940, 21, 330–331b).—Chemical analyses [F. T. Seelye] of muscovite (I) from Duffer Creek, and Cr-bearing (0.27%  $\text{Cr}_2\text{O}_3$ ) muscovite (II) from Whitcombe Valley, are recorded. (I) has  $\alpha$  1.5590  $\pm$  0.0002,  $\beta$  1.5932,  $\gamma$  1.5976,  $\rho_{20}$  2.819, and (II),  $\alpha$  1.5590  $\pm$  0.0002,  $\beta$  1.5930,  $\gamma$  1.5973,  $\rho_{20}$  2.821. The analyses agree with the formula  $\text{KX}_2\text{Y}_4\text{O}_{10}(\text{OH},\text{F})_2$ , where X represents cations of co-ordination no. 6, and Y cations of co-ordination no. 5. L. S. T.

**What do "traces of oil" indicate?** M. Ongley (*New Zealand J. Sci. Tech.*, 1940, 21, 332b).—The danger of concluding erroneously that a trace or seepage of oil indicates the proximity of an oilfield is pointed out and discussed. L. S. T.

**Geology of British oilfields. I. Geology of the Assam-Arakan oil region (India and Burma).** H. M. Sale and P. Evans (*Geol. Mag.*, 1940, 77, 337–363).—The development of the oil industry, occurrences of oil and gas, and the stratigraphy of the rocks are described. L. S. T.



# INDEX OF AUTHORS' NAMES, A. I.

MARCH, 1941.

- ANON., 88.  
Achumov, E. I., 80.  
Adler, J., 90.  
Agronomov, L. E., 74.  
Alexander, A. E., 80.  
Allison, L. R., 85.  
Altman, G. O., 69.  
Alvarez, L. W., 68, 68.  
Amdur, I., 67.  
Andersen, E. B., 67.  
Arakawa, H., 70.  
Aravamudachari, S., 77.  
Arbuzov, K. N., 81.  
Arnoff, S., 72.  
Auer, H., 79.
- BACH, J. M., 88, 89.  
Balfe, M. P., 74.  
Baltzer, O. J., 76.  
Barkas, W. H., 69.  
Batalin, A. C., 86.  
Baughan, E. C., 74.  
Beams, J. W., 91.  
Belton, J. W., 75.  
Bennett, W. H., 66.  
Bentley, E. P., 89.  
Berlaga, R. J., 78.  
Bernardini, G., 69.  
Beyer, H. G., 80.  
Beynon, W. J. C., 74.  
Biber, V., 87.  
Bitter, F., 77.  
Boguslavskaja, B. E., 87.  
Bolschakov, P. E., 85.  
Bombelli, A. A., 88.  
Bonino, G. B., 75.  
Boroman, D. W., 66.  
Brackett, F. S., 89.  
Breit, G., 70.  
Briner, E., 80.  
Brooks, H., 75.  
Brown, W. F., jun., 77.  
Brunot, A. W., 79.  
Burawoy, A., 75.  
Burdick, M. D., 85.  
Burgoyne, J. H., 84.  
Buswell, A. M., 73.  
Byard, A. G., 75.
- CACCIAPUOTI, B. N., 69.  
Calcagni, G., 74.  
Carapella, L. A., 76.  
Champion, F. C., 67.  
Ch'en, S. Y., 65.  
Cinnamon, C. A., 78.  
Cole, P. A., 89.  
Cooper, E. P., 68.  
Copley, G. N., 78.  
Corben, H. C., 70.  
Costeanu, R. N., 87.  
Crackston, J. E., 76.  
Creutz, E., 69.
- DAVIDSON, W. L., jun., 68.  
Davis, D. S., 80.  
Demidov, K. K., 78.  
De Sousa, A. R., 68.  
Dickson, G. K., 68.  
Diehl, E. A., 92.  
Dimitrow, S., 92.  
Duboux, M., 86.  
Dunning, J. R., 80.
- EÄRMETSÄ, O., 87, 88.  
Ebers, E. S., 90.  
Evans, M. G., 76.  
Evans, P., 92.
- FASTOVSKI, V., 80.  
Ferretti, B., 69.  
France, W. G., 83.  
Fraser, A. M., 91.  
French, J. W., 91.  
Frick, (Miss) M., 84.  
Frumkin, A., 85.  
Furman, N. H., 69.
- GAMOW, G., 71.  
Gantmacher, A. R., 72.  
Gerasimov, I. J., 84.  
Germann, F. E. E., 90.  
Giacalone, A., 80.  
Glocker, R., 76.  
Gonikberg, M., 80.  
Gorenbein, E. J., 85.  
Gorman, M., 84.  
Green, J. B., 66.  
Griffith, H. D., 91.  
Groetzinger, G., 70.
- HALL, W. H., 79.  
Halliday, E. C., 67.  
Hansche, G. E., 71.  
Harrison, G. R., 89.  
Harrison, V. G. W., 81.  
Hartung, E. J., 85.  
Haslam, J., 88.  
Haxby, R. O., 68.  
Hayasi, T., 66.  
Hazlehurst, T. H., jun., 84.  
Heitler, H., 67.  
Hemmendinger, A., 69.  
Hensley, J. W., 90.  
Hermann, R. N., 81.  
Herzfeld, K. F., 76.  
Hess, V. F., 69.  
Heymann, E., 85.  
Higgs, A. J., 67.  
Hirschi, H., 92.  
Hoeffler, H., 86.  
Holstein, T., 75.  
Hugi, E., 92.  
Hull, D. E., 90.  
Hunter, R. S., 90.  
Hurlburt, E. H., 66.  
Hutton, C. O., 92.
- IRWIN, M., 74.  
Ivanov-Emin, B. N., 87.  
Ivantscheva, E. G., 92.
- JAUNCEY, G. E. M., 76.  
Johnstone, H. L., 78.  
Jordan, E. B., 67.
- KARGIN, V. A., 82.  
Karpatschov, S., 81.  
Kasarnovski, J. S., 78.  
Katsurai, T., 81.  
Kaufmann, A. R., 77.  
Kenyon, J., 74.  
Kikuchi, K., 66.  
Kisseleva, V. V., 82.  
Kistiakowsky, G. B., 78.  
Kita, T., 81.  
Kniaginitschew, M. I., 83.  
Kokubo, S., 66.  
Konopinski, E. J., 68.  
Kotecki, A., 71.  
Krasny-Ergen, W., 91.  
Krebs, K. F., 78.  
Kurnakov, N. S., 85.  
Kuroda, K., 92.  
Kuroya, H., 72.
- LACHER, J. R., 78.  
Landau, L., 70.  
Landé, A., 70.  
Lebedeva, E. S., 85.  
Leggett, C. W., 83.  
Lepper, H. A., jun., 91.  
Leviadi, A., 90.  
Levy, S., 89.  
Lewis, G. E., 91.  
Lichtblau, H., 90.  
Loeb, L. B., 74.  
Lutschinski, G. P., 87.  
Lyddane, R. H., 76.
- McBAIN, J. W., 83, 84.  
McCale, C. H., 76.  
McCloskey, K. E., 78.  
Martin, A. B., 78.  
Martin, A. R., 81.  
Masson, R., 92.  
Meek, J. M., 74.  
Miller, L. C., 67.  
Milligan, W. O., 82.  
Möller, C., 70.  
Mohler, F. L., 67.  
Moss, C. C., 71.  
Moss, H., 91.  
Mrozowski, S., 66.  
Munro, L. A., 82.  
Myers, W. G., 83.
- NARITA, M., 86.  
Neiman, I., 87.  
Nelson, E. C., 68.  
Nielsen, H. H., 71, 90.
- Nilakantam, P., 76.  
Nikitin, L. V., 85.  
Nikitina, E. A., 85, 88.  
Nix, F. C., 80.
- O'CONNOR, J., 76.  
Offner, F., 90.  
Oncly, J. L., 83.  
Ongley, M., 92.  
Orr, W. J. C., 84.  
Oseledko, K. N., 79.  
Ott, L. H., 68.  
Ottamanovskaja, O. M., 87.
- PAMFILOV, A. V., 92.  
Pao, C. S., 65.  
Pearce, J. A., 82.  
Pearlman, H., 67.  
Perrottet, E., 86.  
Perucca, E., 90.  
Piccioni, O., 69.  
Pickara, A., 75.  
Pierce, J. A., 67.  
Pitzer, K. S., 68.  
Polanyi, M., 74.  
Polotzki, I. G., 86.  
Pough, F. H., 92.  
Powell, C. F., 67.  
Prasad, M., 83.  
Preobraschenski, N. A., 87.  
Prichotko, A., 71.  
Primakoff, H., 75.
- RAMAN, (Sir) C. V., 76.  
Ranson, W. W., 78.  
Rao, S. R., 77.  
Raynor, G. V., 79.  
Ringo, R., 67.  
Roberts, R. F., 88.  
Rodebush, W. H., 73.  
Rodgers, J., 92.  
Roginski, S., 81.  
Rojansky, V., 69.  
Rona, E., 69.  
Rubenstein, (Miss) P. J., 65.  
Rudnick, P., 77.
- SACHS, R. G., 76.  
Saksena, B. D., 73.  
Sale, H. M., 92.  
Satoh, S., 78.  
Schaaber, O., 76.  
Scheichenberger, H., 69.  
Schein, M., 70.  
Schoenberg, M., 71.  
Schroder, H., 79.  
Schtscherbakov, N. A., 86.  
Schulman, M. S., 77.  
Schultz, H. L., 68.  
Schwinger, J., 68, 70.  
Scott, R. B., 89.  
Seemann, H., 76.  
Shoupp, W. E., 68.
- Silver, S., 74.  
Sirkin, J. K., 72.  
Skarstrom, C., 91.  
Slack, F. G., 77.  
Shavutskaja, I. M., 85.  
Sogabe, T., 78.  
Soloveva, L. R., 82.  
Spedding, F. H., 71.  
Spitzin, V. I., 87.  
Starr, C., 77.  
Stephens, W. E., 68.  
Stevenson, A. F., 70.  
Stitt, F., 78.  
Stradelli, A., 84.  
Straley, J. W., 71.  
Stromberg, A., 81.  
Swyaprakasam, V., 77.  
Suzuki, H., 80.
- TAMM, I., 70.  
Terenin, A., 72.  
Thompson, H. W., 71.  
Tindal, C. H., 71.  
Todes, O., 81.  
Tolansky, S., 65.  
Tominaga, H., 86.  
Treadwell, W. D., 89.  
Trelles, R. A., 89.  
Treviño, S. N., 90.  
Trivedi, S. A., 65.  
Tschescheva, Z. P., 79.  
Tsuchida, R., 72.  
Tumanski, S. S., 77.
- ULLNER, O. E., 79.  
Urazovski, S. S., 86.  
Usanovitsch, M., 85.
- VARADACHARI, P. S., 67.  
Visuranath, C. V., 83.  
Vold, R. D., 83, 84.  
Vondrak, J., 91.
- WALKER, H. N., 69.  
Waller, R. C., 71.  
Walt, R., 89.  
Ward, A. F. H., 82.  
Watson, W. W., 68.  
Weiser, H. B., 82.  
Wells, W. H., 68.  
Wick, (Miss) F. G., 73.  
Wick, G. C., 69.  
Wiens, J., 65.  
Williams, G., 76.  
Wilson, C. L., 91.  
Wolkenstein, M. W., 72.  
Wollan, E. O., 70.  
Wood, R. G., 76.  
Wu, T. Y., 65.
- YAMAGUCHI, S., 82, 87.  
Yamasaki, K., 72.  
Yui, N., 84.

